



6.7 Annexure G - Electrical Project Specification

CSIR HIP (HOT ISOSTATIC PRESS)

ELECTRICAL & ELECTRONIC ENGINEERING SERVICES TECHNICAL SPECIFICATION

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**CSIR HIP (HOT ISOSTATIC PRESS)
ELECTRICAL & ELECTRONIC ENGINEERING SERVICES: TECHNICAL SPECIFICATION**

1. GENERAL

- 1.1 This specification comprises all aspects regarding the building electrical installation of the CSIR HOT ISOSTATIC PRESS (hereinafter referred to as "CSIR HIP") Building situated in the East of Tshwane (Pretoria), Gauteng.
- 1.2 The Technical Specification shall be read in conjunction with the Standard Specifications listed in section 4 below, schedule of quantities, drawings and Special Conditions of Contract included in this document. Where contradictions occur between the documents, the most stringent requirement shall rule, unless otherwise stated by the Engineer.
- 1.3 All work shall be scheduled in liaison with the Main Contractor to suit his contract programme.

2. SCOPE OF WORKS

- 2.1 The scope of the installation shall comprise of the following: the supply, delivery, off-loading, installation, commissioning, testing and guarantee of the following material and equipment associated with the above-mentioned works:
 - 2.1.1 Replacement of existing Building 16 main distribution board
 - 2.1.2 Stripping out of all existing services in the HIP project area.
 - 2.1.3 The installation of low voltage cable between the main distribution board & generator change-over panel, DB HIP (Standby Power), Sub DB-FF, Cooling Tower Sub DB and the UPS.
 - 2.1.4 New Generator installation
 - 2.1.5 New UPS installation
 - 2.1.6 New lighting installation.
 - 2.1.7 New small power installation.
 - 2.1.8 Wireways and conduits to lights, socket outlets and power outlets.
 - 2.1.9 Cable tray and ducting installation.
 - 2.1.10 Wiring of lighting and power points with PVC insulated conductors and bare copper earth wire.
 - 2.1.11 Excavation, backfilling and compaction of cable trenches.
 - 2.1.12 Access control system
 - 2.1.13 Fire detection system
 - 2.1.14 Oxygen sensor installation
 - 2.1.15 Earthing and bonding including lightning protection Provide earthing to all metal structures and sanitary ware.
 - 2.1.16 Site supervision and quality management.
 - 2.1.17 Training: The Contractor shall provide basic training to the technical personnel (End-User) for the UPS, Generator and Oxygen sensor and Oxygen sensor controller configuration, operation & maintenance.
 - 2.1.18 Commissioning, testing and handing over of complete electrical installation detailed above and to provide "as-built" drawings.
 - 2.1.19 Maintenance during the maintenance period.

- 2.1.20 Attending to defects during the defects liability period from the completion of the whole project, in line with the defects liability period stipulated in the contract in respect of building services and/or engineering services.
- 2.2 These aspects should be seen only as a brief summary of the scope of work and not as a complete record. Quantities and volume of work shall be read or obtained from the drawings and the text of the specification.
- 2.3 All components, mounting brackets, draw boxes, junction boxes, cabling, wiring and all other electrical, mechanical and civil works required to complete the works in accordance with the specification, prior to first delivery, shall be deemed to be included in the tendered rates and prices, even though some items may not be mentioned separately. No claims whatsoever, in this regard, will be considered after the contract has been awarded.
- 2.4 In addition, the work shall be neat, of high standard and to the satisfaction of the Engineer, the Client and all other members of the professional team and Contractors on site.

3. SITE LOCATION AND DETAILS

- 3.1 The site of the works is located in the East of Tshwane (Pretoria), Gauteng..
- 3.2 The site is subject to the following prevailing conditions:

Maximum Temperature : 30 °C
 Minimum Temperature : 5 °C
 Relative Humidity : Average annual is 60%

 Altitude : ±1370m above sea level

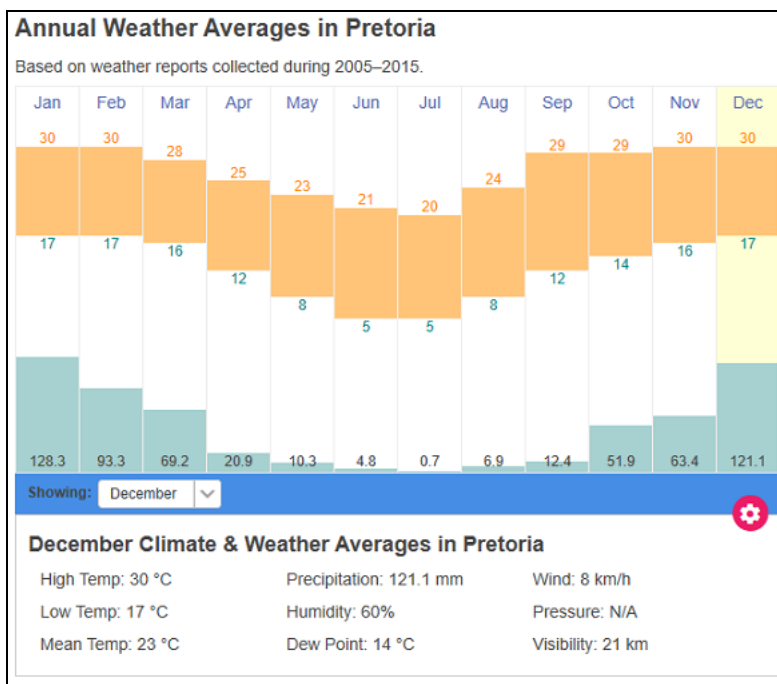


Figure 1: Weather Conditions for Pretoria, Gauteng

4. STANDARDS AND CODES OF PRACTICE

- 4.1 The electrical work shall be carried out strictly in accordance with:

- SANS 10142 – 1 “The wiring of premises. Part 1: LV Installation”
- Upgrading of the lighting installation to achieve minimum average light levels as stipulated in the code of practice for interior lighting, “SANS 10114-1.

- The OHS Act, 1993 (Act 85 of 1993) as amended
- SANS Code of Practice - 10313-1999: “The Protection of Structures Against Lightning”
- The National Department of Public Works’ Standard Specification for Electrical and Mechanical Installations
- The National Building Regulations and Building Standards Act 1977 (Act 103 of 1977) as amended
- The Municipal By-Laws and any Local Authority Regulations which may be in force
- The Local Fire Office Regulations
- The Local Government Ordinary 1939 (Ordinary 17 of 1939) as amended.
- The Electricity Act 1984 Act 41 of 1984
- The Green Building Act 2012-1 of 2013 as amended
- Manufacturer’s specifications and installation instructions

Additional SANS and NRS standards not explicitly stated shall still apply.

5 QUALITY OF MATERIALS

- 5.1 All materials supplied or utilised under the electrical contract works shall be new and unused. Only materials of first-class quality shall be utilised. Samples of all materials e.g. luminaires, outlets, cable support systems, etc, may be subject to approval by the Engineer before the procurement process commences.
- 5.2 All materials shall comply with the relevant specifications as listed in Section 4 above.
- 5.3 All materials shall be unconditionally guaranteed for a period of 12 months from the date of practical completion of the Whole of the Contract Works. Where Supplier's guarantees are of a shorter duration than 12 months, the Contractor shall unreservedly agree to the extension and cession of all warranties and guarantees.
- 5.4 The Contractor shall replace any materials that are found to be defective during the defects liability period.
- 5.5 The Contractor shall arrange factory inspections and tests to be witnessed by the Engineer for all the distribution boards and generator unit manufactured and supplied as part of this project.

6. COMPETENCE OF PERSONNEL, WORKMANSHIP AND STAFF

- 6.1 All Electrical work shall be executed and supervised by suitably qualified staff. Only suitably qualified Artisans shall be permitted to carry out and supervise work on electrical installations. The Contractor shall provide proof of current Artisan qualifications and experience on request.
- 6.2 The Contractor shall at all times have an adequate number of employees, plant and equipment available during the construction period to ensure that the electrical work does not delay the construction programme.

7. CO-ORDINATION OF SERVICES

The Contractor shall be responsible for the on site co-ordination of the electrical services with the Contractor and other Contractors. Due allowance shall be made for this continuous liaison and on-site co-ordination in the tender price.

