

SABC Studio 6 Reinstatement

ELECTRICAL INSTALLATION SPECIFICATION: GENERAL TECHNICAL SPECIFICATION

2021-11-17
Revision 0

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1. INTRODUCTION

- 1.1 This section covers general requirements for the supply, delivery, installation, testing, commissioning and maintenance of the medium voltage and low voltage installation as specified.
- 1.2 The scope may comprise of the following major components as described in the Detailed Technical Specification document:
 - Medium voltage reticulation
 - Low voltage reticulation
 - Small power & lighting installation
 - Main and Sub low voltage distribution boards
 - Infrastructure for electronic services (CCTV, access control, smoke detection and suppression, data, BMS etc)
- 1.3 The Contractor shall provide details of the equipment heat loads in order that the plant room (where applicable) ventilation can be determined.
- 1.4 The Contractor shall provide details of the equipment weights and loads in order for the structural engineer to confirm layouts.
- 1.5 The Contract includes the provision of all connectors, mounting brackets, cable ducts and trays etc., required.
- 1.6 The Contract includes for the provision of all test equipment, dummy loads, temporary connections, etc., required to take all measurements and readings specified or stated by the Contractor or as otherwise required to ensure that the installation is handed over in good working order in compliance with the specification.
- 1.7 The Contract includes the supply and use of all materials and equipment that are not specifically stated in these documents but which are nonetheless necessary to execute the Contract in accordance with the requirements of the Specifications and all the other Regulations, Statutes and Codes of Practice which are applicable to the installation.
- 1.8 The Contractor shall be responsible for the provision of all manufactured items, materials, labour, cartage, tools, plant, appliances and fixing necessary for the proper execution of the works together with all minor and incidental works.
- 1.9 All equipment supplied under this Contract shall be suitable for working at the specified criteria and it shall be the responsibility of the Contractor to ensure that all equipment supplied by others is at the correct voltage, frequency, rating etc., before connecting to the supply.
- 1.10 Additionally, this Contractor shall ensure that design, construction or grading of all circuit breakers, controls, cables or other items of equipment in the installation is such that it will

operate with the design criteria set down hereunder.

2. REGULATIONS

2.1 The installation shall be erected and tested in accordance with the following regulations:

SANS 10142, The wiring of premises Part 1: Low-voltage installations

SANS 10142, The wiring of premises Part 2: Low-voltage installations: Medium voltage installations above 1kV a.c. not exceeding 22kV a.c. and up to and including 3MVA installed capacity

SANS 10103, The measurement and rating of environmental noise with respect to annoyance and to speech communication

MOSA, The Machineries and Occupational Safety Act of 1983.

SANS 1091, National Colour Standard.

SANS 1195, Busbars

SANS 121, Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods

SANS 152 (SABS 152), Low-voltage air-break switches, air-break disconnectors, air-break switch-disconnectors, and fuse-combination units. (Superseded by SANS 60947-3.)

SANS 156, Moulded-case circuit-breakers.

SANS 164-0, Plug and socket-outlet systems for household and similar purposes for use in South Africa – Part 0: General and safety requirements.

SANS 164-1, Plug and socket-outlet systems for household and similar purposes for use in South Africa – Part 1: Conventional system, 16 A 250 V a.c.

SANS 164-2, Plug and socket-outlet systems for household and similar purposes for use in South Africa – Part 2: IEC system, 16 A 250 V a.c.

SANS 164-3, Plug and socket-outlet systems for household and similar purposes for use in South Africa – Part 3: Conventional system, 6 A 250 V a.c.

SANS 164-4, Plug and socket-outlet systems for household and similar purposes for use in South Africa – Part 4: Dedicated system, 16 A 250 V a.c.

SANS 164-5, Plug and socket-outlet systems for household and similar purposes for use in South Africa – Part 5: Two-pole, non-rewirable plugs, 2,5 A 250 V a.c., with cord, for connection of class II equipment.

SANS 164-6, Plug and socket-outlet systems for household and similar purposes for use in South Africa – Part 6: Two-pole systems, 16 A 250 V a.c., for connection of class II equipment.

SANS 337, Stove couplers.

SANS 529, Heat-resisting wiring cables.

SANS 556-1, Low-voltage switchgear – Part 1: Circuit-breakers.

SANS 767-1, Earth leakage protection units – Part 1: Fixed earth leakage protection circuit-breakers.

SANS 780, Distribution transformers.

SANS 950, Unplasticized polyvinyl chloride rigid conduit and fittings for use in electrical installations.

SANS 1012, Electric light dimmers.

SANS 1063, Earth rods, couplers and connections.

SANS 1065-1 (SABS 1065-1), Metal conduits and fittings (screwed-end and plain-end) for electrical wiring – Part 1: Metal conduits. (Superseded by SANS 61386-1 and SANS 61386-21.)

SANS 1065-2 (SABS 1065-2), Metal conduits and fittings (screwed-end and plain-end) for electrical wiring – Part 2: Metal fittings. (Superseded by SANS 61386-1 and SANS 61386-21.)

SANS 1085, Wall outlet boxes for the enclosure of electrical accessories.

SANS 1195, Busbars.

SANS 1213, Mechanical cable glands.

SANS 1239, Plugs, socket-outlets and couplers for industrial purposes.

SANS 1411-1, Materials of insulated electric cables and flexible cords – Part 1: Conductors.

SANS 1418-1, Aerial bundled conductor systems – Part 1: Cores.

SANS 1433-1, Electrical terminals and connectors – Part 1: Terminal blocks having screw and screwless terminals.

SANS 1433-2, Electrical terminals and connectors – Part 2: Flat push-on connectors.

SANS 1473-1, Low-voltage switchgear and controlgear assemblies – Part 1: Type-tested, partially type-tested and specially tested assemblies with a rated short-circuit withstand strength above 10 kA

SANS 1507-1, Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) – Part 1: General.

SANS 1507-2, Electric cables with extruded solid dielectric insulation for fixed installations

(300/500 V to 1 900/3 300 V) – Part 2: Wiring cables.

SANS 1507-3, Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) – Part 3: PVC distribution cables.

SANS 1507-4, Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) – Part 4: XLPE distribution cables.

SANS 1507-5, Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) – Part 5: Halogen-free distribution cables.

SANS 1507-6, Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) – Part 6: Service cables.

SANS 1524-1, Electricity payment systems – Part 1: Prepayment meters.

SANS 1574-3, Electric flexible cores, cords and cables with solid extruded dielectric insulation – Part 3: PVC-insulated cores and cables.

SANS 1574-5, Electric flexible cores, cords and cables with solid extruded dielectric insulation – Part 5: Rubber-insulated cores and cables.

SANS 1607 (SABS 1607), Electromechanical watt-hour meters. (Superseded by SANS 62053-11.)

SANS 1619, Small power distribution units (ready-boards) for single-phase 230 V service connections.

SANS 1765, Low-voltage switchgear and controlgear assemblies (distribution boards) with a rated short-circuit withstand strength up to and including 10 kA.

SANS 1777, Photoelectric control units for lighting (PECUs).

SANS 1799, Watt-hour meters – AC electronic meters for active energy.

SANS 1973-1, Low-voltage switchgear and controlgear ASSEMBLIES – Part 1: Type-tested ASSEMBLIES with stated deviations and a rated shortcircuit withstand strength above 10 kA.

SANS 1973-3, Low-voltage switchgear and controlgear ASSEMBLIES – Part 3: Safety of ASSEMBLIES with a rated prospective short-circuit current of up to and including 10 kA.

SANS 1973-8, Low-voltage switchgear and controlgear ASSEMBLIES – Part 8: Safety of minimally tested ASSEMBLIES (MTA) with a rated short-circuit current above 10 kA and a rated busbar current of up to and including 1 600 A a.c. and d.c.

SANS 10086-1, The installation, inspection and maintenance of equipment used in explosives atmospheres – Part 1: Installations including surface installations on mines.

SANS 10089-2, The petroleum industry – Part 2: Electrical and other installations in the distribution and marketing sector.

SANS 10108, The classification of hazardous locations and the selection of apparatus for use in such locations.

SANS 10198-4, The selection, handling and installation of electric power cables of rating not exceeding 33 kV – Part 4: Current ratings.

SANS 10198-10 (SABS 0198-10), The selection, handling and installation of electric power cables of rating not exceeding 33 kV – Part 10: Jointing and termination of paper-insulated cables.

SANS 10198-11 (SABS 0198-11), The selection, handling and installation of electric power cables of rating not exceeding 33 kV – Part 11: Jointing and termination of screened polymeric-insulated cables.

SANS 10198-14 (SABS 0198-14), The selection, handling and installation of electric power cables of rating not exceeding 33 kV – Part 14: Installation of aerial bundled conductor (ABC) cables.

SANS 10199, The design and installation of earth electrodes.

SANS 10222-3, Electrical security installations – Part 3: Electric security fences (non-lethal).

SANS 10292 (SABS 0292), Earthing of low-voltage (LV) distribution systems.

SANS 10313, Protection against lightning – Physical damage to structures and life hazard.

SANS 60269-1/IEC 60269-1, Low-voltage fuses – Part 1: General requirements.

SANS 60309-1/IEC 60309-1, Plugs, socket-outlets and couplers for industrial purposes – Part 1: General requirements.

SANS 60309-2/IEC 60309-2, Plugs, socket-outlets and couplers for industrial purposes – Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories.

SANS 60439-1/IEC 60439-1, Low-voltage switchgear and controlgear assemblies – Part 1: Type-tested and partially type-tested assemblies.

SANS 60439-2/IEC 60439-2, Low-voltage switchgear and controlgear assemblies – Part 2: Particular requirements for busbar trunking systems (busways).

SANS 60439-4/IEC 60439-4, Low-voltage switchgear and controlgear assemblies – Part 4: Particular requirements for assemblies for construction sites (ACS).

SANS 60439-5/IEC 60439-5, Low-voltage switchgear and controlgear assemblies – Part 5: Particular requirements for assemblies for power distribution in public networks.

SANS 60529/IEC 60529, Degrees of protection provided by enclosures (IP Code).

SANS 60570/IEC 60570, Electrical supply track systems for luminaires.

SANS 60598-2-18/IEC 60598-2-18, Luminaires – Part 2: Particular requirements – Section 18:

Luminaires for swimming pools and similar applications.

SANS 60598-2-23/IEC 60598-2-23, Luminaires – Part 2-23: Particular requirements – Extra low voltage lighting systems for filament lamps.

SANS 60601-1/IEC 60601-1, Medical electrical equipment – Part 1: General requirements for basic safety and essential performance.

SANS 60669-1/IEC 60669-1, Switches for household and similar fixed electrical installations – Part 1: General requirements.

SANS 60669-2-1/IEC 60669-2-1, Switches for household and similar fixed electrical installations – Part 2-1: Particular requirements – Electronic switches.

SANS 60730-2-7/IEC 60730-2-7, Automatic electrical controls for household and similar use – Part 2-7: Particular requirements for timers and time switches.

SANS 60906-3/IEC 60906-3, IEC system of plugs and socket-outlets for household and similar purposes – Part 3: SELV plugs and socket-outlets, 16 A 6 V, 12 V, 24 V, 48 V, a.c. and d.c.

SANS 60947-2/IEC 60947-2, Low-voltage switchgear and controlgear – Part 2: Circuit-breakers.

SANS 60947-3/IEC 60947-3, Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse combination units.

SANS 60947-4-1/IEC 60947-4-1, Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters.

SANS 60947-4-2/IEC 60947-4-2, Low-voltage switchgear and controlgear – Part 4-2: Contactors and motor-starters – AC semiconductor motor controllers and starters.

SANS 60947-4-3/IEC 60947-4-3, Low-voltage switchgear and controlgear – Part 4-3: Contactors and motor-starters – AC semiconductor controllers and contactors for non-motor loads.

SANS 60947-5-1/IEC 60947-5-1, Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices.

SANS 60947-5-2/IEC 60947-5-2, Low-voltage switchgear and controlgear – Part 5-2: Control circuit devices and switching elements – Proximity switches.

SANS 60947-5-5/IEC 60947-5-5, Low-voltage switchgear and controlgear – Part 5-5: Control circuit devices and switching elements – Electrical emergency stop device with mechanical latching function.

SANS 60947-6-1/IEC 60947-6-1, Low-voltage switchgear and controlgear – Part 6-1: Multiple function equipment – Transfer switching equipment.

SANS 60950/IEC 60950, Safety of information technology equipment. (Superseded by SANS

60950-1).

SANS 60950-1/IEC 60950-1, Information technology equipment – Safety – Part 1: General requirements.

SANS 60998-2-1/IEC 60998-2-1, Connecting devices for low-voltage circuits for household and similar purposes – Part 2-1: Particular requirements for connecting devices as separate entities with screw-type clamping units.

SANS 60998-2-2/IEC 60998-2-2, Connecting devices for low-voltage circuits for household and similar purposes – Part 2-2: Particular requirements for connecting devices as separate entities with screwless-type clamping units.

SANS 61000-4-5/IEC 61000-4-5, Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test.

SANS 61000-4-7/IEC 61000-4-7, Electromagnetic compatibility (EMC) – Part 4-7: Testing and measurement techniques – General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto.

SANS 61008-1/IEC 61008-1, Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules.

SANS 61036/IEC 61036, Alternating current static watt-hour meters for active energy (classes 1 and 2). (Superseded by SANS 62053-21.)

SANS 61084-1/IEC 61084-1, Cable trunking and ducting systems for electrical installations – Part 1: General requirements.

SANS 61238-1/IEC 61238-1, Compression and mechanical connectors for power cables for rated voltages up to 30 kV ($U_m = 36$ kV) – Part 1: Test methods and requirements.

SANS 61312-3/IEC/TS 61312-3, Protection against lightning electromagnetic impulse – Part 3: Requirements of surge protective devices (SPDs).

SANS 61347-2-2/IEC 61347-2-2, Lamp controlgear – Part 2-2: Particular requirements for d.c. or a.c. supplied electronic step-down convertors for filament lamps.

SANS 61386-1/IEC 61386-1, Conduit systems for cable management – Part 1: General requirements.

SANS 61386-21/IEC 61386-21, Conduit systems for cable management – Part 21: Particular requirements – Rigid conduit systems.

SANS 61386-22/IEC 61386-22, Conduit systems for cable management – Part 22: Particular requirements – Pliable conduit systems.

SANS 61386-23/IEC 61386-23, Conduit systems for cable management – Part 23: Particular requirements – Flexible conduit systems.

SANS 61558-1/IEC 61558-1, Safety of power transformers, power supplies, reactors and similar products – Part 1: General requirements and tests.

SANS 61558-2-2/IEC 61558-2-2, Safety of power transformers, power supplies, reactors and similar products – Part 2-2: Particular requirements and tests for control transformers and power supplies incorporating control transformers.

SANS 61558-2-5/IEC 61558-2-5, Safety of transformers, reactors, power supply units and combinations thereof – Part 2-5: Particular requirements and test for transformers for shaver power supply units for shavers and shaver supply units.

SANS 61558-2-6/IEC 61558-2-6, Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V – Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers.

SANS 61558-2-15/IEC 61558-2-15, Safety of power transformers, power supply units and similar – Part 2-15: Particular requirements for isolating transformers for the supply of medical locations.

SANS 61643-1/IEC 61643-1, Low-voltage surge protective devices – Part 1: Surge protective devices connected to low-voltage power distribution systems – Requirements and tests.