8. FINISHING AND TIDYING

- 8.1 In view of the concentration of construction and other activities likely to be experienced during the Contract period, progressive and systematic finishing and tidying will form an essential part of this Contract. On no account will soil, rubble, materials, equipment or unfinished operations be allowed to accumulate in such a manner as to unnecessarily impede the activities of others.
- 8.2 Finishing and tidying shall therefore not be left to the end of the Contract, but shall be a continuous operation.

9. SUPERVISION

Work shall at all time be subject to full time supervision by a qualified and experienced Master Electrician. This representative must be authorised and competent to receive instructions on behalf of the Contractor.

10. PROTECTION OF OTHER SERVICES AND STRUCTURES

- 10.1 The Contractor shall take all the necessary precautions to protect existing services, finishes and structures during the execution of the Contract, and shall be fully responsible for all repairs and damages thereto. The costs for any repairs of damages shall be recovered from the Contractor.
- 10.2 The Contractor shall also exercise extreme care when excavations are made, to avoid damage to existing or newly installed services. Any damages to other services shall be rectified forthwith and the costs for the rectification will therefore be recovered from the Contractor.

11 BALANCING OF LOADS

The electrical contractor shall be responsible for the measurement, testing and balancing of load between all the phases of busbars to the satisfaction of the Engineer. Distribution board equipment shall be connected in such an order that the load is balanced across all three phases.

12 SITE TESTS AND COMMISSIONING

- 12.1 It is the responsibility of the Electrical Contractor to provide all labour, accessories and properly calibrated and certified measuring instruments necessary for all the tests required under this contract.
- 12.2 Prior to beginning any aspect of commissioning, the contractor shall present for the Engineer's review/approval, two copies of a complete commissioning procedures manual including checklists. The relevant checklists shall be utilised and formally signed off as part of the commissioning phase.
- 12.3 Preparation of commissioning report shall include, but not necessarily limited to:
- 12.3.1 Manufacturer's operating, servicing and maintenance manuals for each and every individual item of plant installed.
- 12.3.2 Inventory for the items of mechanical/electrical plant(s) and or equipment that shall be for installation in the project.
- 12.4 The following minimum site tests shall be carried out by the electrical contractor and the results presented to the Engineer:
- Insulation resistance between all conductors and earth

- Insulation resistance between all conductors and neutral
- Insulation resistance between all 3 phase conductors
- Resistance of earth path between the main earth bar, all exposed conductive parts of the installation and distribution boards
- Polarity of light switches and socket outlets
- Earth leakage protection
- Phase rotation of three phase circuits

12.5 After submission of the test results, the Electrical Contractor shall notify the Engineer that the installation is complete, tested and in working order. The Client and/or the Engineer will witness the re-testing of the installation.

12.6 Final Testing and Certification as per the Client Specification

- The Clients Standard Specification for Electrical and Mechanical Installations of the CTC Building
- The application of the National Building Regulation – South African National Standard (SANS) 10400 (Part A – XA)
- Electrical Installations of Buildings - Fundamental Principles, Assessment of General Characteristics, Definitions - IEC 60364-1
- Electrical Installations of Buildings - Protection for Safety - IEC 60364-4
- Electrical Installations of Buildings - Selection and Erection of Electrical Equipment IEC 60364-5
- Electrical Installations of Buildings - Verification - IEC 60364-6
- Electrical Installations of Buildings - Requirements for Special Installations or Locations - IEC60364-7
- Rotating Electrical Machines - BS EN 60034
- Degrees of Protection Provided by Enclosures Ip Code - IEC 60529
- The By-Laws and any Local Authority Regulations which may be in force.
- Manufacturer's specifications and installation instructions

13 MAINTENANCE PERIOD

13.1 The equipment and installation supplied under this contract shall be guaranteed for a period of twelve months from date of completion of the whole project of the Contract Works. The tender price shall include for the above.

13.2 The maintenance period will be for a period of twelve months, calculated from the date the installation has been taken over by the Client. Payment of the full amount of the retention money will be effected after the lapse of the maintenance period, provided the installation has been in satisfactory working order during this period. The Electrical Sub-Contractor shall be responsible for the replacement of all faulty electrical equipment supplied and installed as part of this contract, including blown or faulty lamps during the maintenance period.

14 POWER SUPPLY TO SITE

Building 16 has existing LV cable supplies from Buildings 12 and 19 to the Building 16 main LV distribution board. This board shall be replaced.

15 **LOW VOLTAGE CABLE INSTALLATION**

- 15.1 The tender price shall include the supply, delivery, installation, testing and commissioning of all the cables indicated on the drawings, including the making off and connections at both ends.
- 15.2 All cables shall have stranded copper conductors and shall be of the PVC/SWA/PVC type, 600/1000V grade and shall comply with Wiring Regulations, SANS 10142 and the National Building Regulation – South African National Standard (SANS) 10400 (Part A – XA).
- 15.3 All terminations shall be done with lugs, glands and shrouds as specified. Shrouds shall cover the gland completely.
- 15.4 All cables shall be labelled at both ends. The cables shall be labelled by means of “Grafoplast” or approved type cable markers. The cable labelling shall indicate the full name of both distribution boards. Thus, if DB MAIN feeds DB HIP, the label at each cable end shall read “DB MAIN/DB HIP”.
- 15.5 Copper earth continuity conductors will not be installed with low voltage cables. All cables shall have tinned copper earth conductors as part of the armouring (i.e. ECC conductors shall be included as part of the armouring).
- 15.6 Cables in which the phase conductors are colour coded by means of a coloured stripe along the insulation will not be accepted. The entire conductor PVC insulation shall be fully colour coded in red, white, blue or black. The conductors of cables used for single phase loads or connections shall be red and black. Cables with red, white and blue conductors will not be accepted for use on single phase loads or connections.
- 15.7 All cables shall be tested after installation in accordance with Electrical Installations of Buildings - Verification - IEC 60364-6. In addition, all cables shall be phased out to ensure correct phase rotation.
- 15.8 All test results shall be submitted to the Engineer in writing, before the final commissioning of the equipment and cables take place.
- 15.9 It shall be the responsibility of the electrical Contractor to determine the correct lengths of cable required on site, before placing an order. The Contractor shall not be reimbursed for any surplus or shortfall of cable.
- 15.10 Cable reticulation outside the buildings shall be by means of underground cables installed in uPVC sleeves. Where sleeves are not specified, cables shall be laid directly in the ground. Minimum laying depths shall be 600 mm below final ground level unless otherwise specified, and routes shall be as indicated on the drawings. Detail Trench Lay-out is reflected on the Site Plan Layout for CSIR (Refer to the Site Layout Drawing).
- 15.11 All trenching, including excavations, bedding layers, shoring and prevention of waterlogging, drainage of excavations, backfilling and compaction of trenches form part of this contract. Trenches shall be compacted to a minimum of 93% of modified AASHTO density during backfilling.
- 15.12 Contractor shall take cognisance of the fact that other services might be installed along the same routes as the cables. The contractor shall, before commencing with any excavations, peg out the proposed cable route and confirm it with the engineer.
- 15.13 Positions of cable markers shall be pegged on site in collaboration with the engineer. The wording of the labels shall be provided by the engineer.
- 15.14 Joints will not be permitted in any of the low voltage cables.
- 15.15 Cables Installed on Cable trays

15.15.1 Cables shall be fixed to the cable trays by means of stainless-steel strapping at 600mm spacing.

15.15.2 The Contractor shall plan cable runs prior to installation of cables as crossing of cables will not be accepted unless it is impossible to avoid.

15.16 Cable Schedule:

Table 1: Cable Schedule

Item	Type and size	Distance per circuit (m)	Circuit qty	Total distance (m)	From	To
1	POWER CABLE SCHEDULE					
1.1	185mm ² 4-core Cu PVC/SWA/ECC/PVC 600/1000V cable	15	2	30	New Main DB	Generator Change-Over Panel
1.2	185mm ² 4-core Cu PVC/SWA/ECC/PVC 600/1000V cable	25	2	50	Generator Change-Over Panel	New DB HIP (Standby Power)
1.3	16mm ² 4-core Cu PVC/SWA/ECC/PVC 600/1000V welding cable	15	1	15	Main DB (Standby Power)	Sub DB-FF
1.4	35mm ² 4-core Cu PVC/SWA/ECC/PVC 600/1000V cable	33	1	33	Main DB (Standby Power)	Cooling Tower Sub DB
1.5	10mm ² 4-core Cu PVC/SWA/ECC/PVC 600/1000V cable	15	1	15	Main DB (Standby Power)	UPS

16 DISTRIBUTION BOARDS

16.1 Construction of Distribution Boards and Specification:

16.1.1 A new single compartment distribution board for the CSIR HIP building shall be supplied and installed as part of this contract. The distribution board shall be powder coated and colour shall be as specified.