SANS 61643-12/IEC 61643-12, Low-voltage surge protective devices – Part 12: Surge protective devices connected to low-voltage power distribution systems – Selection and application principles.

SANS 62040-1/IEC 62040-1, Uninterruptible power systems (UPS) – Part 1: General and safety requirements for UPS.

SANS 62053-11/IEC 62053-11, Electricity metering equipment (a.c.) – Particular requirements – Part 11: Electromechanical meters for active energy (classes 0,5, 1 and 2).

SANS 62053-21/IEC 62053-21, Electricity metering equipment (a.c.) – Particular requirements – Part 21: Static meters for active energy (classes 1 and 2).

SANS 62103/IEC 62103, Electronic equipment for use in power installations.

SANS 62305-1/IEC 62305-1, Protection against lightning – Part 1: General principles.

SANS 62305-2/IEC 62305-2, Protection against lightning – Part 2: Risk management.

SANS 62305-3/IEC 62305-3, Protection against lightning – Part 3: Physical damage to structures and life hazard.

SANS 62305-4/IEC 62305-4, Protection against lightning – Part 4: Electrical and electronic systems within structures.

2.2 International and foreign standards

BS 1363-2, 13 A plugs, socket-outlets, adaptors and connection units – Specification for 13 A switched and unswitched socket-outlets.

IEC 60664-1, Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests.

IEC 60695-2-10, Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure.

IEC 61557-8, Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 8: Insulation monitoring devices for IT systems.

IEC/TR 62066, Surge overvoltages and surge protection in low-voltage a.c. power systems – General basic information.

UL 508, Industrial control equipment.

- 2.3 The installation shall in total comply with the Machinery and Occupational Safety Act as amended, the requirements of the local supply authority and the SANS Code of Practice 10142 for the Wiring of Premises, Parts 1 & 2.

3. RADIO INTERFERENCE

- 3.1 The entire system shall be such that it does not cause any radio interference and the installation will also not be effected by radio and TV transmissions.

4. NEW DISTRIBUTION BOARDS

- 4.1 The contractor and his supplier shall be responsible for the physical design of the distribution boards in accordance with the requirements of Client specification and the schematic layout diagrams forming part of their documentation must be submitted for approval.
- 4.2 As far as possible the tenderer must design their control panels to suit
- 4.3 Allowance must be made for sectionalising and closed compartmenting the distribution boards into normal, emergency and uninterrupted power supplies if necessary.
- 4.4 Distribution boards shall be installed in positions as indicated on the drawings. The contractor shall ensure that the dimensions of the distribution boards are suitable to fit into the indicated positions.
- 4.5 Tenderers are advised to order their distribution boards from a reputable manufacturer as inferior boards will be unacceptable. Preference will be given the use of the same

manufacturer.

- 4.6 The distribution boards shall be manufactured in accordance with SANS 10142-1.
- 4.7 If not indicated otherwise, Circuit breakers used are to be of the Schneider or similar type. The contractor is to ensure that full discrimination of circuit breakers in the reticulation system is achieved.
- 4.8 All boards shall be of the free standing type with front access, or surface mounted, or flush mounted types as specified. Cognisance shall be taken of all the cables and overhead busbars entering and leaving the distribution boards.
- 4.9 Gland plates must be sized to accommodate the amount and size of cables as indicated on the schematic line diagram. Gland plates may not be less than 3 mm thick.
- 4.10 The total height of the free standing boards shall not exceed 2200mm measured from final floor level. The boards shall be manufactured to suit the schematic layouts indicated on the drawings. Tenderers shall ensure that the distribution boards can fit into the space provided for them.
- 4.11 Where the distribution boards are fed by means of a number cables in parallel, overhead busbars or when the size of the feeder cable is such that the cores cannot be accommodated on the terminals of the main isolator, suitable stub busbars shall be provided to terminate these cables.
- 4.12 All equipment used shall be rated for the fault levels indicated on the busbars. The kA values refer to the symmetrical rupturing capacities at 400V, 50Hz for AC installations and at 50V for DC installations.
- 4.13 All MCCBs and ACBs installed shall be fitted with the MCCB's and ACB's standard inter-phase barriers. It shall be deemed that the contractor has allowed for this in his tendered rate.
- 4.14 No cables rated at less than 600/1000V will be permitted in distribution boards.
- 4.15 Busbars or power cables shall not be taped. Heat shrink insulation sleeves shall be used on busbars and cable terminations for colour coding purposes.
- 4.16 Cable ties may only be used on cables for bunching purposes. Cable supports will be selected based on the cable sizes and must be discussed and be approved by the Electrical Engineer.
- 4.17 Cluttered up drawings will not be accepted. Only electrical information must be indicated.
- 4.18 Under normal supply conditions the mains supply circuit breaker shall be closed. A failure of the mains supply shall be detected on the incoming side of the mains circuit breaker.
- 4.19 The mains and standby circuit breakers shall be mechanically and electrically interlocked to prevent paralleling of the two supplies.

- 4.20 Complete circuit and wiring diagrams of the change-over panels shall be submitted to the Engineer for approval before manufacture commences.
- 4.21 All distribution boards shall be painted as follows (or as indicated in the Detailed Technical Specification):
- Normal power : Electric orange
 - UPS power : Purple and Blue
 - Standby power : Signal red
- 4.22 All equipment on distribution boards shall be mounted behind removable panels. The panels shall be enclosed by hinged doors with clear view panels.
- 4.23 The grouping of equipment shall be arranged in order that future extensions and additions may be done in a logical fashion. At least 20% spare capacity shall be allowed for in each distribution board for future extensions, spare capacity space must be full populated.
- 4.24 Current transformers, contactors, fuses etc., shall be fitted so that they can be removed without dismantling busbars etc.
- 4.25 Door hinges shall be of the Procast, Perano or Barker Nelson manufacture. Front panels shall be secured by means of knurled catches with a 1/4 turn to open action. Alternatives will not be accepted unless authorised by the Engineer in writing.
- 4.26 All equipment utilised in distribution boards shall be rated at 400/230 volt AC. Circuit breakers shall have a minimum rupturing capacity of 5kA unless otherwise indicated on the drawings or specified.
- 4.27 The engineer will not approve the workshop drawings of the boards unless all information as requested is submitted as a complete package. General arrangement drawings, or incomplete drawings will not be considered to be a complete package and shall be returned to the contractor forthwith.
- 4.28 It shall further be noted that late approval of workshop drawings or distribution boards, due to non-compliance with the specifications, schematic layouts and diagrams, or approval procedures as specified in this document, will not relieve the Contractor from any of his obligations to complete the contract according to programme. No claims for delays, for extension of time or extra costs in this regard, will be entertained.
- 4.29 The following procedure for the approval of distribution boards and workshop drawings is to be strictly followed:
- Board manufacturer submits workshop drawings for approval, to the Electrical Engineer.
 - Engineer returns 1 copy as approved or for re-submission, to the Tenderer.
 - Manufacture of equipment commences after approval of the drawings by the Electrical

Engineer. Workshop drawings shall include the scaled and dimensioned general arrangement, sections, busbar dimensions, equipment clearances, cubicle layouts, busbar stubs, instrumentation details, equipment schedules detailing manufacture and ratings of equipment, comprehensive wiring diagrams, terminal and cable numbers, etc.

- The wiring diagrams shall be complete with wire and terminal numbers as well as the status of each contact, normally open or normally closed. The wiring diagrams shall include the description of all symbols used in the diagrams.
- Tenderer checks and inspects boards at the manufacturer during all stages.
- Tenderer presents the Electrical Engineer with written confirmation that the boards are in full compliance with the specifications, schematic layouts and diagrams, that they have been checked, inspected, and fully tested. This confirmation, signed and dated by the board manufacturer is to accompany a written request, by the Tenderer, for the Electrical Engineer to witness the re-inspection and re-testing of the distribution boards. The Tenderer shall also confirm that each of the distribution boards will fit into the space or area allocated.
- During the inspections, a fault list, if necessary, will be drawn up and handed to the Tenderer.
- After satisfactory rectification of the fault list, and subsequent re-inspection, the Tenderer may instruct the board manufacturer to dispatch the boards to site. No repairs or rectification of fault list items will be permitted to be carried out on site.
- All tests, i.e. pressure tests, trip tests, injection tests, and functional tests shall be carried out as specified in the technical specification, at the premises of the board manufacturer. All tests as specified shall be performed by the board manufacturer for the Tenderer, and shall be repeated for witnessing by Electrical Engineer.

5. LOW VOLTAGE DISTRIBUTION BOARDS

5.1 General

- 5.1.1 Low voltage switchgear and control gear assemblies shall form part of a 4-wire (400V), 50 Hz, solidly earthed, distribution system.
- 5.1.2 Multi-cubicle type low voltage switchgear and control gear assemblies shall consist of equipment as laid down in the Detailed Technical Specification. Assemblies and associated components and systems covered by this Specification shall be designed, constructed, wired and tested according to the requirements of the relevant regulations, codes of practice and of this specification.
- 5.1.3 Each assembly shall be equipped with all necessary switchgear and control gear (including

auxiliary control devices, and specified instrument transformers, current transformers, relays, meters, and switches) in accordance with the requirements detailed in the Detailed Technical Specification.

- 5.1.4 The Contractor shall detail in their final offer any deviations from this specification, or alternatively state that the equipment offered complies in all respects with the requirements of this specification.
- 5.1.5 The Contractor shall produce a full Type Test Report issued by a recognised independent testing authority, covering all seven (7) of the type test items according to SANS 60439-1.
- 5.1.6 Verified deviations supported by documentary evidence, Technical Schedules and /or calculations in respect of partially type tested assemblies shall also be submitted.
- 5.1.7 The Contractor shall produce an independent test report confirming internal arc proof compliance.
- 5.1.8 Assemblies and components shall be designed for a service life expectancy of at least 35 years and an in-production life expectancy of at least 10 years from the date of contract. The equipment shall be capable of a minimum of 5 years normal, continuous operation at the duty specified, without maintenance.
- 5.1.9 The manufacturer shall give an undertaking that all spares and components will be available for the full duration of the service life from the date of installation. The manufacturer shall supply comprehensive maintenance requirements, drawings and documentation.
- 5.1.10 The switchgear offered shall have a technical and commercial 'back-up' service acceptable to the client and be available locally.
- 5.1.11 Equipment offered should have at least 3 years' service experience and there shall be an acceptable technical and commercial 'back-up' service available locally.

5.2 Cabling

- 5.2.1 Cabling connected to incoming or outgoing circuits shall be terminated on gland plates supplied for this purpose.
- 5.2.2 Power cables up to and including 70mm² may terminate on clamp type terminals where the clamping screws are not in direct contact with the conductor.
- 5.2.3 Connection to the equipment can then be made with cables that are similarly connected to the clamp terminal. All power cables larger than 70mm² shall terminate on busbars that are connected to the associated equipment. Parallel incoming or outgoing cables shall be connected to a collector busbar without crossing the conductors.
- 5.2.4 All cables shall have stranded copper conductors, shall be new and shall be of the

PVC/SWA/PVC type, 600/1000 V grade and shall comply to SANS 1507. No aluminium conductors will be allowed.

- 5.2.5 All cables shall be terminated by means of suitably sized cable glands. Glands shall be heat shrunk. The exclusive use of insulation tape will not be acceptable.

5.3 Terminal Strips

- 5.3.1 External wiring for low voltage, control, interlocking, alarm, measuring and DC circuits shall terminate on numbered wiring terminals.
- 5.3.2 The correct terminal size as recommended by the manufacturer for each conductor to be connected shall be used throughout. The terminal numbers shall appear on the wiring diagrams of the switchboard.
- 5.3.3 Terminals for internal wiring shall not be interposed with terminals for external circuits. All connections to terminals shall be identified as described in this document. Where switchboards consist of separate sections, the control wiring passing between sections shall be terminated on strips in each section so that control wiring can be readily reinstated when reassembling the board. Terminals for power wiring shall be separated from other terminals.

5.4 Current Ratings

- 5.4.1 The current rating of conductors for the internal wiring shall be sufficient for the maximum continuous current that can occur in the circuit. This value shall be determined from the circuit breaker or fuse protection of the circuit.

5.5 Load End Connections

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

5.6 Wiring to Circuit Breakers

- 5.6.1 Equipment with a rating exceeding the current rating of 70mm² conductors shall be connected by means of busbars to the main busbars. Looped connections may only be installed for a maximum of two outgoing circuits. Where there are more than two outgoing circuits, busbars shall be used and equipment connected individually to the busbars. Where miniature circuit breakers are mounted in continuous rows and supplied by busbars connected to each MCB, each busbar shall be supplied by a separate conductor.

- 5.6.2 This conductor shall be connected to the busbar by means of a separate lug and not via an MCB terminal.

5.7 Conductor Terminations

- 5.7.1 Connections to circuit breakers, isolators, contactors, etc., shall be made by one of the following methods:

- A ferrule of the correct size shall be used as far as possible where the cable conductors are connected directly to equipment with screws against the conductor strands.
- Soldering the end of the conductor

- 5.7.2 All conductors terminating on meters fuse holders and other equipment with screwed terminals shall be fitted with lugs. The lugs shall be soldered or crimped to the end of the conductor. The correct amount of insulation shall be stripped from the end to fit into the terminal. The correct size of lugs shall be used, as strands may not be cut from the end of the conductor to facilitate the use of smaller lugs/ferrules.

5.8 Identification

- 5.8.1 The colour of the conductors for all 220/250V circuits shall correspond to the colour of the supply phase for that circuit. Neutral conductors shall be black.
- 5.8.2 Earth conductors shall be green or green/yellow, except for cases where bare copper earth straps are used.
- 5.8.3 All control conductors shall be grey.
- 5.8.4 All conductors shall 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.
- 5.8.5 Where wiring channels are used they shall be installed horizontally and vertically. Under no circumstances may power and control circuit wiring be installed in the same wiring channel. Channels shall not be more than 80% full.
- 5.8.6 All wiring between different panels within the same switchboard shall be installed in wiring channels.
- 5.8.7 Grommets shall be installed in each hole in the metalwork through which conductors pass. Insulation stripped of cables/wires will not be used as grommets.
- 5.8.8 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.

- 5.8.9 Conductors may be jointed at equipment terminals or numbered terminal strips only. No other connections are allowed.
- 5.8.10 Where conductors change direction, smooth bends shall be formed with a radius of at least five (5) times the outside diameter of the conductor or harness.
- 5.8.11 Where screened cables are specified, the screening shall be earthed in the switchboard or control board only, unless clearly specified to the contrary. Screened cables entering control boxes through pressed knockouts shall terminate in compression glands. Conductors shall as far as possible remain inside the screening at terminations.
- 5.8.12 Where conductors have to be separated from the screen, the braiding shall be separated and the conductors drawn through the braid without damaging the braiding. The conductors shall then be connected to their respective terminals and the screening smoothed and connected to the earth terminal.
- 5.8.13 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.
- 5.8.14 Wiring should as far as possible be confined to the front portions of switchboards for ease of access.
- 5.8.15 A maximum of two conductors will be allowed per equipment terminal. Where more conductors must be connected to the same equipment terminal (e.g. a main circuit breaker feeding other circuit breakers), stud busbars shall be provided for the various conductors.

5.9 Earth Conductors

- 5.9.1 Earth wires with a cross sectional area of less than 2.5 mm² will not be permitted.
- 5.9.2 Where Earth conductors enter a distribution board (or any other similar metal surface) it will be protected by a suitable sized gland.

6. **LABELLING**

6.1 Labelling of LV Cables

- 6.1.1 All cables shall be labelled with Brother Type labels (black letters on white background), protected with a clear crimp sleeve, at both cable ends. When cables penetrate the different floor levels, cables shall be labelled at the top and bottom entry to each distribution board cupboard or cable duct.
- 6.1.2 The labels shall be positioned to be easily visible and accessible.

6.2 Labelling of Earth Conductors

- 6.2.1 All earth conductors with a cross sectional area bigger than 16mm² shall be labelled with Brother Type labels (black letters on white background), protected with a clear crimp sleeve, at both cable ends. When cables penetrate the different floor levels, cables shall be labelled at the top and bottom entry to each distribution board cupboard or cable duct.
- 6.2.2 Protective earth conductors forming part of power cable distribution are excluded from the above, since these conductors are fixed to the power cables.
- 6.2.3 The labels shall be positioned to be easily visible and accessible.

6.3 Labelling of Distribution Boards

6.3.1 *Distribution Board Names*

- All electrical distribution boards shall be fitted with labelling as required in SANS 10142-1.

6.3.2 *Warning Notice*

- Where distribution boards are concealed by a cupboard or other covering (such as a plain distribution board door), the notices referred to in SANS 10142-1 shall be in conspicuous places.

6.3.3 *Cascading Labels*

- When a distribution board is indicated as having cascaded equipment, a Yellow warning label with wording as per SANS 10142-1 shall be fitted to each panel having such equipment, on the upper right corner.

6.3.4 *Discrimination Labels*

- When a distribution board is indicated as having discriminated equipment, a Yellow warning label with the following wording shall be fitted to each panel having such equipment, on the upper right corner:

6.3.5 *Circuit Breaker Labels*

- All circuit breaker labels will be engraved traffolite. Continuous strips should be used as far as possible.
- Black letters on white background.
- Each circuit breaker module will be labelled. i.e. a 3phase breaker/isolator will have 3 labels.
- All labels shall be numerical in format, i.e. 1, 2, 3...

7. CABLE INSTALLATIONS

- 7.1 Tenderers shall take cognisance of the fact that other services are installed along the same route as the electrical cables. All safety measures shall be taken to prevent damage to other services. Tenderers shall be responsible for any damage done to other services.
- 7.2 All cables shall have stranded copper conductors, shall be new and shall be of the PVC/SWA/PVC type, 600/1000 V grade and shall comply to SABS 1507. No aluminium conductors will be allowed.
- 7.3 All cables shall be terminated by means of suitably sized cable glands. Glands shall be heat shrunk. The exclusive use of insulation tape will not be acceptable.
- 7.4 Copper earth conductors shall be installed with each cable and shall be strapped to the cable at 2000mm intervals. The bunching of earth conductors is not acceptable. Cables installed in outdoor cable trenches shall be buried at least 600mm below final ground level and shall be backfilled as follows:
- 100mm bedding material
 - Lay cable
 - 100mm bedding material compacted
 - Sieved backfill compacted to 200mm below final ground level
 - Plastic marker tape 200mm below final ground level
 - Backfill compaction to final ground level
- 7.5 Should the Detail Scope of Work call for it, cable routes shall be physically marked by means of cable route markers at 20m intervals, changes in direction and where cables enter sleeve pipes and buildings.

8. EARTH CONDUCTORS

- 8.1 Earth wires with a cross sectional area of less than 2,5 mm² will not be permitted.
- 8.2 Where Earth conductors enter a distribution board (or any other similar metal surface) it will be protected by a suitable sized gland.
- 8.3 Where earth wires are installed with cable on cable trays and ladders, the earth wire shall be strapped to the cable with nylon cable ties at 1,5m intervals.
- 8.4 For earth wires installed with cables in trenches, the earth wire may be taped to the cable using a PVC Insulation tape. The earth wire shall be taped at 1,5m intervals.

9. EXCAVATIONS FOR LV CABLING

- 9.1 The electrical contractor shall take all precautions to prevent cable trenches from being hazardous to personnel and public and shall have the responsibility of safeguarding all structures, roads, water and sewerage works, or other property from the risk of subsidence or damage.
- 9.2 The volumes of excavations in the bills of quantities are based on a trench depth of 700 mm and a width of 400 mm. Where variations to the contract may be called for, the total trench volume will be calculated using these dimensions and applying the tendered unit rate to establish the variation cost.
- 9.3 Electrical cable trenches shall not be less than 700 mm deep to ensure that with a 100 mm thick bedding layer, the minimum cable depth of 600 mm will be achieved. The contractor may deviate either way, from the nominal 400 mm width, to suit his excavating and compaction machinery, however trenches narrower than 320 mm will not be acceptable. Trenches dug by means of “ditch witches” where the trench width is less than 320 mm will also not be acceptable.
- 9.4 Earthing conductor trenches shall not be less than 700 mm deep to ensure that the minimum conductor depth of 700 mm will be achieved. The contractor may also deviate either way, from the nominal 400 mm width, to suit his excavating and compaction machinery, however trenches narrower than 320 mm will not be acceptable.
- 9.5 Where more than one cable runs in a common trench a minimum spacing of two cable diameter shall apply.
- 9.6 For contract purposes, soil classification for excavations and percentage of each classification shall be as follows:
- 9.6.1 Hard rock
- shall mean granite, slate rock, solid shale and boulders over 0,03m³ in volume.
- 9.6.2 Soft Rock
- shall mean rock that can be loosened by hand-pick and shall include for hand shale, compact oukrip, and boulders from 75mm to 0,03m³ in volume.
- 9.6.3 Earth
- shall mean ground that can be removed by pick and shovel and shall include for loose gravel, clay, loose or soft shale, loose oukrip and boulders less than 75mm in diameter.
- 9.7 Bedding and backfilling
- 9.7.1 All trenches dug for the placing of services or other reasons should be backfilled with slightly moist sifted natural soil. In layers not exceeding 150mm. All rocks shall be removed from

backfilling, and be removed from the site by the contractor. Compacting by handtampers or small mechanical tampers to the density of the natural undisturbed soil in the immediate vicinity.

- 9.7.2 This re-compaction of the soil applies especially to material below the pavement (and similar areas) which will prevent the formation of special drainage paths that can become sinkholes. Compaction - The material used in the fill shall be compacted at optimum moisture content to at least 90% of modified AASHTO maximum density. Should the material be too wet, owing to rain or other cause, it shall be harrowed and allowed to dry out to the correct moisture content before compaction is undertaken. This will prevent the filled trenches from acting as french drains that could cause doline (subsidence) or sinkhole formation.

10. TRENCHING

- 10.1 The Electrical Installation Contractor is responsible for all trenching excavations that do not form part of the original building plan, unless specified to the contrary.

10.2 Existing Services

- 10.2.1 The Electrical Installation Contractor shall determine the position of all the existing services such as water, storm water, sewer, gas, telephone cables, etc. before commencing with excavations. The Electrical Installation Contractor shall furthermore employ a metal detecting apparatus over the entire planned cable route to determine the exact position of existing services crossing the planned cable route or running parallel to it.
- 10.2.2 The Electrical Installation Contractor shall contact, in writing, the Client Representative / Electrical Engineer, the local municipal authority and any other authority that may be involved, to determine and confirm the positions of existing services.
- 10.2.3 If existing services are parallel and close to the planned cable route, or cross the planned cable route, the Electrical Installation Contractor shall excavate and expose the existing service carefully by hand.
- 10.2.4 In the event of damage to other services or structures during trenching operations, the Client Representative / Electrical Engineer shall be notified and repairs instituted without delay.
- 10.2.5 The Electrical Installation Contractor shall be held responsible for any damage to existing services resulting from their failure to take the precautionary measures described above.

10.3 Safety

- 10.3.1 The Electrical Installation Contractor shall take the necessary precautions and provide the necessary warning signs and/or lights to ensure that open trenches do not endanger the public and/or employees on site.
- 10.3.2 Trenches across roads, access ways or footpaths shall not be left open. If cables cannot be laid immediately, temporary bridges or cover plates of sufficient strength to accommodate the traffic concerned shall be installed.
- 10.3.3 The excavations must not endanger existing structures, roads, railways, other site constructions or other property.

10.4 Excavations

- 10.4.1 Extreme care shall be taken not to disturb Surveyor's pegs. These pegs shall not be covered with excavated material. If the Surveyor's pegs are disturbed, a qualified Surveyor must replace them.
- 10.4.2 The bottom of the trench shall have an even contour without any sharp dips or rises that may cause mechanical tension in the cable during backfilling or thereafter.
- 10.4.3 The trenches shall be thoroughly inspected and all objects likely to cause damage to the cables shall be removed before laying the cables.
- 10.4.4 The excavated material shall be placed next to each trench in such a manner as to prevent nuisance, interference or damage to adjacent drains, gateways, trenches, water furrows, other works, properties or traffic. Where this is not possible, the excavated material shall be removed from site and returned for backfilling after laying the cable. The Electrical Installation Contractor must remove and dispose of surplus material at their own expense.

10.5 Soil Definitions

- 10.5.1 Earth: "Earth" means soil that can be loosened by hand tools and includes ground, clay, loose or soft shale, loose "oukclip" and any boulders less than 75 mm diameter.
- 10.5.2 Soft Rock: "Soft Rock" means rock that can be loosened by hand, pick or crowbar and includes hard shale, compact "oukclip", stone of similar hardness and boulders exceeding 75 mm in diameter but not exceeding 0,03 m³ in volume.
- 10.5.3 Hard Rock: "Hard Rock" means rock that can only be loosened by jack-hammer or blasting and includes granite, quartz tic, sandstone, solid shale, slate and rock of similar or greater hardness and boulders exceeding 0.03 m³ in volume.
- 10.5.4 Wet Earth: "Wet Earth" means conditions where there is an excess amount of water present in

the trench that needs to be pumped out. The water may originate from the soil around or underneath the trench, or from rain. This condition is applicable to any of the three soil types described above.

10.5.5 If the Electrical Installation Contractor is of the opinion that any portion of the excavation encountered is in "Soft Rock" or "Hard Rock" they must immediately inform the Client Representative / Electrical Engineer in writing. Failing such notification the excavation will be deemed to be in "Earth" and must be measured and adjusted accordingly. The Client Representative / Electrical Engineer will decide as to which excavation is "Soft Rock" or "Hard Rock".

10.5.6 The Electrical Installation Contractor shall notify the Client Representative / Electrical Engineer of any obstacles encountered along the cable route so that an alternative route can be planned, if justified.

10.6 Mechanical Excavations

10.6.1 Power driven mechanical excavators may be used for trenching 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.

10.6.2 Written permission shall be obtained from the Client Representative / Electrical Engineer before employing power driven mechanical excavators. Payments, based on volumetric excavation rates, shall be calculated on the required dimensions only, regardless of the dimensions of the trench produced by the excavator.

10.7 Blasting

10.7.1 No guarantee is given or implied that blasting will not be required.

10.7.2 Should blasting be necessary and approved by Client, the Electrical Installation Contractor shall obtain the necessary authority from the relevant Government Departments and Local Authorities. The Electrical Installation Contractor shall take full responsibility and observe all conditions and regulations set forth by the above authorities. A qualified person with a valid blasting ticket must do the blasting work.

10.8 Routes

10.8.1 The Electrical Installation Contractor shall inspect the site conditions and confirm all cable routes before trenching commences. The Electrical Installation Contractor shall preferably follow established cable routes or use cable servitudes.

- 10.8.2 Cable trenches shall be provided in such a manner as to follow a rectangular route in relation with the boundaries and buildings on site.
- 10.8.3 The Electrical Installation Contractor shall plan and provide excavations for cable trenches as servitude areas running along sidewalk ways or as close as possible to buildings in such a way as to ensure that as many cables as possible will follow the same route in the most economical manner. Open spaces where future buildings might be erected shall be avoided.
- 10.8.4 Trenches shall be excavated in straight lines between the starting point and end point and any turning points in-between. Deviations from the routes indicated on the drawings due to obstructions or existing services must be approved by the Client Representative / Electrical Engineer beforehand.
- 10.8.5 The Client Representative / Electrical Engineer reserves the right to alter any cable route or portion thereof before the cable is laid. Payment for any additional or fruitless work shall be calculated on the tendered rates.
- 10.8.6 The removal of obstructions along the cable routes is subject to approval from the Client.

10.9 Soil Conditions

- 10.9.1 Where soil conditions are likely to reduce maximum current carrying capacities of cables or where the cables are likely to be subjected to chemical or other damage or electrolytic action, the Client Representative / Electrical Engineer shall be notified before installing the cables. The Client Representative / Electrical Engineer will advise on the course of action to be taken.

10.10 Dimensions of Trenches

- 10.10.1 The trenches shall be excavated to the dimensions specified.
- 10.10.2 Cable trenches for one or two cables shall not be less than 300 mm wide and need not be more than 450 mm wide. This width shall be maintained for the total trench depth.
- 10.10.3 The width shall be increased where more cables are installed to allow for the spacing stipulated in section "Cable Spacing".
- 10.10.4 Where trenches change direction or where cable slack must be accommodated, the Electrical Installation Contractor shall ensure that the requirements of the manufacturer regarding the bending radii of cables are met when determining trench widths.
- 10.10.5 Trench depths shall be determined in accordance with the cable laying depths and bedding thickness stipulated in section "Cable Installation Depth Below Ground Level".
- 10.10.6 Payment shall be calculated using the running metre rate or the volumetric excavation rate (whichever is specified in the bill of quantities) and the specified maximum dimensions or the

actual dimensions, whichever is the lesser.

10.11 Joint Holes

10.11.1 The Electrical Installation Contractor shall excavate a joint hole of sufficient size to enable the cable jointer to work efficiently and unimpeded where cable joints are required.

10.12 Bedding

10.12.1 The Contractor shall fill the bottom of the trench across the full width with a 75 mm thick layer of sandy soil sifted through a 6 mm mesh and level it off.

10.12.2 Only sandy clay or loam soil with a satisfactory thermal resistivity (not exceeding 1.5°C m/W) shall be used for this purpose. Sea sand, ash, chalk, peat, clinker or clayey soil shall not be used. Crusher sand and river sand are acceptable.

10.12.3 Where no suitable soil is available on site, the Contractor shall import fill from elsewhere. The cost of importing soil for bedding shall be included in the unit rates for excavations.

10.12.4 A further layer of bedding that extends to 75 mm above the cables, after laying the cables, shall be provided.

10.12.5 In the case of HV cables, an additional 200 mm cover of sifted soil from the backfill material, on top of the 75 mm bedding above the cable, shall be provided to lay the protective concrete slabs on.

10.13 Cable Sleeve Pipes

10.13.1 Where cables cross under roads, railway tracks, other service areas, etc. and where cables enter buildings, the cables shall be installed in ribbed and reinforced PVC pipes. Asbestos cement or earthenware sleeves are also acceptable but pitch-fibre sleeves are not allowed.

10.13.2 The pipes shall be joined in accordance with the manufacturer's instructions.

10.13.3 Sleeves to cross roads and railway tracks shall be installed at right angles.

10.13.4 Sleeves shall have a minimum diameter of 100 mm, except at road crossings where the minimum diameter shall be 150 mm. The sleeves shall extend at least 2 m beyond the tracks of a railway line or of the outermost tracks where there is more than one line. In the case of roads, the sleeves shall extend at least 1 m beyond the road edge or kerb on both sides of the road.