16.1.2 The new Building 16 main distribution boards shall be of the floor mounted type with square key turn-locks on each face plate and shall be installed in the position as indicated on the drawings. All equipment shall be mounted behind removable panels with handles.

16.1.3 The new sub-distribution board, DB-HIP, located at the ground floor / machine room building 16, shall be of the floor mounted type with square key turn-locks on each face plate and shall be installed in the position as indicated on the drawings. All equipment shall be mounted behind removable panels with handles.

16.1.4 The new sub-distribution board located at the first floor (Sub DB - FF) shall be wall recessed mounted type with key-lockable doors and shall be installed in the position as indicated on the drawings.

16.1.5 The Cooling Towers Sub-DB (located at the cooling towers and argon gas storage) shall be wall surface mounted type with key-lockable doors and shall be installed in the position as indicated on the drawings. The Sub-DB shall be an outdoor weather-proof type panel.

- 16.1.6 A steel pocket shall be provided on the inside of the DB door to accommodate an A4 size drawing and/or circuit list.
- 16.1.7 All equipment shall be mounted behind removable panels with handles.
- 16.1.8 Door hinges shall be of the "Procast" or similar type
- 16.1.9 All phase, neutral and earth bars shall be adequately sized to accommodate existing circuits as well as allow for 30% future.
- 16.1.10 Circuit breakers shall be used in the cascade arrangement and only cascade arrangements proven by SABS tests or Electrical Installations of Buildings - Protection for Safety – IEC 60364-4 shall be utilised throughout.
- 16.1.11 Lightning arrestors with indication shall be fitted in each distribution and sub-distribution board. Minimum size of the earth conductor between the lightning arrestors and the earth bar shall be 16mm².
- 16.1.12 Electrical contractors are advised to order their distribution boards from a reputable manufacturer as inferior boards will not be accepted.
- 16.1.13 The electrical Contractor to note that manufacturer of the distribution board shall only commence after approval of the factory drawings by the Engineer.
- 16.2 Additional requirements
- 16.2.1 Conduit and cable entry: Top and bottom.
- 16.2.2 Face plates to have chrome handles (2 off) on each plate for removal and be secured with catches.
- 16.2.3 Gland plate: 2mm thickness.
- 16.2.4 Allow 30% spare space for maintenance purpose or future additions.
- 16.3 Colour:
- 16.3.1 Frame inside and outside: electric orange B26.
- 16.3.2 Face plates: Normal power compartment - Electric Orange B26.
 Standby power compartment - Signal Red A11
 UPS power compartment – Violet
- 16.3.3 Door: Electric Orange B26.
- 16.4 Equipment:
- 16.4.1 Square key turn locks required (2 off) on each face plate.
- 16.4.2 All circuit breakers to be of approved by engineer.
- 16.4.3 Busbars to be colour coded with heat shrink insulation for full length.
- 16.4.4 Minimum earth wire connection between surge protection devices and earth bar: 16mm² green insulated earth wire.
- 16.4.5 Copper busbar sizing: 1.5A/mm².
- 16.4.6 Switching contactors to be of reputable manufacture.
- 16.4.7 Circuit breakers for all air conditioning circuits to be "Curve D", motor curve or equivalent type.
- 16.5 Labelling:
- 16.5.1 All labels shall be engraved sandwich board fixed with metal threaded screws and nuts.
- 16.5.2 All internal equipment to be labelled e.g. fuses, contactors etc.
- 16.5.3 All equipment to be labelled with 20mm lettering.
- 16.5.4 DB board name labelling to be 30mm high.
- 16.5.5 MCB's shall not be numbered; engraved labels required.
- 16.5.6 Provide steel pocket inside each door for A4 size drawing and/or circuit descriptions.

Table 2: Distribution Boards Schedule

DB Name	Specification
New Main-DB	Refer to notes on Single Line Diagram (SLD) drawing for detail Construction, Colour, Equipment and Labelling requirements.
New DB-HIP	Refer to notes on Single Line Diagram (SLD) drawing for detail Construction, Colour, Equipment and Labelling requirements.
Sub DB-FF	Refer to notes on Single Line Diagram (SLD) drawing for detail Construction, Colour, Equipment and Labelling requirements.
Sub DB-Cooling Tower	Refer to notes on Single Line Diagram (SLD) drawing for detail Construction, Colour, Equipment and Labelling requirements.

17 CONDUITS, POWERSKIRTING, CABLE TRAYS, CABLE LADDERD, AND CABLE DUCTS

17.1 Conduits

17.1.1 All conduits and accessories shall bear the SABS mark or similar approved equal.

17.1.2 SABS approved (or similar approved equal) PVC conduit and accessories may be used inside the building.

17.1.3 All external conduits exposed to sunlight or rain shall be galvanised steel. External draw box covers shall be sealed with white silicone after the installation is completed.

17.1.4 Conduit installation on masonry wall surfaces shall not be permitted inside the building. All conduit to be chased into walls. Chasing by means of hammer and/or chisel will not be accepted. All chasing work shall be carried out by means of power-driven machinery using abrasive cutting discs.

17.1.5 Conduit work under open roof structures and inside accessible ceilings shall be done in a rectangular grid pattern. Steel saddles shall be used inside ceilings. Caddy clamps shall be used on roof purlins, maximum spacing of saddles and clamps shall be 750 mm.

17.1.6 All steel conduits shall be securely bonded to earth.

17.1.7 Bushes fitted to steel conduits shall be brass only. Other materials are unacceptable.

17.1.8 Raised conduit saddles shall be installed at 1500mm intervals.

17.1.9 All conduit offsets shall be neat and at equal angles.

17.1.10 All conduits installed for services provided by others shall be fitted with 2,5 mm \varnothing galvanised draw wire if the wiring is not installed as part of this contract.

17.2 Powerskirting

17.2.1 Powerskirting shall be the 165 mm high x 55 mm deep, 2-lid 2-compartment type manufactured from 0.8mm steel and powder coated. The electrical Contractor shall confirm colour with the Architect and the Engineer before placing an order.

17.2.2 Powerskirting shall be supplied complete with purpose-made faceplate equipment and all the necessary accessories including covers, bends, clip-on partitions, etc.

17.2.3 Powerskirting shall be used for power, data and telephone wiring and outlets shall be compatible with the powerskirting.

17.2.4 The powerskirting shall be linked to the distribution board by conduit installed to a pre-manufactured conduit entry unit behind the powerskirting. The powerskirting shall be clearly marked on the front cover "conduit entry". The conduit shall be run in floor screed, walls and/or in the ceiling void.

17.2.5 The same arrangement shall apply at positions where powerskirting are interlinked. A minimum of five 25 mm diameter PVC conduit shall be installed in each case; i.e power 3x, data 1x and telephone 1x. Tenderers shall allow in their price for drilling through walls and chasing in the walls or floor for the interlinks as may be necessary or as indicated on drawings.

17.3 Cable trays

17.3.1 Cable trays, where required, shall be of the heavy-duty 2.5 mm thickness hot dipped galvanised steel type or approved equivalent trays. The cable tray width shall be as specified on the relevant drawings.

17.3.2 Only purpose-made splices, risers, offsets and bends shall be used.

17.3.3 Trays shall be fastened onto 500 mm lengths of P2000 or similar approved unistrut. Each unistrut section shall be fixed to the roof or wall steel sheeting with galvanized 10 mm x 50mm Ø Fisher or similar approval anchors. Unistrut spacing shall be 600 mm maximum. Only purpose-made accessories shall be used.