10.13.5 Sleeves shall be installed with a 1:400 fall for water drainage.

10.13.6 The Electrical Installation Contractor shall supply and install galvanised metallic sleeves up to

and including 76 mm diameter where specified.

10.13.7 The ends of all sleeves shall be sealed with a non-hardening watertight compound after the installation of cables. All sleeves intended for future use shall be sealed in the same manner.

10.13.8 Where new buildings are built across existing cable routes, the Electrical Installation Contractor shall open the cables and install the cables in split type PVC sleeves.

10.13.9 The Electrical Installation Contractor shall backfill trenches at least 300 mm on top of sleeves before compacting to avoid damage to the sleeves. The backfilling and compacting shall be completed as per section "Backfilling".

10.13.10 The Electrical Installation Contractor shall install 75 mm diameter sleeves to distribution boards installed in 110 mm walls.

10.13.11 Spare sleeves shall be installed in the quantities specified, or at least 1 if no quantities are specified.

10.13.12 Sleeves shall extend at least 1 m outside the building. In the case of a building apron, rain water channel, walkway or other building work directly next to the building, the sleeves shall be extended 1 m beyond it.

10.14 Backfilling

10.14.1 The Electrical Installation Contractor shall install a coloured plastic marking tape 300 mm beneath the final ground level directly above the cables. The tape must be yellow and marked with the words "ELECTRIC CABLE BELOW". These markings must not be more than 1 m apart from centre to centre.

10.14.2 Trenches shall be backfilled with suitable soil to ensure settling without voids. The maximum allowable diameter of stones present in the backfill material is 75 mm.

10.14.3 The Electrical Installation Contractor shall allow in the tender rates for importing suitable backfill material if required.

10.14.4 The backfill shall be compacted in 150 mm thick layers. The Electrical Installation Contractor shall backfill the first layer by hand.

10.14.5 The Electrical Installation Contractor shall allow for final settlement when backfilling.

10.14.6 The refilled trench shall be maintained at the Electrical Installation Contractor's expense for the duration of the contract.

10.14.7 The Electrical Installation Contractor shall remove and dispose of all surplus backfill material.

10.14.8 Damage to concrete walkways, tarred surfaces, lawns and flowerbeds, shall be restored to their original finish after installation of cables. The Electrical Installation Contractor shall remove lawns in sods and carefully replace the sods after installation of the cable. The sods shall be

rammed down and neatly levelled off with sifted soil. The restored area of the lawn shall be properly watered.

10.14.9 In the case of roadways or paved areas, the Electrical Installation Contractor shall compact the excavations to the original density of the surrounding material before reinstating the surface finish.

10.15 Cable Markers

10.15.1 The Electrical Installation Contractor shall allow for the manufacture, supply and installation of approved cable route and cable joint markers in positions as shown on drawings or indicated on site.

10.15.2 The cable marker shall be made of concrete with a capping at the upper horizontal surface of a fine mixture. After removal from the mould, the cable marker shall be cured in the approved manner by wetting or immersion. The capping at the upper horizontal surface of the marker shall be about 30mm deep and be of a 1:3 cement and sand mixture. This fine mixture is for providing a suitable base for forming the recessed lettering and directional double-headed arrow. The remaining portion of the marker shall consist of an adequately compacted concrete mixture of 1:3:4 cement, sand, and crushed stone. The lettering and double-headed directional arrow of the upper horizontal surface of the marker must be recessed to a depth of at least 5 mm.

10.15.3 Location of Cable Markers

10.15.3.1 The Electrical Installation Contractor shall install cable route markers along all underground cable routes. Cable markers shall be installed at:

- the beginning and end of a cable run (e.g. where a cable enters a substation or building)
- all changes of direction
- above cable sleeve entries and exits
- intervals not exceeding 50 m along the cable route.

10.15.3.2 Cable markers show the actual route of a buried cable; therefore, the cable markers shall be located at such intervals that the deviation of the actual buried position of the cable from a straight line between any two adjacent cable markers does not exceed 500 mm horizontally.

10.15.3.3 The cable joint marker shall be located above the joint of a buried cable. The position of cable markers shall be indicated on the "as built" drawings. First delivery will not be considered until the cable markers are installed neatly in their positions.

10.15.3.4 The cable marker shall be manufactured in the shape of a truncated pyramid with an

overall height of 300 mm.

10.15.4 Installation of Cable Markers

10.15.4.1 The Electrical Installation Contractor shall plant the cable marker and the cable joint marker over the buried cable with the upper horizontal face of the marker about 30 mm to 50 mm above the levelled surrounding ground, or in the case of a hardened surface, protruding by not more than 10 mm above such a hardened surface.

10.15.4.2 The double-headed arrow recessed on the face of the marker shall be set parallel to the direction of the buried cable in the case of a straight portion of the route, or tangentially in the case of a curved portion of the route.

11. SUBSTATIONS & PLANTROOMS

11.1 General

11.1.1 This section covers the general arrangements and requirements for substations and plant rooms.

11.1.2 Substations and plant rooms shall conform in all respects to the requirements of the General Requirements.

11.2 Notices

11.2.1 The following notices in the official languages, as required, shall be installed by the Contractor at all entrances to, and in suitable positions within the plant rooms housing electrical equipment. (Generating plant, transformers, switching or linking apparatus).

- A notice prohibiting unauthorised persons from entering such premises.
- A notice prohibiting any unauthorised persons from handling or interfering with electrical apparatus.
- A notice containing directions as to procedure in case of fire.
- A notice containing directions as to resuscitation of persons suffering from the effects of electric shock.
- All other notices which may be required by the above laws and regulations specified in the General Requirements.

11.3 Switch Rooms

- 11.3.1 The equipment shall be installed and secured to the floor in accordance with the manufacturer's specification in the positions as indicated on the drawing of the substation layout.
- 11.3.2 The tools, earthing and operating devices of the switchgear shall be contained in a purpose made sheet metal box secured to the wall of the substation, 1500mm above floor level.
- 11.3.3 The electrical installation shall not be switched "ON" before final tests have been approved by the Engineer.
- 11.3.4 When the equipment is to be installed in the plantrooms the Contractor shall ensure:
- The Builder is aware of the intended rigging
 - Prior to the rigging being undertaken the actual integrity of the floor shall be assessed and any damages to the floor will be for the account of the Contractor.
 - The finishes to the floor and the stages at which it will be applied to the floor will also be agreed with the Builder as time lost as a result of either painting or epoxy of the floor restricting access to the plantrooms by the Contractor shall not by any means constitute a claim for delay.
- 11.3.5 Same as the above will apply for the painting of the plantroom especially the final coat to be applied to the plant room.

11.4 Vermin Proofing

- 11.4.1 The Contractor shall be responsible for the vermin proofing of cable entrances and exits into substations and plant rooms by means of non-hardening compound or mesh with openings of 4mm maximum.

11.5 Cable Trenches

- 11.5.1 All cable trenches (where applicable) shall be provided with chequered plate, suitably sized and supported by adequate kerbing. Each section of the plate shall be provided with cut outs to facilitate lifting. Chequered plates shall only be fitted once all cables have been installed and approved.

12. REMOTE MONITORING

- 12.1 The plant wide control network will be utilized to remotely monitor the LV switchgear.
- 12.2 The following must be made available by the switchgear supplier for each circuit breaker for easy connection to the control system by the Control Sub-contractor:
- Circuit breaker status (separate auxiliary contacts for open and closed indication shall be used, i.e. breaker status shall not be derived from one contact)
 - Remote/local indication
 - Trip circuit supervision healthy
 - Voltage and current of the incomers
 - Current of all feeders
- 12.3 Where the protection relays offered have status input auxiliary output and communication facilities these may be utilised provided the protocol utilised is compatible with the plant wide network protocol.

13. MISCELLANEOUS

- 13.1 All the DC circuits used in the control equipment shall be designed to operate from either 12V or 24V. Confirmation is required from the vendor that 24V supplied to the machine can not affect the supply voltage to the control system e.g. it shall not be possible if the 24V to the fuel probe on the day tank is being short circuited to drop the supply voltage to the control system. The control system shall preferably have its own power supply which is separate from the machine control system power supply.
- 13.2 Devices shall be constructed from modular, either solid-state or dry-element components.
- 13.3 The solid-state or dry-element components shall be mounted on open printed circuit cards.
- 13.4 Sealed or encapsulated devices are not acceptable.
- 13.5 All printed circuit cards shall be silver screened and readily accessible for maintenance purposes.
- 13.6 All relays within the control cubicle shall be securely mounted by using suitable spring clips.
- 13.7 Transformers shall have individual primary and secondary windings separated by a metal screen, which shall be bonded to the earth terminal.
- 13.8 All transformers and chokes shall be impregnated either by vacuum impregnation or by slow-dip impregnation with subsequent baking.
- 13.9 All terminals on transformers and chokes shall be of the rail type.

- 13.10 The control cubicle equipment shall be suitable in all respects for continuous duty at full load at an ambient temperature of 40°C and relative humidity of 90%.
- 13.11 All contactors and relays in the apparatus shall be fitted with contacts suitable to break 1.5 times the rated current passing through them.
- 13.12 All components shall be readily available in South Africa. A list of components not available in South Africa shall be provided under this section.

14. INSULATING RESISTANCE

- 14.1 The insulation resistance between any component and wiring forming part of a circuit and earthed frame, between any two separate circuits shall not be less than 5M OHM when tested with 500V DC after steady electrification for two minutes. The insulation test shall not be applied to components such as semiconductors, which may be damaged by the high test potential. Alternatively the insulation between components and wiring and the earthed frame shall withstand a test voltage of 2kV (rms) for all main circuits and 1kV for all DC circuits with the exception of electronic control modules, applied for not less than three seconds.
- 14.2 The above tests shall be carried out at a relative humidity of 85%.

15. PROTECTION

- 15.1 Adequate provision shall be made to protect the circuits against voltage transients induced by switching or lightning surges. The requirements laid down in IEC publication 60.1 shall be adhered to.
- 15.2 All metal work, including the cabinet shall be electrically bonded to the earthing terminal. Earth continuity conductors shall not be less than half the cross sectional area of mains cables to the cubicle with a minimum of 4mm².
- 15.3 The neutral point of the system shall be connected to this bar. Suitable terminals shall be provided on the earth bar for connection of the main earth conductor.
- 15.4 All relays or other components carrying mains voltages shall be labelled:
"DANGER - MAINS VOLTAGE"
- 15.5 All coils of contactors and relays used in the apparatus shall be rated at twice, or more the operating current. All solenoids must have their switching surges suppressed by diodes or RC combinations.
- 15.6 Mains terminals shall be separated by at least 20mm from each other or from other terminals, and shall be protected from accidental contact. The rod test shall be applied as laid down in

NEMA Standard.

- 15.7 All circuits shall be protected via suitably rated moulded case circuit breakers with a minimum fault level of 5kA. For instruments suitably rated fuses must be used.

16. EARTHING

- 16.1 In addition to the internal control panel equipment, the motors/generators, the engines, the sections of the base frames, and the fuel tank supports shall be connected to the earth bar in the control panel.
- 16.2 The star point of each of the generators shall be connected to the neutral busbar and the neutral busbar shall in turn be connected to the earth bar via a removable connection.
- 16.3 The earth bars shall be bonded to the main distribution system earth by means of stranded green PVC insulated copper conductors. The minimum size shall be 70mm².
- 16.4 Earth conductors shall be separately bolted to the earth bar and the sizes of earth wires shall comply with the recommendation of SANS 10142.

17. PROGRAMME AND PROGRESS

- 17.1 It will be expected of the Tenderer to discuss the programme with the Main Contractor, Sub-Contractor, Engineer, Client and / or other contracting parties and to ensure they are au fait with the programme and the accuracy thereof. The Contractor must provide a delivery schedule of equipment leading up to the completion date.
- 17.2 The programme for carrying out the works shall be submitted in detailed form covering all significant operations and shall be in the form of Microsoft Project or similar. In addition, should the information be required in a particular format to suit project management requirements then such information shall be provided as part of this contract.
- 17.3 The Contractor shall liaise with all necessary parties (other Contractors, Sub-Contractors, Consultants, equipment suppliers, etc.) to ensure that the programme is as accurate and as realistic as possible.
- 17.4 The Contractor shall submit the programme as soon as possible after award of the contract, but at the latest fourteen days after award of the contract.
- 17.5 The programme shall list each scheduled item of equipment in the contract and shall indicate periods for:
- Preparation, approval and finalisation of manufacturing drawings.
 - Ordering.

- Manufacturing.
 - Inspection and testing during manufacture.
 - Delivery
 - Installation.
 - Testing.
 - Commissioning.
- 17.6 The Contractor shall build into the programme a period of two weeks for approval of drawings.
- 17.7 The Contractor shall allocate to a senior member of his staff, the duties of studying and evaluating the works in relation to the approved programme, of devising methods to overcome or prevent delays and of co-operating with other contracting parties. He shall report to the Engineer and the other contracting parties and draw their attention timeously to anything, which may cause a delay in the execution of the works.
- 17.8 The programme shall be updated as and when necessary to take account of changed circumstances.

18. SITE CONDITIONS

- 18.1 Tenderers are advised to visit the site and acquaint themselves with all local conditions pertaining to the execution of the installation before tender closing date, this will only be applicable if the construction on the site has adequately advanced to a stage where this inspection will be of any value. In the event this not being the case the tenderer shall assess the site requirements from the drawings and should there still be any uncertainties be clarified with the Engineer.
- 18.2 No claims from the Contractor which may arise from insufficient knowledge of site access, type of site, labour conditions, establishment space, transport and loading/unloading facilities, power and water supply, etc., will be considered after submission of tenders.
- 18.3 For facilities where prior permission is required before Tenderers can visit the site, a visit will be arranged for all interested parties.
- 18.4 The Contractor shall ensure prior to submitting the tender they have familiarised themselves with all the information available regarding the building as well as site conditions. No claims whatsoever will be entertained for items which are of a nature that should have been assessed during tender stage.

19. QUALITY & STANDARDS

- 19.1 The following standards, quality of materials and standards of workmanship shall apply, where applicable, for the various sections of the works, whether specifically mentioned or not.
- 19.2 It shall be the Contractor's responsibility to fully acquaint himself with all relevant standards and with the standards of others in as much as they affect his works.
- 19.3 The Contractor shall obtain and fill in all notices required by the authorities and shall obtain all consents necessary for the various works to be performed.
- 19.4 The Contractor shall obtain the final approval of all statutory authorities where possible before the issue of the Certificate of Practical Completion.
- 19.5 Maximum system reliability is required and all aspects of the design and installation shall be optimised to this end.
- 19.6 All materials and equipment supplied shall be new and of acceptable quality.
- 19.7 All equipment shall comply with relevant SABS/SANS specifications or with the requirements of recognised international standards organisations such as IEC, NEC, ISO, NEMA and ANSI.
- 19.8 The entire installation shall be executed in accordance with standard practice for the industry and to the approval of the Engineer or his duly authorised representative.
- 19.9 It shall be assumed that the Contractor is conversant with the above-mentioned regulations and requirements. Should any requirements, by laws or regulations, contradict the requirements of this document, apply or become applicable during erection of the installation, such requirements, by laws or regulations 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 installation in terms of such contradictions without obtaining written permission to do so from the Engineer.
- 19.10 The installation shall in total comply with the Machinery and Occupational Safety Act as amended, the requirements of the local supply authority and the SANS Code of Practice 10142 for the Wiring of Premises.
- 19.11 The Engineer will do quality inspections of the installation from time to time during the progress of the work. Discrepancies will be pointed out to the Contractor and these shall be remedied at the Contractor's expense.
- 19.12 Under no circumstances shall the abovementioned inspections relieve the Contractor of his obligations in terms of the document. It is the responsibility of the Contractor to ensure the materials supplied and the installation conforms fully to this specification.
- 19.13 The Contractor shall notify the Engineer timeously when the installation reaches important stages of completion (e.g., equipment installation, pressure testing, etc.), so the Engineer may schedule his site inspections in the best interests of all concerned. Work shall not be unduly

closed up prior to inspection.