17.4 Cable ladders

17.4.1 Cable ladders, where required, shall be hot dipped galvanized and all members shall be 2 mm thick, with 76 mm side rails and cross rungs at 375 centres. Cable ladders shall be supported at maximum 800 mm intervals with approved galvanized suspension brackets or P2000 or similar approved Unistrut or 10 mm galvanized threaded rod hangers.

17.4.2 The width shall be as specified and only purpose-made accessories shall be used.

17.5 Trunking

17.5.1 Steel trunking, where required, shall be the hot dip galvanised type with 0,8 thickness complete with elbows, tees and covers. The width shall be as specified.

17.5.2 The distribution board shall be linked to openings in ceilings by means of 127 mm wide, hot dip galvanised steel trunking supplied complete with distribution outlets and covers. The trunking shall be powder coated and the colour shall match the DB exterior colour.

18 LIGHTING INSTALLATION

18.1 General

18.1.1 The electrical Contractor shall allow for the supply and installation of the complete new lighting layout for the CSIR HIP building as indicated on the relevant drawings.

18.1.2 Samples of luminaires shall be submitted to the engineer for approval before ordering commences.

18.1.3 All new light fittings shall be delivered to site in boxes as packed by the manufacturer. When the Work is handed over, all light fittings shall be in a working condition, new and unused.

- 18.1.4 The permanent light fittings intended for installation shall not be used for temporary lighting during construction. The certificate of completion for the installation will not be finalised, unless all light fittings and lamps are in working order.
- 18.1.5 Tenderers to note the 16A current rating of switches and motion sensors as indicated on the drawing shall be installed. The new lighting installation shall be controlled individually from 16A light switches in different office spaces. All light switches shall be of the same manufacturer.
- 18.1.6 The internal lighting installation of various areas of the CSIR HIP building shall be provided by means of LED type luminaires. Colour temperatures of LED luminaires shall be equivalent to the fluorescent and PL type lamp colour temperatures stated below.
- 18.1.7 All linear fluorescent type luminaires, if required, shall be equipped with 26 mm diameter tubes generally 1 200 mm long and with a colour temperature of 4300 K (cool white) and minimum colour rendering index (Ra) of 64 unless otherwise stated. The engineer will reject unmarked lamps. All costs to replace these lamps with marked lamps will be for the contactor's account.
- 18.1.8 All PL type lamps, if required, shall be colour 41, with a temperature of 2700 K. Lamps not marked thus will not be accepted, as stipulated above.
- 18.1.9 Conduits: Special care shall be taken to ensure that conduit connections do not violate the IP rating of luminaires. This applies specifically to the exterior luminaires. Mounting holes and conduit entries shall be sealed with black silicone after connection.
- 18.1.10 No luminaires shall be fitted to masonry wall with fasteners smaller than 3,5 mm diameter and a wall plug smaller than 8 mm diameter. Galvanised 30 mm \varnothing fender washers shall be used with each fastener.
- 18.1.11 In suspended ceilings, the circuit wiring shall consist of 20 mm conduits and standard 100 x 50 mm draw boxes above the ceiling. In close vicinity of the luminaire positions, a 5 A unswitched socket outlet shall be provided, fixed to the conduits for support, for power supply to luminaires, where wiring channels are used, the unswitched socket outlets may be mounted on the outside of the wiring channel in suitable outlet box, and conduit connections shall be properly established between socket outlet boxes and wiring channels and correct glands used. Under no circumstances may wiring pass through a hole in metal channels or outlet boxes without proper protection against damage on the edges of the metal holes.
- 18.1.12 All indoor luminaires to be supplied with 3 m electrical cord fitted with a 5 Amp socket.
- 18.1.13 For light switches, 100 x 50 x 50 mm drawboxes shall be provided.
- 18.1.14 Photocell shall be accommodated inside IP 65 bulkhead luminaires. No direct switching of lighting circuits via photocell contacts can be accepted.
- 18.2 Schedule of Luminaires

All luminaires shall bear the SABS mark or similar equal approved. Luminaires shall be provided complete with lamps and control gear.

The following luminaire types are to be installed in the positions indicated on the drawing:

Table 3: Luminaire Schedule and light switches

Type	Luminaire Description	Luminaire Watts
Type A	1 x 33W LED, 3956 Lumens, 600mm x 600mm x 30mm Panel, 99.9% efficiency recessed / surface mounted Luminaire, or equal, better or similar	33W

Type	Luminaire Description	Luminaire Watts
	approved	
Type A1	1 x 33W LED, 3956 Lumens, 600mm x 600mm x 30mm Panel, 99.9% efficiency recessed / surface mounted Luminaire, with 1-hr battery back-up unit or equal, better or similar approved	33W
Type D	LED 18W Downlight Luminaire - with battery back-up or equal, better or similar approved	18W
Type B	20W LED Series 21 with Prismatic Diffuser Wall Surface Mounted Luminaire or equal, better or similar approved	20W
Type E	8W Single Sided Surface mounted emergency escape signage luminaire with 1-hr battery back-up unit or equal, better or similar approved	8W
Type J	55W 1050mA WIDE BEAM Bulkhead Surface Mounted or equal, better or similar approved	55W
Type F	LED FLOOD 215W 700mA, 25661 Lumens, 600mm x 350mm x 100mm Panel, surface mounted Luminaire, Mounted at 5.0m Height or equal, better or similar approved	215W
	Light Switches Description:	
	16A, 1-WAY, 1-LEVER LIGHT SWITCH	
	16A, 2-WAY, 1-LEVER LIGHT SWITCH	
	16A, 3-WAY, 1-LEVER LIGHT SWITCH	
	16A, INTERMEDIATE LIGHT SWITCH	
	360° MOTION SENSORS	

19 SMALL POWER INSTALLATION

19.1 General

Contractor to note that new single-phase small power installation is required for the CSIR Building 16 HIP facility, which will comprise of new single-phase socket outlets, new wireways and new wiring.

19.2 Power skirting

19.2.1 All power skirting outlets shall be compatible with the power skirting installed as part of this contract.

19.2.2 Normal outlets shall be the standard 16 Amp, 3-pin switched type. Dedicated outlets shall be red 16 A, 3 pin of the switched type with a half round earth pin. One red plug top shall be supplied with each dedicated socket outlet installed (and shall be included in the price of the dedicated socket outlet).

19.2.3 Telephone and data outlets shall consist of purpose-made outlet covers. Telephone outlets shall be RJ11 sockets. Data outlets shall consist of RJ45 sockets.

19.3 Single phase socket outlets in wall

Normal socket outlets shall be the 16 Amp, flush mounted single or double 3-pin switched socket with cover plates to match the outlets and colour to be approved by architect.

19.4 Isolators

Local isolator for air conditioning units shall if required, consist of 20A or 30A surface mounted double pole complete with outlet box and cover plate; position shall be as indicated on the drawing.

20 WIRING

20.1 All internal wiring shall, unless stated otherwise, comprise of PVC insulated, stranded copper conductors and bare stranded copper earth continuity conductors.

20.2 Wiring shall not be drawn into conduit until the conduit installation has been completed, fitted with bushes and all moisture and debris has been removed.

20.3 No joints of any kind shall be permitted in wiring. No more than 1 single or 1 three phase circuit may be drawn into any conduit.

20.4 No "surfix" / "twin & earth" wiring will be accepted.

20.5 The following minimum conductor sizes shall be used:

Table 4: Conductor Sizes

Circuit	Minimum conductor (size)	
	Phase (mm ²)	Earth (mm ²)
Lighting	2.5	2.5
Socket outlet	4	2.5
Air conditioners	4 Unless otherwise required by the equipment rating	2.5 Unless otherwise required by the equipment rating

20.6 Wiring for telephone and data shall be supplied, installed and terminated by others. The electrical Contractor shall only be responsible for provision of all wireways and termination panels required for the data and telephone installation.

21 TELEPHONE AND DATA INSTALLATION

21.1 Supply, delivery and installation of the telephone distribution board, conduit, draw boxes, outlets and cover plates form part of this contract.

21.2 Telephone points (if required) not installed in power-skirting shall be flush mounted 100 x 50 x 50 mm draw boxes complete with cover plate.

21.3 2,5mm diameter galvanised draw wire shall be installed in all telephone conduits. All telephone points shall be interlinked by means of 20mm diameter conduit which shall terminate in the telephone distribution board supplied and installed as part of this contract.

21.4 Telephone outlets shall be RJ11 sockets and data outlets shall be the RJ45.

21.5 Telephone distribution board (if required) shall be 300mm x 200 mm flush mounted cabinet with door and fitted with a wooden backboard. The board shall be labelled "Telephone DB". Engraved labels shall be used.

22 UPS INSTALLATION

22.1 General

This part of the specification covers all aspects regarding the dedicated UPS installation for the CSIR HIP building situated in the East of Tshwane (Pretoria).

The minimum equipment requirements are outlined, but do not cover all the details of design and construction. Such details are recognised as being the exclusive responsibility of the contractor.

22.2 Scope of work

The scope of the installation shall comprise of the following: the transport, manufacture, supply, testing, delivery, off-loading, connection, installation, commissioning, site testing and guarantee of one (1) x 6kVA UPS system, 230V/230V 50Hz 1Ø input / 1Ø output, manual and static by-pass and battery temperature sensor.

The new UPS be installed as follows:

- The dedicated UPS power for the CSIR for all critical load at the CSIR Building which would provide loads to the PLC and critical computerized equipment in the HIP Building in the building.
- The UPS is powered by normal power when there are no power failures, and by the standby generator in the event of power failures.
- A 30-minute battery back-up for 6kVA at 0.8pf (power factor). Batteries to be protected by DC fuses.

22.3 Accommodation

The plant rooms / space will be provided by the Client and the contractor shall ensure that the space allowed is sufficient for the installation of the UPS and that the ventilation of the plant room is adequate. If any changes to the design have to be made the contractor must inform the consulting engineer in writing. It is anticipated that the UPS will be installed in the Metrology laboratory.

22.4 Nature of UPS load

Single-phase input (1Ø in), single phase output (1Ø out), 230V/230V 50Hz, 6kVA UPS system.

The UPS will mainly supply:

- PLC and critical computerized equipment in the HIP Building in the building
Computer workstations (Plugs Dedicated)

22.5 Technical Requirements

22.5.1 Quality, Standards and Regulations

All material and equipment supplied for this contract shall be new and the best of their respective kind. All new materials and equipment supplied, shall comply fully with the requirements laid down in the specification. The whole of the works shall be executed in accordance with best practice and to approval of the engineer. The equipment shall comply with the latest issues of the following standard specifications:

(A) South African Bureau of Standards

SABS 150	Insulated wire.
SANS 1091	Colour standards for paint.

SANS 0142	Wiring code of practice.
SANS 1474	UPS units.

(B) Regulations and Rights of Engineer

Apart from any other authority, which the engineer may have in terms of the contract, he shall have the right to set the standard and to accept or reject part of the specified equipment depending on the quality of material and workmanship offered.

The contractor shall be notified if the quality of such materials and/or workmanship is not acceptable. In such an event, the contractor shall replace the specific part or repair it to the satisfaction of the engineer, all at the cost of the contractor. Such an instruction shall not exempt the contractor from any of his obligations in terms of the contract.

The installation shall be erected and carried out in accordance with:

- a) The Basic Conditions of Employment Act and the Machinery and Occupational Safety Act of 1983, as amended.
- b) The local Municipality by-laws and Regulations as well as the regulations of the local Supply Authority.
- c) The local Fire regulations.
- d) The Regulations of the Department of Posts and Telecommunications.
- e) The Standard Regulations of any Government Department or public service company where applicable.

In addition, the contractor shall at his cost issue all notices in respect of the installation to the local authorities, and shall exempt the client from all losses, costs or expenditures which may arise as a result of the contractor's failure to comply with the requirements of the regulations enumerated above.

It shall be assumed that the contractor is conversant with the above-mentioned requirements. Should any requirements, by-law or regulation, which contradicts the requirements of this document, apply or become applicable during erection of the installation, the contractor shall immediately inform the engineer of such a contradiction. Under no circumstances shall the contractor carry out variations to the installation in terms of such contradictions without obtaining the written permission to do so from the engineer.

22.5.2 Uninterrupted Power Supply (UPS)

Definitions

- (a) UPS shall denote the complete UPS unit with associated controls, remote alarm panel and batteries and any accessories required by the system for its successful operation.
- (b) Power Converter Module shall denote a rectifier, battery charger, inverter, electromechanical by-pass switch and manually operated by-pass switch.
- (c) Rectifier shall denote that portion of the converter module containing the equipment and controls to convert the incoming AC power to regulated DC power required by the inverter.
- (d) Inverter shall denote that part that converts the DC supplied by the rectifier to AC satisfying the load requirements.
- (e) Electro-mechanical by-pass static switch shall denote a by-pass system provided break free switching from inverter to mains operation and vice versa.

- (f) Battery charger shall denote that portion of the power converter module containing the equipment and controls to convert the incoming AC power to precisely regulated DC power required for battery charging.
- (g) Critical load denotes the load as presented to the UPS by the computer or other load requiring constant supply and associated circuits and apparatus.
- (h) Mean-Time-Between-Failure (MTBF) shall denote an overall MTBF of the UPS as a complete system.
- (i) A system failure shall denote any interruption to, or degradation of the critical load bus voltage or frequency beyond the limits set forth herein.
- (j) Efficiency shall denote the ratio of real output power (kW) to real input power (kW) with the UPS operating at a defined load power at the defined power factor, the battery fully charged and with nominal input voltage.

22.5.3 System Requirements (The Required Input and Output Voltages)

(A) Input to the UPS

- (a) Input voltage : 230V \pm 10%
- (b) Frequency : 50Hz \pm 4%
- (c) System : 1 phase, 2 wire with operative earth conductor, supplied from utility network or standby generator set. Refer to detail specification.
- (d) Power factor : Not less than 0,8 lagging.
- (e) Max starting current : 10 times full load current for not more than $\frac{1}{2}$ a cycle with rectifier soft starting facility.

(B) Output to Load

- (a) Rating : 6 kVA
- (b) Output voltage : 230V \pm 1 % single phase
- (c) Frequency : 50 Hz \pm 0,5 Hz.
- (d) System : 1 phase 2 wire with operative earth conductor
- (e) Voltage regulator : \pm 10% maximum deviation of steady state voltage recovering to within 5% in less than 50 ms and to within 1% less in that 100 ms.
- (f) Frequency stability : Normally automatically synchronised to mains frequency if the latter is within 50 Hz \pm 2% (adjustable window) Runs free at 50 Hz \pm 0,5 Hz at any load when mains is out of limits.
- (g) Harmonic content : Less than 4% total distortion.
- (h) Amplitude modulation : Less than 2%

(C) Overall Performance

- Efficiency (overall) : 80 - 85%

(D) Ambient Operating Conditions

Refer to Section 1, General – Clause 5

(E) System Description

The system shall consist of a static 6kVA UPS complete with the following components :

- (a) Rectifier/charger.
- (b) Inverter.
- (c) Battery.
- (d) Automatic electronic no-break bypass circuit and switch.
- (e) Separate manual bypass switch.
- (f) Protective devices and measuring equipment.
- (g) The required controls and necessary equipment.
- (a) A self-monitoring system with digital readout by means of which all critical functions can be checked.

The system shall be capable of providing an uninterrupted supply to the load with the output characteristics as specified for a minimum period of **30 minutes** during a total mains failure (i.e. normal mains and standby generator supply failure). The batteries shall be rated at an AC load power factor of 0,8 lagging.

The complete system, including all controls shall be designed in such a way that the failure of any one vital central component will **NOT** cause a complete system failure. If necessary, such a failure must be avoided by connecting the load directly to the mains by means of the bypass switch.

The UPS shall operate satisfactorily synchronous with the mains supply even under severe conditions of up to 100% unbalanced load.

The UPS shall be amply rated to carry the stated full load current. The UPS shall furthermore be capable of withstanding the following overloads.

Static Overloads: 100% of full load continuously.
125% of full load for 5 minutes.
150% of full load for 2 minutes.
165% of full load for 1 second with inductive decay after initial equipment switch on surge current.

Dynamic Overload : 300% for less than 5 msec.
1000% for less than 1 msec.

All component parts, cables and other connections shall be amply rated to withstand the overloads stated and maintain the input voltage **at the load** within the tolerances stated.