20. INSPECTIONS

- 20.1 The Engineer reserves the right to arrange for the inspection of all goods forming the subject of this Contract or order, at any stage before final acceptance and by any means he may deem necessary.
- 20.2 When inspecting the Contractor's works or warehouse, free access shall be afforded to the staff conducting the inspection to the premises of the Contractor at all times during working hours, shall have the liberty to inspect work which is the subject of the Contract or order, at any stage of manufacture, and may reject any goods which are found to be incomplete, defective or in any way not in conformity with the terms of the Contract or order. The Contractor shall afford all reasonable facilities for such access and inspection.
- 20.3 The Contractor shall supply without charge all tools, gauges, meters, templates and other equipment which may be required for checking the accuracy of the work; shall provide the labour necessary for inspecting the work in accordance with requirements specified in the Contract or order and shall render all reasonable assistance in carrying out this checking and inspection.

21. TESTS

- 21.1 The complete testing including the provision of test facilities, instruments, dummy loads and switchgear (where applicable) at both the manufacturer's premises and on site shall form part of this Contract.
- 21.2 For tests at the manufacturer's premises and/or on site, two weeks advance notice shall be given in order that a representative can be sent to witness these tests.
- 21.3 The Contractor shall prove all specified values contained in this Document and issued in his own specifications and literature.
- 21.4 On completion of the tests, a full test report shall be issued.
- 21.5 The entire system is subject to tests, inspection and acceptance by the Engineer and/or a representative appointed by the Client.

22. ARRANGEMENTS WITH THE SUPPLY AUTHORITY

- 22.1 The Contractor shall give all notices required and pay all necessary fees, including any inspection fees, which may be required by the Local Supply Authority, unless otherwise specified.
- 22.2 It shall be the responsibility of the Contractor to make the necessary arrangements, at his own cost, with the Local Supply Authority and to supply the labour, equipment and means to inspect, test and commission the installation to the requirements of the Local and Supply Authorities.
- 22.3 The Contractor shall supply and install all notices and warning signs that are required by the appropriate laws, regulations and/or the documents.

23. MATERIAL, EQUIPMENT AND WORKMANSHIP

- 23.1 All material shall conform in respect of quality, manufacture, tests and performance, with the requirements of the South African Bureau of Standards, or where no such standards exist, with the appropriate current specification of IEC, BSI, ANSI, IEEE or similar.
- 23.2 All material shall be new and in accordance with the specifications and suitable for the conditions on site. These conditions shall include weather conditions as well as conditions under which materials are installed, stored or used. Should the materials not be suitable for use under temporary site conditions, then the Contractor shall, at his own cost, provide suitable protection until these unfavourable site conditions cease to exist.
- 23.3 Access shall be agreed with the Main Contractor (where applicable) to ensure areas where work is to be executed shall be free of building rubble and all other building activities for example such as painting, smoothing and sanding down of walls etc. shall have been completed
- 23.4 The Contractor shall, where requested to do so, submit samples of equipment and materials to the Engineer for approval prior to installation. Samples may be retained in the Engineer's possession until the contract is completed after which they will be returned.
- 23.5 Locally manufactured equipment shall be used where possible and practical, in preference to imported equipment.
- 23.6 The Client in no way binds himself to assist the Contractor in obtaining import permits for imported equipment.
- 23.7 The works shall be so installed as to provide ease of inspection, cleaning and maintenance. This shall be done by way of workshop drawings indicating all equipment layouts to be agreed and signed off by the Engineer.
- 23.8 The Contract shall be executed to an acceptable standard and shall comply with all quality assurance processes and documentation as agreed to at the outset of the Project. Should any

workmanship, equipment or material not comply with quality assurance processes, procedures and documentation, it shall be rectified at the cost of the Contractor and all rejected materials shall be removed from site.

- 23.9 All artisans employed on site shall be competent in terms of the Regulations and Acts. All installations shall be carried out by qualified artisans or under the direct supervision of qualified artisans. Installations (or part thereof) will be rejected if found not to comply with the quality assurance audits.
- 23.10 If it has been assessed that any member of the Contractor's staff is not competent to carry out the work to the required standard as laid out in the quality assurance processes, procedures and documentation, then that person shall be removed from the project.
- 23.11 Uniformity of type and manufacture of each individual item of apparatus, fitting and/or accessory shall be preserved throughout the whole of the works. Failure to comply with this provision may result in the rejection of any non-standard equipment or fitting.

24. SUPERVISION AND SITE ORGANISATION

- 24.1 For the full duration of this contract, the Contractor shall employ a competent Supervisor, skilled in all aspects of the trades and skills required by the Contract. This supervisor shall be on site whenever work, associated with this contract, is being carried out and shall at all times be available to attend to queries by the Client, Engineer and the Main Contractor.
- 24.2 The supervisor shall be the Contractor's authorised representative for the project and shall be available to attend progress meetings when called upon to do so by the Engineer, the Client or the Main Contractor whether or not these take place prior to work actually starting on site.
- 24.3 The supervisor shall be empowered to make all decisions necessary for the execution of the contract.
- 24.4 The supervisor shall not be transferred from his position without approval of the Engineer or the Client.
- 24.5 The Contractor shall at all times have on site copies of all relevant drawings as well as a copy of the specification. The Contractor shall institute the necessary procedures to ensure the drawings on site are the latest drawings and that all superseded drawings are removed from site.

25. TOOLS AND EQUIPMENT

- 25.1 Unless otherwise specified, the Contractor shall provide all tools, materials, scaffolding, power, water, etc., necessary for the proper and efficient execution of the work covered by this specification.
- 25.2 No extra payment will be made for plant, equipment and materials required by the Contractor to complete the work.
- 25.3 The Contractor shall provide all rigging, cranes, lifting, equipment, etc., necessary to execute the works.

26. STORAGE OF EQUIPMENT AND MATERIALS

- 26.1 The Contractor shall ensure all stored materials and equipment are safely stacked in a suitable enclosure and stacking does not damage them.
- 26.2 The Contractor shall ensure stored materials and equipment do not overload the structure or floor construction.
- 26.3 The storage of combustible materials on site shall be kept to a minimum. The Contractor shall be responsible for ensuring such combustible materials are safely stored. Suitable fire-fighting equipment shall be provided by the Contractor if not provided by others, who shall further ensure that staff capable of using the equipment is at hand.

27. LOCATION OF EQUIPMENT

- 27.1 The Contractor shall check on doorways, passages, openings, lifts, etc., provided and shall ensure that all equipment offered can be moved through them to its final position. If necessary, equipment shall be ordered in a partially dismantled condition so that it is suitable for moving through the restricted openings or areas of restricted height or areas of restricted load.
- 27.2 The Contractor will, by the fact of his tendering, be regarded as having satisfied themselves that their equipment can be satisfactorily installed in the areas provided. Should the equipment offered require additional space, or access for installation of services, it shall be the Tenderer's responsibility to advise of such requirements at the time of tendering.
- 27.3 All changes, modifications and or out of sequence building work required to allow for the rigging of the equipment will be for the account of the Contractor if this has not been disclosed at tender stage.

28. CO-OPERATION WITH OTHER TRADES

- 28.1 The Contractor shall ascertain the extent of the work of other trades on site.
- 28.2 The Contractor shall give all necessary assistance to other trades to ensure that the work of all trades can be installed satisfactorily and without delay.
- 28.3 The Contractor shall liaise with other trades working in close proximity to the work covered by this specification, and shall assist in planning equipment and material positions to ensure that all trades can complete their work satisfactorily.

29. BUILDER'S WORK

- 29.1 The successful Tenderer shall, within 15 days, provide all the builders works requirements for this installation
- 29.2 It is the responsibility of the Contractor to check the Builder work as it is completed to ensure that the work has been correctly carried out in accordance with the drawings. The Contractor shall point out any problem areas as soon as possible to the Builder and Engineer so that they can be rectified. No claims will be considered for delays or other additional costs which arise out of the Contractor's failure to check the Builder's work in good time.
- 29.3 The successful Contractor will be expected to provide detailed general arrangement drawings indicating the plantroom requirements. Sufficient information shall be provided in order for the project Architect and Engineers to prepare the construction drawings of the plantrooms.
- 29.4 The builder's work drawings shall be fully dimensioned and shall include the following:
- details of all plant bases required.
 - details of all openings in walls and concrete work required.
 - details of ventilation required.
 - details and positions of all equipment to be built into walls.
 - any other work required.
- 29.5 All areas where the installation affects the integrity of the waterproofing, the penetrations shall be carefully detailed by the Contractor. All necessary precautions as required to make the installation waterproof shall be provided as part of this contract and shall be agreed with the Architect or Engineer prior to being implemented.

30. MAKING GOOD

- 30.1 The Contractor will be responsible for making good in all trades, and damage or disturbance to the buildings, installation, tarred surface, concrete surfaces, drains and other services, which he or his employees may have caused in the course of the construction of the system or installation.
- 30.2 The Contractor will be responsible for keeping the site tidy during the course of the construction of the system, and shall remove from the site all rubble and litter resulting from the construction work.

31. OPERATOR TRAINING

- 31.1 On completion of the installation and all tests, the Contractor shall continue to be responsible for the complete operation and maintenance of the plant during which time instructions and training shall be given to the Client's staff of the proper operation and maintenance of the plant.
- 31.2 The operation and maintenance of the plant, for the duration of the instruction period and up to stage of works completion, shall not in any way relieve the Contractor of his responsibility under the terms of the contract.
- 31.3 The cost of such training shall be included in the tender price.

32. MAINTENANCE TOOLS

- 32.1 The Contractor shall provide one set of all special tools, panel keys, etc., required for testing, maintaining and operating of all items of equipment.
- 32.2 Duplicate keys shall be provided for all control panels, instrument locks, etc.

33. AVAILABILITY OF SPARES

- 33.1 Spares and replacement parts shall be readily available in the Republic of South Africa and a guarantee of availability for a period of ten years shall be furnished.
- 33.2 The Contractor shall submit with their tenders a priced schedule of recommended spare parts which should be carried on site.

34. INSURANCE

- 34.1 Tenderers shall ensure their insurance policies provide adequate cover for the installation activities as the construction work progresses. Should insurance have to be extended to cover eventualities that may arise from the construction activities, these additional premiums may be included in the tender price and shall be enumerated in the covering letter.

35. DRAWINGS AND MANUALS – GENERAL

- 35.1 Detailed outline drawings, drawings of the proposed positioning of the equipment in the room, schematic diagrams and wiring diagrams shall be submitted to the Engineer for approval as soon as possible after the Contract has been awarded.

- 35.2 On completion, the manuals and drawings, in addition to those mounted behind the Perspex covers shall be issued to the Engineer.

- 35.3 The Contractor shall supply the following handbooks and drawings in English:

- Test Certificates
- Engine and Motor/Generator Handbooks
- Service Manual
- Spare Parts Manual
- Spare Parts List - indicating make, rating etc.

35.3.1 Test Certificates

All test certificates to be included in the handover file

35.3.2 Control Cubicle Handbooks

Manuals and handbooks shall be provided:

- Description (operating) Manual
- Fault-finding Manual
- Component Lists - indicating make, rating etc.

35.3.3 Drawings

Wiring and schematic drawings showing detailed circuitry of the following:

- Engine
- Motor/Generator
- Automatic Voltage Regulator
- Control Cubicle
- Interfacing between assemblies, subassemblies, components, etc.

Each wire, component, terminal etc. shall be clearly annotated on the drawing for identification and maintenance purposes.

35.3.4 Basis of Provision

Handbooks and drawings shall be provided on the following basis:

- Three copies of every handbook and of every drawing per plant.
- A separate schematic drawing shall be pasted inside the control cubicle behind a transparent plastic cover.

36. DRAWINGS

36.1 The Engineer's drawings for the Contract shall be those issued at the time of tender as well as those in addition to what has been issued reflecting the actions status of the installation together with any others issued to cover the variations to the contract.

36.2 As part of this contract, the Contractor shall provide the following drawings:

36.2.1 Manufacturing and Installation drawings

- The manufacturing and installation drawings ("shop drawings") shall provide all details of the components necessary for the manufacture and installation of the system in accordance with the specification.

36.2.2 Wiring Diagrams

- The wiring diagrams shall provide details of all the wiring associated with the installation. The same drawing symbols and system shall be used, as used on the Engineer's drawings.

36.2.3 Builder's Work Drawings

- All necessary builder's work drawings, as described elsewhere in this specification, shall be provided as part of this contract.

36.2.4 Record Drawings

- On completion of the installation, but before the plant is handed over; the Contractor shall provide a complete set of drawings showing the completed installation.

36.3 In addition to the drawings listed above, the Contractor shall provide all drawings necessary for the execution of the contract and shall submit such general and detailed drawings of the components and apparatus, as the Engineer may require, to approve construction of the system. All drawings shall comply with relevant standards as applicable to the specific installation and shall take cognisance of all the requirements as stipulated in the standards and shall under no circumstances deviate from the standard

36.4 Details and drawings of all major items of equipment, made by the Contractor or selected from

suppliers, shall be submitted for approval without specific request from the Engineer. The Contractor shall ensure equipment submissions shall include all relevant details on which an informed decision can be taken as to the mean time to repair and mean time to fail parameters which will be used to arrive at an availability calculation of 99.997% of the overall system. It will be expected of the Contractor to submit adequate information on each and every element of the installation for a function failure analysis to be conducted.

36.5 All required drawings shall be submitted to an agreed programme to suit the construction of the system.

36.6 All drawings shall be clearly numbered or marked with the equipment item numbers, area references etc. as well as comply to the relevant SABS/SANS standards

36.6.1 Approval of Drawings

- The Contractor shall submit, for approval, copies of all abovementioned drawings prior to starting work or issue to other parties. Any work started (off site or on site) prior to receiving the Engineer's approval of drawings, meaning the drawings have been coordinated with other services, shall be at the Contractor's own risk.
- The Engineer may require from the Contractor further detailed drawings and/or calculations which clarify features not adequately shown on the layout drawings. The request for additional details shall not be construed as extending the scope of this contract or altering the programme.
- The Engineer will return to the Contractor, within two weeks of their receipt by him, one copy of each drawing marked "THIS DESIGN CONFORMS TO THE PROJECT SPECIFICATION" (or similar) or marked with any changes, which are necessary. The Contractor shall modify the details and drawings as required by the Engineer. The nature and date of each modification and a distinguishing symbol shall be added and the drawings shall be submitted again for approval.
- Alterations to drawings are not intended to change the scope of work unless explicitly stated as doing so. Should any alterations in the opinion of the Contractor change the scope of work, the Contractor shall notify the Engineer, the Client and the Main Contractor immediately of receipt of the altered drawings before any further drawing work or fabrication is carried out. Claims for a change of scope made after performance of the work, constituting the claimed change of scope of work, will not be considered.
- The review of drawings by the Engineer shall not relieve the Contractor of any responsibility in terms of the contract. The Engineer will check the drawings for design only and approval of the drawings, schedules and catalogues shall not be construed as a complete check.
- The Contractor shall be responsible for any discrepancies, errors or omissions in the drawings and other particulars supplied by him whether such drawings or particulars have

been approved by the Engineer or not, provided that such discrepancies, errors or omissions are not due to inaccurate information or particulars furnished in writing to the Contractor.