The equipment shall be designed for the maximum operating efficiency. The efficiency shall be determined when the system is delivering full load at 0,8 power factor with the batteries fully charged. The load required by the auxiliary equipment (controls, alarms, etc). electronic switches and cabinet fan shall be included in the determination of overall efficiency. A typical test report clearly showing how the efficiencies are calculated, shall be submitted with the tender.

It shall be the responsibility of the successful tenderer to ensure satisfactory operation of the complete system for the load to be supplied. It is, therefore, essential that the tenderer acquaint himself fully with typical load conditions before the tender closing date.

All cabinets containing thyristors shall be adequately screened and earthed to prevent direct radio frequency radiation.

(F) Inverter Oscillator

The inverter shall contain an oscillator capable of operating and maintaining the inverter output frequency as specified. The inverter oscillator shall be capable of frequency synchronisation and phase locking to the mains (or standby generator) power source frequency. When operating as a slave to the mains or standby power and a failure occurs in the slaving signal, the inverter oscillator shall automatically revert to a free running state and maintain the specified limits. All changes in output frequency to free run or synchronise shall be gradual to suit the load requirements.

(G) Rectifier

The UPS shall have its own rectifier and rectifier transformer which shall operate satisfactorily from the mains or standby supply.

The rectifier shall be of the solid state type providing full wave rectification of the input voltage suitably regulated to suit the input requirements of the inverter. Where necessary, a high grade DC filter shall be utilised to limit the output ripple to within acceptable levels for the inverter input. Current limiting features shall be provided to protect the rectifier. The current limiting settings shall be variable for final adjustment on site.

Voltage free contacts shall be provided for the malfunction alarms of the rectifier.

An input monitoring circuit shall be provided for the rectifier. This circuit shall switch off the rectifier when the r.m.s. value or frequency of the input voltage falls below present values.

The necessary protection circuitry shall be provided to switch off the rectifier if any one of the rectifier phases should fail, thus presenting an unbalanced load to the incoming supply.

The output of the rectifier shall be connected in parallel to the battery and inverter.

The rectifier shall have over temperature protection. Temperature sensing probes shall be placed on the thyristor housing, thyristor mounting, or on the heat sink close to the thyristor. The sensing of the off coming air temperature alone is not acceptable.

Tenderers shall take into account the possible effects of harmonics that may be present on the input supply due to non-sinusoidal waveforms at the rectifier input, phase commutation, the effect of reactance during phase commutation etc. The input voltage monitoring circuits of the rectifiers shall be adequately filtered and buffered to ensure reliable load control and to prevent continuous on-off switching of the rectifiers.

For three phase units each of the three rectifier transformers shall have a different primary to secondary phase displacement in order to minimise the harmonics generated by the rectifiers.

22.6 Maintenance and Operating Manuals

22.6.1 The Contractor shall provide and prepare comprehensive technical data catalogues, operating instructions, maintenance procedures and fault-finding instructions for the UPS unit supplied.

22.6.2 One complete set of the UPS maintenance and operating manuals must be prepared and submitted to the Engineer for approval 3 weeks before commissioning.

22.6.3 Upon receipt of the Engineers comments, the Contractor shall edit his submission and provide the Engineer with two complete sets of the O&M manuals to enable the User Department to maintain and adjust the system.

22.6.4 The installation shall be deemed incomplete until the final corrected sets of documentation has been delivered to the Engineer.

22.7 Training of an operator

After the installation has been commissioned, the Contractor shall train an appointed person to operate and control the UPS unit. The cost of training shall be included in the tender price. The training procedures shall be submitted to the Engineer in writing. After completion of the training period, the trainee will be evaluated by the Engineer.

22.8 Guarantee period

The installation shall be guaranteed for 12 months. Inspections, services, repairs and adjustments during this period will be provided free of charge and within 6 hours following any call-out.

22.9 Maintenance and Operating Manuals

The UPS and battery unit will be inspected by the Engineer at the Manufacturer's premises before delivery takes place.

The Manufacturer shall carry out the following tests, in order that the Engineer may witness compliance of the unit to specified requirements. The manufacturer shall submit a proposed detail test procedure to the Engineer at least two weeks before testing:

(a) Performance tests

- i) input
- ii) output
- iii) output overload
- iv) regulation
- v) efficiency
- vi) transfer time
- vii) battery load test
- viii) 1 step full load acceptance
- ix) full load discharge for 30 minutes
- x) harmonic transfer characteristics

(b) Simulation test

- i) each alarm condition to be simulated
- ii) each visual alarm to be tested
- iii) each audible alarm to be tested

All necessary equipment and test gear shall be available during these tests.

23 GENERATOR

(A) GENERAL AND EQUIPMENT REQUIREMENT:

23.1 Intent of Document

The specification is intended to cover the complete installation of the generator plant at the CSIR under the "CSIR HIP Building 16" project. The minimum equipment requirements are outlined, but do not cover all the details of design and construction. Such details are recognised as being the exclusive responsibility of the contractor.

In all cases where a device or part of the equipment is referred to in the singular, it is intended that such reference shall apply to as many devices as are required to complete the installation.

23.2 Standards and Codes

All work and equipment shall be in accordance with the requirements of BS5514 and shall comply with the Occupational Health and Safety Act, No 85 of 1993 and current regulations of all other codes applicable to this work.

23.3 Regulations

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

- a) The latest issue of SABS 0142: "Code of Practice for the Wiring of Premises",
- b) The Occupational Health and Safety Act, 1993 (Act 85 of 1993) as amended,
- c) The Local Government Ordinance 1939 (Ordinance 17 of 1939) as amended and the municipal by-laws and any special requirements of the local supply authority,
- d) The Fire Brigade services Act 1993 Act 99 of 1987 as amended,
- e) The National Building Regulations and Building Standards Act 1977 (Act 103 of 1977) as amended,
- f) The Post Office Act 1958 (Act 44 of 1958) as amended,
- g) The Electricity Act 1984 (Act 41 of 1984) as amended and
- h) The Regulations of the local Gas Board where applicable.

23.4 Scope of Work

Supply, delivery and installation of the complete new 500kVA, 3-phase, 400V standby generating set (complete with sound attenuated weatherproof canopy) dedicated for the entire CSIR HIP Building 16 is required for all essential load at the CSIR.

The generator shall be mounted in an outdoor weatherproof sound attenuated canopy. 8-12 hours of diesel storage is required, which is stored in a tank fitted into the base of the generator.

500kVA, 3 phase, 400V prime rated diesel engine and alternator set with 10% over-load (8 to 12-hour standby time).

Generator container set (soundproof enclosure) (entire genset, sound attenuation and control panel to be installed within container). Air / Water Cooling – System.

Generator bulk fuel tank system (to allow for 8-12 hour standby time) including fuel pump and minimum 8m fuel pipes / extension hose pipe.

The generator shall be mounted on a concrete plinth in a bund wall area, with suitable fuel/storm water separator. It is recognized that generator physical dimensions may differ and it will be the responsibility of the contractor to provide the detail design of the concrete plinth and bund-wall area, designed and sign-off by a professional structural engineer sourced by the Contractor. The client's civil/structural engineer shall only confirm that the

design conforms top basic requirements, and the suitability of the plinth and bund-wall design remains the responsibility of the contractor.

The bund-wall area shall be sized such that it can contain 130% of the fuel capacity of the generator. Storm water accumulating in the bund-wall area shall be separated from any fuel spillage and shall be disposed of to the existing storm-water system.

23.5 Co-ordination

All supports and openings and channels required for the new gen-set shall be provided and these shall include but not be limited to plinths, openings, etc., required by the Contractor for the installation of the plant and equipment. A detail of all such foundations, plinths, openings, rebates, etc must be supplied with his tender.

The Contractor shall co-ordinate his program with his Building Contractor and the Client to ensure that the plant plinth is ready prior to delivery of the generator set.

Delays due to lack of co-ordination between the Contractor and his Contractors shall not form a basis for claims be the Contractor of this Contract.

23.6 Test Certificates and Inspections

The following tests are to be carried out:

- (a) At the supplier's premises, before the generating set will be delivered to site, the Engineer and representatives of the client may be present during the test to satisfy them that the generating set complies with the specification and delivers the specified output. The test must be carried out in accordance with BSS 5514, Part 2 and 3. The Engineer must be timeously advised of the date for the test.
- (b) After completion of the works and before first delivery is taken, a full test will be carried out on the installation for a period of sufficient duration to determine the satisfactory working thereof. During this period the installation will be inspected and the contractor shall make good, to the satisfaction of the Representative/Agent, any defects which may arise.
- (c) The Contractor shall provide all instruments and equipment required for testing and any water, power and fuel required for the commissioning and testing of the installation at completion. Upon completion, the contractor shall fill up the fuel tank and hand-over a generator with a full tank to the client. Fuel for commissioning is not separately listed and shall be included in the contractor's commissioning costs. Only one full tank is to be priced in the bills of quantities by the contractor.
- (d) Test reports of both tests as specified under (a) and (b) are to be submitted to the CSIR.

23.7 Guarantee and Maintenance

The Contractor shall guarantee the complete plant for a period of twelfth (12) months after the first delivery has taken place.

If during this period the plant is not in working order, or not working satisfactorily owing to faulty material, design or workmanship, the Contractor will be notified and immediate steps shall be taken by him to rectify the defects and/or replace the affected parts on site at his own expense.

The Contractor shall maintain the plant in good working condition for the full twelfth (12) month period to the final delivery of the installation. However, should the Contractor fail to hand over the plant in good working order on the expiry of the specified twelfth months, the Contractor shall be responsible for further monthly maintenance until final delivery is taken.

During this period the contractor will undertake to arrange that the plant be inspected at least once per month by a qualified member of his staff who shall: -

- (a) Report to the Officer-in-charge, keeping the maintenance records, and enter into a log book the date of the visit, the tests carried out, the adjustments made, and any further details that may be required.
- (b) Grease and oil moving parts, where necessary.
- (c) Check the air filter and, when necessary, clean the filter and replace filter oil.
- (d) Check the lubricating oil and top-up when necessary.
- (e) After the plant has run one oil change for the number of hours stipulated by the manufacturers, drain the sump and refill with fresh lubricating oil. The reading of the hour meter on the switchboard will be taken to establish the number of hours run by the plant.

Under this heading only the cost of the actual oil used, shall be charged as an extra on the monthly account.

- (f) Clean the lubricating oil filter and/or replace the filter element at intervals recommended by the engine manufacturer, the cost of a new filter element to be charged as an extra on the monthly account.
- (g) Check and when necessary adjust the valve settings and the fuel injection equipment.
- (h) Check the battery and top-up the electrolyte when necessary.
- (i) Test-run the plant for 0,5 hour and check the automatic starting with simulated faults on the mains, the proper working of all parts, including the electrical gear the protective devices with fault indicators, the changeover equipment and the battery charger. Make the necessary adjustments.
- (j) Report to the Department and to the Contractor on any parts that become unserviceable through fair wear and tear, or damaged by causes beyond the control of the Contractor.

The Contractor on receiving the report, shall immediately submit a detailed quotation for the repair or replacement of such parts to the CSIR.

- (k) Advise the Client when it has become necessary to de-carbonise the engine and submit a quotation for this service.
- (l) Top up the water of the radiator, if applicable.
- (m) Clean the plant and its components.

23.8 Materials and Workmanship

- (a) The work throughout shall be executed to the highest standards and to the entire satisfaction of the Representative/Agent who shall interpret the meaning of the Contract Document and shall have the authority to reject any work and materials, which, in his judgement, are not in full accordance therewith. All condemned material and workmanship shall be replaced or rectified as directed and approved by the Engineer.
- (b) All work shall be executed in a first-class manner by qualified tradesman.

- (c) The Contractor shall warrant that the materials and workmanship shall be of the highest grade, that the equipment shall be installed in a practical and first-class manner in accordance with the best practices and ready and complete for full operation. It is specifically intended that all material or labour which is usually provided as part of such equipment as is called for and which is necessary for its proper completion and operation shall be provided without additional cost whether or not shown or described in the Contract Document.
- (d) The Contractor shall thoroughly acquaint himself with the work involved and shall verify on site all measurements necessary for proper installation work. The Contractor shall also be prepared to promptly furnish any information relating to his own work as may be necessary for the proper installation work and shall co-operate with and co-ordinate the work of others as may be applicable.
- (e) All components and their respective adjustment, which do not form part of the equipment installation work, but influence the optimum and safe operation of the equipment shall be considered to form part of, and shall be included in the Contractor's scope of works.
- (f) All control equipment and serviceable items shall be installed and positioned such that they will be accessible and maintainable.
- (g) The Contractor shall make sure that all safety regulations and measures are applied and enforced during the installation and guarantee periods to ensure the safety of the public and the User Client.

23.9 Brochures

Detailed brochures of all equipment offered shall be presented together with the tender documents.

23.10 Submittals

The following information must accompany the tender documents

- (a) Full particulars, performance curves and illustrations of the equipment offered, must be submitted with the Tender.
- (b) The design of the control system to comply with the requirements for automatic starting, stopping, interlocking and isolation as specified.
- (c) The successful Tenderer must, as soon as possible after receipt of the order, submit detailed drawings and wiring diagrams of the plant and the switchgear. One diagram shall be contained in a metal pouch on the side of the switchboard

(B) TECHNICAL SPECIFICATION

23.11 General

Supply, deliver, install, commission, test and maintain an emergency generating set at the CSIR HIP Building 16, in Pretoria, Gauteng Province.

The set must be installed outdoor on the generator plinth.

23.12 Site Information And Conditions

23.12.1 Location

The site is at situated in Pretoria, Gauteng Province.

23.12.2 Site Conditions

The following site conditions will be applicable and equipment shall be suitably rated to develop their assigned rating and duty at these conditions.

- a) Height above sea level : $\pm 1370\text{m}$ above sea level
- b) Maximum ambient temperature : $30\text{ }^{\circ}\text{C}$
- c) Maximum ambient humidity at lowest temperature : 60%

23.13 Output And Voltage

After the de-rating factors for the engine and generator due to site conditions have been taken into account, the set must have a site output and voltage as follows: -

No load voltage	:	400/230 Volt
Rating	:	500 kVA
Power at 0,8 power factor	:	400 kW
Frequency	:	50Hz
Fault Level	:	25kA

23.14 Change-over Control Panel Unit

All switch- and control gear shall be rated for a fault current level of 25kA.

23.15 Cables

The contractor will be responsible for all electrical cable connections associated with the complete generating set installation.

23.16 Engine

A sump drainpipe must be fitted with a shut-off valve placed in a convenient position outside the base frame to facilitate drainage.

Recommended oil types must be indicated on the engine, or base frames, by means of suitable labels.

All engine instruments shall have clear markings on the faceplates, indicating the normal operating zone(s), maximum and minimum allowable values/limits and danger zone(s).

The flywheel shall be covered by approved hoods.

23.17 Alternator

The Alternator shall be of the low harmonic type.

23.18 Load Acceptance

The generator set shall be capable of accepting 75% of the specified site electrical output 10 seconds after the starter motor is energised and the remaining 25%, 5 seconds thereafter, i.e. 100% load acceptance shall not exceed 15 seconds.

23.19 Fuel Drip Tray

A drip tray approximately 100mm deep shall be mounted below the fuel tank and must be large enough to collect any fuel that drips from the tank accessories. The drip tray shall be manufactured from black mild steel. The thickness of the drip tray sheet steel shall not be less than 2mm.

23.20 Completion Time

The Generator Set is required to be commissioned in conjunction with the building contract.

23.21 Inform

The successful tenderer shall inform the Engineer when the set is ready for installation.

23.22 Fuel Supply Tank

The new 500kVA (400V, 3phase) genset shall be supplied complete with automatic change-over panel, fuel storage tank, fuel pump. The tank shall have sufficient capacity for the generating set to run the engine on full load for a period of 8-12 hours.

A drip tray approximately 100mm deep shall be mounted below the fuel tank and must be large enough to collect any fuel that drips from the tank accessories. The drip shall be manufactured from black mild steel with a thickness of not less than 2mm.

24 ACCESS CONTROL

24.1 Scope of Work

The Scope of Works includes, but is not limited to the following:

- Supply, installation, testing and commissioning high quality access control system along with power supply, power distribution and required accessories in the locations of all ground and first floor doors to the HIP Plant room.
- The price quoted by the bidders should include all the expenses incurred in commissioning of all access control units.
- Training & handing over of all materials, equipment and appliances.
- Any other items/accessories required for installation, testing and commissioning of access control system.
- No extra cost shall be paid for miscellaneous items if required to complete the work.