- The Contractor shall provide, at his own expense, all copies of drawings required by him in the execution of the work and shall also, at his own expense, supply to the Engineer such drawings and copies thereof as are provided for in the specification.
- On completion of the installation, but before final handover, the Contractor shall provide three high quality paper prints of each of the drawings listed below showing the system as fixed:
 - Complete 1:50 scale layouts of plant rooms
 - Complete 1:100 scale drawings of the whole installation
 - Detailed drawings of all items of plant
 - Electrical layouts and wiring diagrams
 - Details of any other items requested by the Engineer
- The drawings shall be sufficient in detail to enable the Client's staff to maintain, dismantle, reassemble and adjust any part of the works.

37. OPERATING AND MAINTENANCE MANUALS

- 37.1 The Contractor shall provide three [3] hard copies and three [3] soft copies of the Operating and Maintenance Manuals.
- 37.2 The Contractor shall submit, for approval, four weeks before completion of the installation, two copies of the Operating and Maintenance manuals for the system supplied.
- 37.3 The manuals will be returned to the Contractor within ten working days of their receipt by him, marked with all changes, which are necessary.
- 37.4 The Contractor shall modify the manuals, as required by the project documentation and submit to the Engineer and the Client, within ten working days, two revised copies of the manuals. On completion of the installation, but before the plant is handed over; the Contractor shall provide three [3] hard copies and three [3] soft copies of the Final Operating and Maintenance Manuals for the system supplied, of all documentation and software related to the installations. The manuals shall be bound in book form with hard plastic covers to withstand constant use.
- 37.5 The manuals shall be properly indexed to facilitate easy reference.
- 37.6 The manuals shall include:
- A list of recommended servicing tools and specialist equipment.

- A list of spares to be supplied by the Contractor to cover the period of warranty.
 - A priced list of recommended spares necessary for a period of two years of operation.
 - Exploded drawings for detailed spares list from which every item of every piece of equipment can be positively identified for ordering replacements.
 - A list giving the name and address of the local agent for each item of equipment.
 - A list giving the name and address of the manufacturer of each item of equipment.
 - A copy of all test certificates obtained with the system.
 - A preventative maintenance programme for all equipment.
 - Operating instructions for each item of equipment.
 - Performance data and/or characteristic curves.
 - Commissioning data.
 - Record drawings.
- 37.7 On completion of the Contract, three complete sets of "As-Built" drawings shall be handed over at the expense of the Contractor.
- 37.8 These final drawings shall include:
- A proper and accurate as-built diagram of the complete installation showing all equipment.
 - A schematic diagram clearly showing function and component values.
 - A material list showing make, model and characteristic of all components and equipment is to be included.
 - Fully dimensioned as-built physical layout drawing of the equipment and installation
- 37.9 The Contract shall be deemed incomplete until all drawings and manuals have been received.

38. GUARANTEE AND MAINTENANCE

- 38.1 The equipment and its installation is to be guaranteed for a period of twelve (12) months and maintained for a period of twelve (12) months after final handing over, the cost of which shall be included in the tender price.
- 38.2 The cost of all spares, oil, filters, labour, etc., for maintaining the complete generating sets shall be included in the tender price.
- 38.3 The Contractor shall visit the installation at least six times per annum for the duration of this twelve month maintenance period and shall carry out the following:
- Report to the person in charge and log the date of the visit, tests performed, adjustments made and any other details considered necessary. The logbook shall remain in the

generator room.

- Clean the equipment.
- Check and top up lubrication oil, cooling water and battery water.
- Apply grease where necessary.
- Check and clean the air filter element.
- Replace the lubrication oil if the replacement period has expired.
- Replace the oil filter and fuel filter elements if required.
- Check and adjust tappets and the fuel injection pump.
- Run the system for a period of at least 30 minutes and test the automatic shut-down systems by simulating faults on all the protection systems and test all the electrical equipment for correct operation.
- Service the batteries.
- Service the cabinet ventilation equipment.
- Clean all equipment or rooms as required.
- To make available, upon request, emergency maintenance service.
- To carry out annually a thorough system check with the use of all the testing equipment and instruments required. A detailed report comparing system performance at the time of testing and the time of handing over shall be prepared and submitted along with comments.

38.4 The availability of all components shall be guaranteed for minimum period of ten (10) years.

38.5 The spare equipment and accessories shall not be used during the twelve (12) month maintenance period.

38.6 Maintenance

38.6.1 The Contractor shall maintain the entire installation as described in this specification for a period of one year (12 months) from the date of final handover.

38.6.2 The maintenance visits shall be carried out at regular intervals.

38.6.3 In addition to the regular maintenance visit, the Contractor shall carry out all necessary visits due to failure of any item of the system. The Contractor shall attend to all complaints by the Client and the Engineer whilst the system is still being handed over as part of the Contract.

38.6.4 The Contractor shall report to the parties above as recorded on arriving and leaving the site. The Contractor shall provide the Client and Engineer with a Service Report for each visit whether scheduled or breakdown.

38.6.5 At each maintenance visit, the Contractor shall check the function of each item and shall ensure the system is performing to specification. All automatic controls and safety devices shall be checked. All electrical control gear, lamps, etc., shall be checked and adjusted or replaced as necessary.

38.6.6 The equipment and plant rooms shall be cleaned at each scheduled visit.

38.6.7 The Contractor shall notify the parties as recorded above prior to the final monthly service so that if need be a person can be seconded to accompany the Contractor.

38.6.8 The professional team may at their discretion, allow the maintenance period to commence on any item of equipment or section of the installation at a date prior to final completion, if it is put into operation for beneficial use of the owner prior to works completion. This will not be permitted in cases where works completion is delayed due to the Contractor not carrying out remedial work in good time.

38.6.9 After the lapse of this 12 month period, the Contractor may be required to enter into a maintenance agreement. This agreement may subsequently be renewed for yearly periods.

38.6.10 The Contractor must be able to render 24 hour maintenance and repair service at all times, including statutory holidays. Full details of the firm's standby service facilities must be submitted at the time of tendering.

38.7 Guarantee

38.7.1 The Contractor shall guarantee the entire installation, as described in this specification for a period of one year (12 months) from the date of works completion. The guarantee shall provide for all parts, spares and equipment that become defective during the guarantee period and these shall be replaced free of charge. The guarantee shall cover all costs including material, labour, overheads, travelling etc.

38.7.2 The complete installation shall be guaranteed against defects whether patent or latent, as well as against faulty materials and workmanship.

38.7.3 The guarantee shall cover all materials, plant and equipment whether or not it is covered by a manufacturer's guarantee. The one-year guarantee, in terms of this contract, on the entire installation shall not be affected by the prior expiry of any guarantee provided by the manufacturer of any item of equipment or plant, nor shall it affect the Client's Common Law rights regarding defects.

38.7.4 The Contractor shall cede to the Client, the remainder of any equipment guarantee which he has received from his suppliers, and which extends beyond the one-year period. It shall be the responsibility of the Contractor to ensure that the guarantee is transferable.

38.7.5 The professional team may at their discretion allow the guarantee period on any item of equipment or section of the installation to start at a date prior to works completion if it is put into operation for beneficial use of the Client prior to works completion. This will not be permitted in cases where works completion is delayed due to the Contractor not carrying out remedial work in good time.

SABC Studio 6 Reinstatement

ELECTRICAL INSTALLATION SPECIFICATION: DETAILED TECHNICAL SPECIFICATION

2021-11-17
Revision 0

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1. INTRODUCTION

- 1.1 The Detailed Technical Specification shall be read in conjunction with the General Technical Requirements and the drawings.
- 1.2 This part takes precedence over the General Technical Requirements and the drawings in respect of any discrepancies in the description of equipment, materials or methods.

2. SCOPE OF WORKS

2.1 Background

- 2.1.1 TV Studio 6 is situated in TV Production Block, Auckland Park TV Centre. The facility was extensively damaged during a fire in 2013. The Studio has since been vacant after the damaged interior was stripped out to allow safe movement in the area.
- 2.1.2 TV Studio 6 is a production studio, and it consists of the following areas:
 - TV Production Studio
 - Drawback area
 - Control rooms
 - Equipment rooms
 - Dimmer room
 - Technical void area
 - Staircases
 - Sound lobbies
 - Stores
- 2.1.3 All the above areas have extensive fire damage
- 2.1.4 The purpose of the project is to reinstate the television studio.

2.2 Upgrade Overview

- 2.2.1 The electrical installation for Studio 6 will be based on the installation of Studio 7.
- 2.2.2 It should be noted that not all components and/or installation methods can be matched, however, the general principles of the installation will be followed where practicable. It is, however, proposed that modern technologies and efficient equipment be installed for the new Studio 6.
- 2.2.3 Briefly the extent of the works contract will comprise of the supply, installation, testing and

commissioning of the following related to the electrical installation, and shall include but not be limited to:

- Main distribution board with associated supply cables
- Sub-distribution boards with associated supply cables
- Wireways (cable ladders, cable trays, conduits)
- Infrastructure for all power and lighting
- Lighting
- Small power
- Earthing and lightning protection
- Cable trays & ladders and wireways
- Conduits and sleeves
- All required wireways for electronic smoke detection / fire services installation
- Hoisting, crange, transport, storage and protection of equipment.
- All necessary labour, tools, mechanical aids, appliances and testing equipment required to complete the installation and acceptance testing of the electrical installation and recording of test results. Test results shall be included in the maintenance manuals.
- Liaison with other Contractors and the Professional Team in the planning of the installation and preparation of workshop drawings.
- Provision of equipment fixings and supports.
- Provision for comprehensive maintenance manuals.
- Set of recommended spare parts.
- Set of tools necessary for maintenance of plant.
- Set of recommended site maintenance equipment including hoists, lifting equipment and the like.
- Operational training on site to instruct the Client's personnel on operation and maintenance procedures.
- Complete maintenance during the guarantee period, as well as comprehensive maintenance proposals for system long-term maintenance.

2.3 General

- 2.3.1 The complete Installation shall comply with the requirements of this specification. Should any discrepancies or contradictions arise between this part of the Specification and the Detailed Technical Specification, then the latter shall take preference. Should any discrepancies appear between the written specifications and the drawings, Tenderers shall ascertain the position before tender closing date, otherwise the decision by the Engineer will be final.
- 2.3.2 All equipment offered shall be of reputable make with adequate spares available in South Africa. Details shall be included in the tender, of similar equipment recently supplied and available for inspection.
- 2.3.3 Tenderers to provide a cost for the entire electrical installation based on the BoQ, specifications and drawings, as well as their own designs, measurements and quantities
- 2.3.4 The following works to be priced for the installation:
- Supply and installation of all main and sub-distribution boards, including associated cabling as indicated on the drawings.
 - Supply and installation of all light fittings as indicated on the drawings and specified.
 - Supply and installation of complete power installation as indicated on the drawings and specified.
 - Supply and installation of the complete electrical reticulation consisting of conduit work, cable ways, wiring and electrical connections of equipment as indicated on the drawings.
 - Supply and installation of all conduit work, conduit boxes and cable ways for electronic services installation, fire detection and protection, etc.
 - Any and all Preliminaries and General
 - Project management and quality assurance
 - Testing, commissioning and preparation of "As Built" drawings.

2.4 Exclusions

- 2.4.1 The following services are excluded from the scope:
- Specialised light fittings
 - Dimming, dimmer controls, dimming equipment, dimmer outlet boxes
 - Power and Tech Power Panels
 - Electrical installation to the mezzanine metal lighting structure (top level)
 - Back-up and standby power (generators and UPS)

- Sound installation and equipment
- Television production installation and equipment
- CCTV, access control and security – provision to be made for wireways and power only
- Smoke detection and fire suppression – provision to be made for wireways and power only
- Voice, data and telecommunications – provision to be made for wireways and power only

3. ELECTRICAL CONTRACTOR

- 3.1 The electrical contractor to be registered with the Department of Labour
- Company Registration certificate as Electrical Contractor from Department of Labour (DOL) to be submitted with the submission
- 3.2 The installation team to be led by a qualified Master or Installation Electrician, with adequate and relevant experience
- Proof to this effect to be submitted with the submission – registrations, certificates, CVs, qualifications
- 3.3 The entire electrical installation to comply with the latest SANS 10142, SANS 10114, SANS 204
- 3.4 Electrical certificates of compliance to be issued for each distribution board and the entire electrical installation after completion of the project

4. SITE

- 4.1 The site is located in Auckland Park, Gauteng: TV Studio 6, situated in TV Production Block, Auckland Park TV Centre, Johannesburg.
- 4.2 The equipment shall be rated to operate continuously for the specific site and under the following site conditions:
- | | |
|----------------------|-----------------------------------|
| ▪ Altitude | 1650m |
| ▪ Temperature | 45°C maximum, -10°C minimum |
| ▪ Relative Humidity | 95% |
| ▪ Lightning | Severe. |
| ▪ Dust | Severe. |
| ▪ Humidity | High |
| ▪ Nominal LV. Supply | 400/231 [no load] 4 wire, 3 phase |

system with earthed neutral.

- Frequency 50 Hz.

- 4.3 Tenderers are advised to visit the site to acquaint themselves with the installation. No claims will be entertained for lack of knowledge regarding the site conditions.
- 4.4 Tenderers are advised to visit the site and acquaint themselves with all local conditions pertaining to the execution of the installation before tender closing date.
- 4.5 No claims from the Contractor which may arise from insufficient knowledge of site access, type of site, labour conditions, establishment space, transport and loading/unloading facilities, power and water supply, etc., will be considered after submission of tenders.
- 4.6 The Contractor shall ensure prior to submitting the tender they have familiarised themselves with all the information available regarding the building as well as site conditions. No claims whatsoever will be entertained for items which are of a nature that should have been assessed during tender stage.

4.7 Studio Environment

- 4.7.1 The site is operational and deemed to be a “LIVE” environment at all times – specifically the adjacent Studio 7
- 4.7.2 All installation work shall be done with utmost care and painstakingly careful planning so as not to affect the operation of Studio 7
- 4.7.3 It shall also be required of the successful Contractor to acquaint himself, together with the Main Contractor, Electrical Engineer and Client, with existing services and reticulation upstream of the installation and how these might be affected by the works. At the same time, procedures for risk mitigation and works will be formulated
- 4.7.4 Sequencing of works and cut-overs to be carefully planned and agreed with the main contractor, Engineer and Client

4.8 Studio Power

- 4.8.1 Normal, generator and UPS power is available on site. The supply to the Studio 6 Main Low Voltage panel will be taken from existing upstream main low voltage distribution boards and existing cable wireways. It is assumed that these boards as well as the cable wireways have adequate capacity.
- 4.8.2 The supply cables to Studio 6 Main Distribution Board (DB14, 14E, 14.5, 14.5E) located on 2nd floor from the upstream MLT DB S3 have reportedly been reinstated and deemed not necessary for the scope of works. An allowance was still made for potentially joining these cables, as well

as terminating these onto the new Main DB. It is assumed that these supply cables are adequately sized for the Main DB capacity

4.9 Load Description

4.9.1 The electrical load requirements will be based on that of Studio 7.

4.9.2 The types of load for the facility can typically be summarised as follows:

- HVAC
- Lighting
- Small power
- General building loads

5. DISTRIBUTION BOARDS

5.1 The distribution boards to be supplied by a specialist firm and is included in this contract. The successful contractor is advised to appoint a specialist supplier for the works and will be responsible for the distribution board installation.

5.2 The installation of all distribution boards, inclusive of taking delivery, storage, positioning and electrical terminations will form part of the Electrical Contract. The distribution boards are schematically indicated on the drawings.

5.3 The Electrical Subcontractor will be responsible for liaison with the supplier regarding programme, taking delivery, unpacking, assisting with placing in position and assembling, where required. Final connections to all distribution boards, testing, preparation of legend cards and commissioning shall be carried out by the Electrical Subcontractor.

5.4 The fault levels are indicated on the schematic diagram. It is the responsibility of the distribution board manufacturer to select current limiting type circuit breakers and select suitable downstream switchgear to ensure that the fault levels indicated will be achieved.

5.5 Documentary proof, calculations and selection of switchgear are to be submitted with the shop drawings for the various distribution boards.

5.6 The distribution board manufacturers shall ensure that distribution boards are correctly sized in order that they may be fitted within the allocated spaces as indicated on the drawings.

5.7 Tenderers are required to price for the supply and installation of the specified distribution boards.

5.8 General Requirements

- 5.8.1 The multi-cubicle type assembly including hinges, locking means for doors, covers etc. shall be constructed only of materials capable of withstanding the mechanical, electrical and thermal stresses as well as the effects of humidity and environmental conditions which are likely to be encountered in normal service and as specified in the data sheet.
- 5.8.2 All switchgear and control gear assemblies and busbar designs shall ensure extendibility with the same type of equipment on either end of the assembly without major modifications that shall negatively affect the type test certification or performance of the installation.
- 5.8.3 Isolation of the assembly shall only be required for connection of the busbars and extension of the control bus wiring.
- 5.8.4 Assemblies shall be maximum continuous rated in respect of the incomers and main busbars according to the full load rating of the supply transformer at maximum ambient temperature and assigned temperature rise limit.
- 5.8.5 The sheet metal enclosure, the primary electrical components and the connecting copper work shall be selected and installed so as to ensure that the maximum specified continuous current rating (In) is available at an external degree of protection IP41 and that the internal surrounding air temperature rise limits specified by the component manufacturer are not exceeded.
- 5.8.6 The current density of copper busbars shall not exceed 1.6 A/mm².
- 5.8.7 Where two or more circuits within a section are connected to the same distribution busbars; a diversity factor as specified in the data sheet shall be applied to the section for the purposes of calculating the connected load and the power losses within the section.
- 5.8.8 The assembly shall be designed for front functional unit access, in a single sided arrangement. This means that back-to-back arrangements will not be considered.
- 5.8.9 Each section of an assembly other than the incomer and bus-section shall be equipped with a cable /wire way / termination compartment located adjacent to the section.
- 5.8.10 The assembly shall be fitted with surge arrestors complying with (SANS) IEC 61643-1. The devices are to be categorized according to Class II and shall be installed according to the requirements laid down in SANS 10142-1
- 5.8.11 The surge protection equipment installation is to be considered a functional unit within the assembly and shall have been type tested.
- 5.8.12 All arc vents and pressure relief flaps shall be covered on the inside with a non-removable IP20 or better-rated grid or meshing to prevent accidental access to live components.
- 5.8.13 Apparatus and circuits including the main and distribution busbars within the assembly shall be so arranged as to facilitate their operation and maintenance, and at the same time to ensure the necessary degree of safety against accidental contact with live parts with the door.

- 5.8.14 Each functional unit combination, either fully withdrawable or fixed shall be contained within an adequately dimensioned assembly compartment taking into account access for maintenance and repair and the expected power losses of all the devices, power wiring and terminations comprising the combination in relation to maximum permissible temperature rise of the respective devices in particular electronic equipment and the ability of the enclosure to dissipate the heat without ventilation.
- 5.8.15 The assembly shall be equipped with a protective earth conductor (PE) running its full length and dimensioned according to (SANS) IEC 60439-1 annex B to which each section shall be bonded by means of a conductor adequately dimensioned to withstand the thermal and dynamic forces associated with the assigned prospective fault current / time.
- 5.8.16 The assembly is to be provided with robust gland plate(s) manufactured from zinc-plated steel, galvanised steel, (aluminium or other non-ferrous material in the case of single core cables) and shall be above floor level.
- 5.8.17 The gland plate(s) are to be bonded to the protective earth (PE) in such a manner that the earth continuity is not compromised during the installation or replacement of cables.
- 5.8.18 The cross-section of the copper earth-bonding conductor for the gland plate(s) shall be in accordance with (SANS) IEC 60439-1
- 5.8.19 Equipment shall be clearly marked (name tagging).
- 5.8.20 The earthing arrangement for chassis mounting plates, doors, removable covers and the like in respect of conductor cross-section shall comply with (SANS) IEC 60439-1
- 5.8.21 Configuration, arrangement and wiring of the functional unit's components shall be done in a logical and consistent manner that shall facilitate rapid fault tracing, repair and maintenance with unrestricted access to all components.
- 5.8.22 Ventilation openings in enclosure doors and other external covers will not be permitted.
- 5.8.23 A degree of separation between the distribution busbars and the functional unit of at least IP2X is to be maintained at all times.
- 5.8.24 Large functional units may be fed directly from the main horizontal busbars either by means of insulated cables or copper busbars.
- 5.8.25 A degree of separation of at least IP2X is to be maintained between the busbar compartment and the functional unit at the point of entry of either the connecting cables or busbars.
- 5.8.26 If the connection is by means of copper busbars, these are to be insulated by means of heat shrink or air shrink sleeving.
- 5.8.27 Accessible live parts must be equipped with finger proofing to IP20 and where this is not possible, additional barriers are to be provided that require the use of a tool for removal.
- 5.8.28 Where two or more functional units are connected to distribution busbars within a section, a

load diversity factor may be applied for temperature rise calculation purposes.

5.8.29 Only reputable switchgear shall be used

5.9 Quality Assurance

5.9.1 Contractors to check and inspect boards at the manufacturer premises during all stages.

5.9.2 Contractors to present the Electrical Engineer with written confirmation that the boards are in full compliance with the specifications and applicable regulations, schematic layouts and diagrams, that they have been checked, inspected, and fully tested.

5.9.3 Contractors to liaise with board manufacturers regarding testing. Once ready, a written request for the Electrical Engineer and Client to witness the inspection and testing of the distribution boards.

5.9.4 During the inspections, a fault list, if necessary, will be drawn up and handed to the Contractor and Board Manufacturer.

5.9.5 After satisfactory rectification of the fault list, and subsequent re-inspection, the Board Manufacturer may dispatch the boards to site. No repairs or rectification of fault list items will be permitted to be carried out on site.

5.9.6 The Contractor shall also confirm that each of the distribution boards will fit into the space or area allocated.

5.10 Nameplates and Labels

5.10.1 Externally visible, permanent nameplates shall be provided to identify each protective relay, meter, instrument, selector switch, indicating light etc. Permanent equipment and terminal blocks within the compartments shall be labelled. Protective relays shall be designated as to use and the phase to which they are connected.

5.10.2 Other door mounted equipment shall be identified by labels on both back and front of the door. The label on the inside shall bear both the number used on the schematic diagram to identify it and the device duty description. The label on the outside shall bear only the device description.

5.10.3 Labels indicating the busbar full load and short circuit rating shall be fitted to the front of the incomer panels and sides of the switchboard.

5.10.4 Each cubicle shall have a door-mounted nameplate marked with the circuit designation and an identical nameplate mounted on the rear.

5.10.5 Each circuit breaker shall be identified by means of a circuit designation nameplate to allow it to be returned to the correct cubicle. An identical nameplate shall be mounted on the back of the panel for identification of the correct circuit breaker.

5.10.6 Nameplates shall be secured with rivets.

5.11 Cable Terminations

5.11.1 Cable terminations shall be of the dry type.

5.11.2 Cable supports shall be provided at maximum intervals of 450 mm between the cable entry and termination.

5.12 Glanding Plates

5.12.1 Removable gland plates shall be provided in cable chambers.

5.12.2 The gland plates used on single-core applications shall be manufactured from a non-ferrous material.

5.12.3 Split gland plates are acceptable, provided mechanical strength and IP ratings are not negatively affected. A dedicated earth strap shall be applied to connect all parts of a split gland plate arrangement.

5.13 Warning Notice

5.13.1 At prominent positions within the plant rooms or DB cupboards, relevant and statutory signage to be provided Notices as specified in Clause C52 of Part III of the Factories, Machinery and Building Works Act of 1941 and relevant SANS 10142, as amended.

5.13.2 The circuit and wiring diagrams shall be mounted behind Perspex covers on the inside of the plantrooms or DB cupboards.

5.14 Testing

5.14.1 All tests, i.e. pressure tests, trip tests, injection tests, and functional tests shall be carried out at the premises of the board manufacturer. All tests shall be performed by the board manufacturer and shall be repeated for witnessing by the Contractor, Electrical Engineer and Client.

5.15 Schedule of Distribution Boards

5.15.1 The following distribution boards to be supplied and installed as per the drawings:

- DB14, 14E, 14.5, 14.5E (Main DB – Second floor)
- DB14.6, 14.6E (Sub DB – Third floor)
- DB14.6.1, 14.6.1E (Sub DB – AC Plant Area)
- DB14.5T (TV Tech DB – Second floor)

5.15.2 Distribution boards provided will serve the following loads:

- DB14, 14E, 14.5, 14.5E (Main DB – Second floor)
 - HVAC
 - Sub DBs (DB-M12, DB B14.6, DB B14.6E, DB B14.6.1, DB B14.6.1E)
 - Dimmer room
 - Lighting
 - Small Power
- DB14.6, 14.6E (Sub DB – Third floor)
 - HVAC
 - Lighting
 - Small Power
- DB14.6.1, 14.6.1E (Sub DB – AC Plant Area)
 - HVAC
 - Lighting
 - Small Power
- DB14.5T (TV Tech DB – Second floor)
 - Control suite lighting
 - Control suite small power

6. CABLE INSTALLATION

6.1 General

- 6.1.1 The LV cable installation shall be carried out in accordance with the requirements of the Code of Practice and as specified in the General Technical Requirements.
- 6.1.2 All LV cables, as indicated on the drawings, shall be supplied and installed by the Electrical Contractor.
- 6.1.3 All cables shall be made off at both ends and connected to the terminals of the equipment as indicated on the drawings or as required.

6.2 Cables

- 6.2.1 All cables shall have stranded copper conductors and shall be of 600/1000V grade. Cables with aluminium conductors are unacceptable.
- 6.2.2 The cables shall be armoured with a single layer of galvanised steel wire.
- 6.2.3 All cables shall bear the SANS mark of approval and shall have colour coded PVC insulated conductors.
- 6.2.4 Tenderers shall note that all earth conductors shall be of cross-section rating equal to the supply cable rating throughout the installation. Tenderers shall note that only insulated earth cables shall be installed.

6.3 Installation

- 6.3.1 All LV cables shall be installed as indicated on the drawings. The installation methods shall comply fully with the General Technical Requirements. The installation shall be carefully planned to reduce the number of cable crossings to a minimum.
- 6.3.2 The following different types of installations shall be employed:
 - On cable trays and ladders
 - In cable wireways and trunking
 - In conduits or sleeves

6.4 Cables on Cable Trays or Ladders

- 6.4.1 Cables on cable trays and ladders shall be neatly laid on the ladders/trays and strapped to the ladders/trays at 1200mm intervals. A minimum of a half cable diameter space shall be allowed between cables.

6.5 Identification of Cables

- 6.5.1 Cables shall be identified as described in the General Technical Requirements. All cables entering or exiting the Main LV Board, sub-distribution boards, and/or any other equipment, shall be clearly marked at both ends with a suitable cable marker fixed to the cables.
- 6.5.2 Identification labels shall indicate the size of the cable and where it feeds to / from.
- 6.5.3 The identification numbers of cables shall be indicated on the "as built" drawings of the installation.

7. **POWER INSTALLATION**

7.1 General

- 7.1.1 Installation methods of the various power outlets indicated on the drawings shall comply fully with the General Technical Requirements.
- 7.1.2 The power installation is indicated on the drawings, all services will be cast into the slab or chased into the walls, or surface mounted
- 7.1.3 The majority of the installation will be surface mounted (wireways, trunking, conduits), affixed to the walls and/or soffit and/or floor.
- 7.1.4 Infrastructure (wireways, trunking, conduits) will be covered by cladding where installed on the walls (refer to architectural drawings) and/or ceilings.
- 7.1.5 No surface mounted installations allowed on the cladding and/or ceilings

7.2 Cable wireways

- 7.2.1 Cable trays, baskets and ladders shall be hot-dip galvanised off the medium or heavy duty type, suitable to the installation
- 7.2.2 Cable trunking (P1000, P2000, P8200, P9000) shall be galvanised and suspended from slabs, fixed to walls and/or fixed to floors using suitable hanger brackets and fixing brackets, as the case may be, suitable to the installation
- 7.2.3 Tenderers to note that the walls will be cladded (refer to architectural drawings and details).
- 7.2.4 No surface mounted cable wireways allowed on the cladding and/or ceilings

7.3 Conduit

7.3.1 The conduit installation shall comply with the requirements of the General Technical Requirements forming part of this document. Bosal conduit will be used for the following installations:

- Cast in concrete.
- Built or chased into brickwork.
- Surface

7.3.2 Installation methods of conduit shall be approved by the Engineer prior to work being carried out. The Electrical Contractor shall familiarise himself with all expansion joints as well as positions where shrinkage cracks may occur on the slabs and shall apply evasive action to prevent damage to cast in conduit work.

7.3.3 Surface mounted conduit work shall consist of galvanised metal conduit. Proper saddles to be used for fixing. All surface conduit to be approved prior to installation.

7.3.4 Tenderers to note that the walls will be cladded (refer to architectural drawings and details).

7.3.5 No surface mounted installations allowed on the cladding and/or ceilings

7.4 Socket Outlets

7.4.1 *General purpose socket outlets*

7.4.1.1 All general purpose socket outlets shall be equal or similar to the Crabtree Classic range (satin chrome finish).

7.4.1.2 General purpose socket outlets shall be of the switched, surface, flush or power skirting mounted types.

7.4.1.3 Socket outlets shall be mounted at 300mm AFFL unless otherwise indicated on the drawings.

7.4.1.4 Socket outlets shall be supplied by means of 4mm² insulated copper conductors and a 4mm² insulated copper earth conductor, or alternatively a 4mm² 2-core plus earth cable, in conduit or trunking, if approved by the engineer. The plug circuit conductors shall be colour coded red for live and black for neutral.

7.4.1.5 Socket outlet layouts are indicated on the drawings

7.4.1.6 All light switches and socket outlets shall be flush mounted with the cladding on the walls

7.4.1.7 Tenderers are advised that samples of all socket outlets, light switches, etc. will have to be provided for approval by the SABC

7.4.2 *UPS socket outlets*

- 7.4.2.1 UPS power socket outlets shall consist of red 16A sockets with “D” type earth pin and shall be wired with green insulated earth wire. The Electrical Contractor shall ensure that the earth pin maintains the integrity of the isolated earth.
- 7.4.2.2 Socket outlets shall be of the switched, surface, flush or power skirting mounted types as indicated in the drawings.
- 7.4.2.3 Socket outlets shall be mounted at 300mm AFFL unless otherwise indicated on the drawings. Socket outlets shall be supplied by means of 4mm² insulated copper conductors and a 4mm² insulated copper earth conductor, or alternatively a 4mm² 2-core plus earth cable, in conduit or trunking, if approved by the engineer. The plug circuit conductors shall be colour coded white for live and black for neutral.
- 7.4.2.4 Socket outlet layouts are indicated on the drawings
- 7.4.2.5 All light switches and socket outlets shall be flush mounted with the cladding on the walls
- 7.4.2.6 Tenderers are advised that samples of all socket outlets, light switches, etc. will have to be provided for approval by the SABC

7.5 Isolators

- 7.5.1 Either one, two or three pole isolators shall be installed, as indicated on the drawings.
- 7.5.2 Isolators shall be of the industrial type, equal or similar to Clipsal 56 Series or GEWISS and shall be of the flush or surface mounted type
- 7.5.3 Flush mounted isolators shall be provided with a gripper gland adjacent to isolator toggles for feeder cabling.

7.6 Connections to Electrical Equipment

- 7.6.1 A variety of equipment may be supplied by specialist contractors which require electrical connections. These connections shall be carried out in accordance with the Codes of Practice and as specified in the General Technical Requirements.
- 7.6.2 The following equipment may be required to be connected:
- Light fittings
 - Fans
 - Studio equipment

7.6.3 *Air conditioning equipment*

- 7.6.3.1 Various air conditioning and heating equipment (HVAC units and fans) will be supplied and installed by the HVAC contractor. The electrical contractor shall be responsible to provide a power supply terminating in an isolator adjacent to the HVAC equipment as indicated on the drawings. Final connections from the isolator to HVAC equipment will be done by the HVAC contractor.

7.7 Power skirting

- 7.7.1 Power skirting shall be installed as indicated on the drawings.
- 7.7.2 The power skirting shall have three compartments, each compartment measuring approximately 70mm x 50mm.
- 7.7.3 The power skirting shall be provided with three separate cover plates fixed to the power skirting by means of locating screw type fixing butterfly clips. "Clip in" type covers will not be acceptable.
- 7.7.4 The power skirting covers shall be delivered pre-cut in a modular form as detailed on the drawings.
- 7.7.5 A data and telephone termination plate shall be provided at each 16A socket outlet as indicated on the drawings.
- 7.7.6 All 16A sockets shall be of the switched type, equal or similar to Crabtree Classic range (satin chrome finish)
- 7.7.7 The top compartment shall be reserved for normal power, middle for UPS power and bottom compartment for data outlets.
- 7.7.7.1 Tenderers are advised that samples of the power skirting, socket outlets, light switches, etc. will have to be provided for approval by the SABC

8. **LIGHTING INSTALLATION**

8.1 General

- 8.1.1 The Lighting Installation shall comply fully with the General Technical Requirements of the specification, unless otherwise specified in this section.
- 8.1.2 The circuit wiring of lighting circuits shall be 2.5mm² insulated copper conductors and a 2.5mm² insulated copper earth conductor in trunking or 20mm diameter conduits.
- 8.1.3 Light switches, where indicated, shall be similar or approved equal to Crabtree Classic range (satin chrome finish) and shall be of the flush or surface mounted type complete with covers, suitable for switching of the actual complements and types of lamps utilised.

- 8.1.4 All light switches and socket outlets shall be flush mounted with the cladding on the walls
- 8.1.4.1 Tenderers are advised that samples of all socket outlets, light switches, etc. will have to be provided for approval by the SABC
- 8.1.5 The wiring trunking in ceiling voids shall be suitably sized to accommodate the number of lighting circuits as indicated on the drawings and shall be pre fitted with knock-outs for un-switched 5A socket outlets to accommodate the number of lighting circuits as indicated on the drawings.
- 8.2 Light Fittings
- 8.2.1 Tenderers shall base their rates on the handling, storage, installation, commissioning, and guarantee maintenance of the light fittings. The rates shall include the handling fee and contractors profit, assembly and installation of lamps as well as the electrical connection to the light fittings.
- 8.2.2 The description of light fitting types below shall serve as a basis for tenderers to price the items.
- 8.2.3 All globes, lamps and control gear shall be new and in working order when the building is handed over.
- 8.2.4 The permanent fittings shall not be used for temporary lighting during construction unless prior arrangements have been made with the Engineer and client. Should the fittings be utilised before practical completion and the hand over date, the Electrical Contractor shall obtain an extended guarantee from the supplier. All light fittings shall be guaranteed for a period of twelve (12) months after the practical completion and hand over date.
- 8.2.5 All lamps, fittings and accessories shall comply with the General Technical Requirements of the document unless specifically specified to the contrary in this section.
- 8.2.6 Tenderers are required to price for the supply and installation of the specified fittings, where indicated in the BOQ
- 8.2.7 Tenderers are required to price for the installation only of the specified fittings, where indicated in the BOQ – an allowance is made in Bill 6 for the supply of light fittings yet to be specified. Tenderers can price for mark-up, placing order, taking delivery and on-site storage
- 8.2.8 Tenderers are urged and advised to visit the site and thoroughly acquaint themselves with the nature and extent of the site conditions, availability of labour and storage of material
- 8.2.9 Tenderers are advised that samples of all light fittings will have to be provided for approval by the SABC
- 8.2.10 The dimming requirements will be specified by the client post tender award

8.3 Lighting Schedule and Specification

8.3.1 The following light fittings are proposed to be supplied and installed in the positions shown on the drawings. The Electrical Contractor is advised that only fittings and control gear bearing the SABS mark of approval will be accepted.

- Type C1: 600x600mm LED panel light, approx. 37W, lay-in fitting, white trim, dimmable, with 3m flexible chord and 5A plug-top
- Type D1: T-bay type fitting, LED, approx. 120W, 1200x400mm, surface mount (similar to Lascon S-BAY-111W-LED)
- Type E1: dust and moisture proof fluorescent-type fitting, LED, approx. 37W, 1200mm, surface mount (similar to Lascon C10 LED C10-37W-LED)
- Type E1-E: dust and moisture proof fluorescent-type fitting, LED, approx. 37W, 1200mm, surface mount, with integrated 30 minute battery back-up (similar to Lascon C10 LED C10-37W-LED)
- Type E2: dust and moisture proof fluorescent-type fitting, LED, approx. 37W, 1200mm, surface mount, dimmable (similar to Lascon C10 LED C10-37W-LED)
- Type E3: dust and moisture proof fluorescent-type fitting, LED, approx. 55W, 1200mm, surface mount, dimmable (similar to Lascon C10 LED C10-55W-LED)
- Type F: surface mounted bulkhead, LED, approx. 12W, round, white trim, opal diffuser (similar to Spazio Flo LED bulkhead)
- Type N1: specialised directional light fitting for Sound Suite areas, surface mounted, 1200mm, dimmable, with 3m flexible chord and 5A plug-top
- Type Q: recessed wall light, LED, approx. 4W, with grid, square, silver trim, mounted next to dimmer boxes (similar to Regent Mira)
- Type R1: surface mounted bulkhead, LED, approx. 20W, round, black trim
- Type U: illuminated exit / directional signage, LED, surface mount
- Type U2: illuminated exit / directional signage, LED, surface mount
- Type V: illuminated exit / directional signage, LED, surface mount
- Type W: surface mounted bulkhead, LED, approx. 10W, round, black trim

9. TELEPHONE, DATA, ACCESS CONTROL, CCTV, FIRE DETECTION & BMS

9.1 General

- 9.1.1 Tenderers shall allow for the supply, delivery and installation of all conduits, draw boxes, outlets, draw-wires, etc. as specified and as indicated on the drawings for the above services.

9.2 Conduits

- 9.2.1 Conduits shall be installed as indicated on the drawings, fitted with draw-wire and shall comply with the General Technical Requirements.

- 9.2.2 Galvanized conduit will be used on all installations.

9.3 Draw-wires

- 9.3.1 All conduits, sleeves, etc. required for the electronic services installation shall be fitted with galvanised steel draw-wires.

9.4 Telephone and Data

- 9.4.1 All telephone and data outlets shown shall consist of 100 x 100 x 50mm boxes, complete with cover, installed at 300mm AFFL, unless otherwise indicated.

10. EARTHING AND LIGHTNING PROTECTION

- 10.1 The complete Electrical Installation shall be earthed and bonded as required by the Code of Practice.

- 10.2 Access floors will have to be earthed and bonded to prevent static

11. TESTING

- 11.1 The Electrical Contractor shall have the complete installation tested and approved by the Local Authorities.

- 11.2 Subsequent to the testing of the installation by the Local Authorities, the Electrical Contractor shall in the presence of the Engineer, test all lighting and power circuits with respect to:

- Phase Balance.
- Insulation Level.
- Earth Continuity.

- Voltage Levels.
 - Polarity.
- 11.3 The Electrical Contractor shall have the following instruments available on site for the full duration of the last nine months of the contract:
- Phase rotation meter.
 - Digital current and voltmeters (0 – 600A, 0 – 400V).
 - Null balance megger testers.
 - Earth leakage testers.
 - 0 – 2500A tong tester.
- 11.4 All instruments required for special tests such as pressure testing, etc. shall be provided when required.
- 11.5 A Certificate of Compliance duly signed by an authorised person shall be provided for each tested area.

12. CO-OPERATION WITH OTHER TRADES

- 12.1 In general, conduit work and wire-ways related to this contract will be supplied and installed by the Electrical Contractor.
- 12.2 The Electronic Services Contractors shall be responsible to ensure that the wire-ways provided are adequate to accommodate the related services.

12.3 Building Contract

- 12.3.1 The following work will be provided by the Building Contractor:
- Construction of the building
 - Construction of the necessary plantrooms
 - Opening or breaking of ducts and openings through walls
 - Closing of ducts and openings through walls after installation of cables, cable ladders, etc.

12.1 Air Conditioning

12.1.1 The following will be provided by the HVAC Contractor:

- HVAC units and associated equipment
- HVAC fans
- HVAC ducting

12.1.2 Electrical contractor to provide isolators for the HVAC equipment as indicated on the drawings

12.2 Electronic Services

12.2.1 The following will be provided by the Electronic Services Contractor (CCTV, security, smoke detection, fire suppression):

- CCTV, security, smoke detection and fire suppression

12.2.2 Electrical contractor to provide isolators and wireways for the electronic services and equipment as indicated on the drawings

12.3 Data Services

12.3.1 The following will be provided by the Data Contractor:

- Data cabling and points

12.3.2 Electrical contractor to provide isolators and wireways for the data services and equipment as indicated on the drawings

13. MAINTENANCE

13.1 The contractor shall maintain the entire installation as described in this specification for a period of twelve (12) months from the date of final hand over (i.e. project practical completion).

14. HANDOVER

14.1 The full electrical installation must be inspected, tested and commissioned. The following documents must be submitted at hand-over:

- Commissioning records
- Commissioning results and figures
- Operational and maintenance manuals
- Monthly, quarterly and yearly maintenance and commissioning
- Training and knowledge transfer to building owner, this must also be conducted on site
- Details and descriptions of equipment that has been used.
- A detailed description of the philosophy of operation
- All details and information on operating instructions
- Manufacturers Technical Brochures and Pamphlets
- Maintenance and troubleshooting instructions
- Description of control systems
- Schedule of spare parts with part numbers
- Schedule of spare parts that are recommended to be held in stock
- Certification for specialised equipment together with serial number.
- Accurate set of as-built drawings showing all details
- A schedule of intended service dates.
- Electrical certificates of compliance
- Manufacturer or supplier guarantees and warranties
- The Contractor is to note that all information in the manuals are to be specific and not generic.

15. INFORMATION TO BE SUBMITTED WITH THE TENDER

15.1 The Contractor is required to submit the following information with his tender:

15.1.1 Proposed variations to the specification, if any

- If none listed, it is deemed that the tenderer complies with all specifications
- If alternative systems are offered, a clear description of the operating characteristics and special features of the equipment along with a motivation for offering the alternative.

15.1.2 Detailed descriptions, pamphlets, brochures and illustrations of the equipment offered together with their tenders.

15.1.3 Completed bills of quantities

15.1.4 Company Registration certificate as Electrical Contractor from Department of Labour (DOL) to be submitted with the submission

15.1.5 Registrations, certificates, CVs, qualifications, proof of adequate and relevant experience etc. of the responsible qualified Master or Installation Electrician

16. BILLS OF QUANTITIES

16.1 Notes to Tenderers

16.1.1 The Bills of Quantities are provisional and no claim for loss of profits etc. will be accepted due to change in the scope of the works.

16.1.2 The Bills of Quantities form part of and must be read in conjunction with the specification document and drawings which contain the full descriptions of the work to be done and material and equipment to be used and unless otherwise described in the Bills of Quantities, reference should be made to the specification for the full meaning of descriptions of work to be done and materials and equipment to be used in this service.

16.1.3 No alteration, erasure or addition is to be made in the text of the Bills of Quantities. Should any alteration, erasure or addition be made, it will not be recognised but the original wording of the Bills of Quantities will be adhered to.

16.1.4 The responsibility for the accuracy of the Quantities written into the Bills remains with the person who prepared the Bills.

16.1.5 The quantities in these Bills of Quantities are provisional and not to be used for ordering materials.

16.1.6 Unless a separate rate for the supply and for the installation of any item is specifically called for, the supply and installation costs of any item shall be fully included in the unit price.

16.1.7 All measurements are nett, unless otherwise stated and the Contractor must allow in the rate

for wastage.

16.1.8 The Contractor shall price the Preliminaries & General under any or all of three groups:

- A fixed amount.
- An amount varied in proportion to the final contract amount as compared to the originally specified contract amount.
- An amount varied in proportion to the final contract period as compared to the originally specified contract period.

16.1.9 All provisional sums shall be expended as directed by the Engineer or Client and any balance remaining shall be deducted from the amount of the contract sum.

16.1.10 All items described as "Provisional" shall be measured as executed and paid for according to prices in the Bills of Quantities and any unexpended amounts shall be deducted from the amount of the contract sum. No work for which "Provisional" items are provided shall be commenced without written instructions from the Engineer or Client.

16.1.11 The lengths and quantities in the Bill of Quantities are estimated for tendering purposes only.

16.1.12 The Contractor will be paid for actual "as installed" quantities, as measured on Site.

16.1.13 The Bills are not intended for use in ordering materials, etc. and the Contractor is advised to obtain his own information from the drawings and specifications. Any orders placed on the direct basis of the Bills is at the Contractor's sole risk.

16.1.14 The unit rates inserted in the Bills of Quantities, including day work items, are in all cases to be exclusive of any current and relevant VAT or similar statutory surcharge.

16.1.15 Tenderers to indicate which equipment and what portions or percentages of the equipment are subject to rate of exchange and specify the relevant currency