The access control system, shall interface to the existing access control system of the CSIR.

24.2 ACCESS CONTROL SYSTEM – TECHNICAL SPECIFICATIONS

Access control system planned for CSIR building 16 is an integrated solution that consists of hardware and software designed to control entry into selected areas and manage movement of people. The system is designed to increase security by defining access permissions based on area and time for each user and maintaining a log of all events.

The access control systems for:

- Employee and Visitors Access Control

The system shall allow interfacing with the oxygen sensors and in case of a leakage, shall unlock doors such that emergency services personnel may obtain access to the facility.

24.2.1 Software

- The number of cards/users shall be limited only by memory available in hardware.
- At least 3 active cards per user shall be supported.
- At least 8 access levels per user shall be supported.
- Access levels should be assigned to a user, not to a card, in order to help issue a new card in a fast and easy manner, without reassigning access levels.
- The software shall support at least 4000 holiday dates and have automatic holiday rescheduling feature.

- The software shall have the ability to produce the following report types: system and alarm event reports, user reports, hardware configuration settings, access level reports, employee time & attendance reports.
- The reports shall be available in Adobe PDF and MS Excel formats.
- Report filters must be convenient and user friendly: content of access levels, hardware settings and time zone configuration.
- The software shall support an unlimited number of building floor plans. □ Floor plan viewing interface shall have convenient zoom in/out controls by mouse wheel. □ The software shall allow operator to conveniently edit floor plans by “dragging and dropping” hardware devices to selected plan areas.
- The downloading shall be done in background and not affect the normal use of the software in any way.
- The software shall use an industry standard database engine released not earlier than 2005 and currently supported by the manufacturer.
- The software shall be available in the official language(s) of the country where it is being installed. If such language is not included in the standard installation, the software shall support user friendly translation method: simply replacing program text directly in the software (“on the fly”), without the need of sending any files to the manufacturer for compiling.
- The software shall have a modern interface, attractively designed and convenient to use.
- The software shall be adapted for operators who have not received any special training related to management of integrated security systems.
- Introducing the system to a new operator shall not take more than 1 hour.
- In order to reduce the amount of work done by an operator, the software shall incorporate an option to copy objects: users, doors, floor plans, time schedules, access levels and holidays.
- The software shall facilitate integration with other systems of the building.
- The software shall have the ability to transfer entry and exit events to HR systems with the purpose of work time calculation.
- The software shall store information and provide reports about visitors and appointments.

24.2.2 Hardware

- The hardware shall support open architecture.
- Communication protocols shall be available to system integrators and software development companies in order to protect end-users from being constrained to a single brand of hardware or software.
- The hardware shall support all industry standard readers that output information in Wiegand or Clock/Data formats (up to 128 bits).
- There shall be at least 2 types of controllers: (a) for one door with an entry reader and an exit button and (b) for one door with two readers (entry and exit) or for two separate doors with entry readers and exit button.
- There shall be an IP-reader available. The IP-reader shall integrate a contactless card reader and controller in a single body, designed for surface mounting on a wall or a door frame eliminating the need for enclosures.
- Each controller and IP-reader shall have a standard RJ-45 network port for communication with software and other controllers.
- Controller and IP-reader shall support standard Ethernet 10/100BaseT network and TCP/IP communication protocol.
- Systems using Ethernet converters, adapters, or terminal servers that enable network connectivity for legacy controllers by tunneling RS-232/485 serial data over Ethernet shall not be acceptable.
- Single-door controller and IP-reader shall have at least 32Mb SDRAM operating memory and 8 MB Flash memory for database and events. Two-door controller shall have an option for expanding Flash memory to 32MB.
- All controllers and IP-readers shall use a 32Bit 100Mhz RISC processor (or better) in order to enable fast execution of advanced functions.

- Controllers and IP-readers shall use Linux operating system and accept firmware upgrades via network.
- All system parameters including card numbers, PINs, access levels, time schedules, holidays and operations modes shall be stored in controller and IP-reader memory and not affected in case of a power loss.
- Single-door controller and IP-reader shall have enough memory to store at least 40,000 users. Two-door controller shall have enough memory to store at least 250,000 users.
- In case communication with the host PC is interrupted, the controller and IP-reader must have enough memory to store at least 5000 latest events (FIFO buffer).
- Operation of controller and IP-reader shall be completely independent of the PC or “Master controller”. Should the PC or the communication link fail, the users should not be affected in any way and all functions should continue working.

a) Maintenance Work:

A technician should be assigned to this agreement, and back up technicians should be available as required to give the CSIR prompt service as required at all times. A service provider (SP) account representative will be assigned to the CSIR, and will be the primary contact personnel for communications regarding this agreement. The SP should also have extensive technical support and parts inventory available to the CSIR in the event as needed and local warehouses and national service distribution centre availability for express delivery in emergencies. The service provider (SP) should periodically examine, lubricate, adjust, and as the need arises repair or replace the components associated with maintenance.

At an additional cost to CSIR, the SP shall be requested to install any additional components or accessories to the equipment which is recommended or required due to parts being unserviceable. Should any form of labour and/or material be required on any of these excluded components, these costs will be brought to the attention of CSIR via a detailed written quotation who will then provide a separate order to cover these costs. Only good quality parts that are correctly designed, manufactured and suitable in all respects, shall be used.

24.2.3 Access Control Equipment

The following access control equipment shall be installed:

Table 5: Access Control Equipment to be installed:

Equipment Description	Location / Position of equipment
Access Control Card Reader	Refer to the design / tender drawing (12964-EE-200 and 12964-EE-201)
Break Glass Unit	Refer to the design / tender drawing (12964-EE-200 and 12964-EE-201)

25 EARTHING AND BONDING

The Contractor is to ensure that the installations covered in this document are effectively earthed and bonded in accordance with the requirements of the Code Of Practice for Earthing - BS7430 or SABS 0142 or similar approved equal.

26 OXYGEN SENSORS

26.1 Clients Requirement:

It is required to monitor the oxygen levels in the HIP machine room to prevent asphyxiation as a result of argon leakage.

The CSIR has standardized on oxygen sensors to ensure stock levels across the CSIR can be managed. The Contractor will not be allowed to purchase any oxygen sensors or controllers unless the type, manufacturer, model and functionality has been assessed and it is compatible with the type and sensors kept by the CSIR.

26.2 Oxygen Sensor

The oxygen sensor shall measure oxygen levels and generate alarms when the oxygen levels fall below 19.5% or rise above 23.5%. Two sensors minimum shall be provided (one on either side of the machine) and to be installed at 1.5m above floor level against the wall.

The sensor shall be a 3-wire 4-20mA and RS485 Modbus output fixed point detector with built-in alarm and fault relays for the protection of personnel and plant from flammable, toxic and Oxygen hazards. Each sensor shall incorporate a transmitter with local display and fully configurable via non-intrusive magnetic switch interface.

Each oxygen sensor shall have a mounting plate with 4 mounting holes suitable for M8 bolts. The sensor cartridge shall be connected to a transmitter with a sensor retaining ring and covered with a weatherproof protection assembly. The oxygen transmitter shall have a display module. The sensor and transmitter shall form an integral unit.

Each sensor shall have an IP66 rating and able to operate in temperatures -20°C to +55°C. Accuracy shall be less than 0.5%Vol. It shall be equipped with two alarms at 19.5%Vol and 23.5%Vol with a default calibration point of 20.9%Vol.

Cable access shall be via 20mm threaded galvanized conduits. Unused cable entry points shall be equipped with suitable seals supplied with the transmitter.

The transmitter shall be of the auto recognizing type when the oxygen sensor is plugged into it. The display shall have a tri-colour backlit area with the three colour modes as follows: green for normal, yellow for fault or warning, and red for alarm.

All sensors shall be connected to a controller suitable for the sensors, which will provide additional functionality and relay alarms to strobe lights.

26.3 Instrument cabling

The sensors shall be connected through 1.0mm² 3-wire overall screened instrumentation wiring to the controller, with the screen only connected to earth at the controller.

26.4 Oxygen Sensor Controller

The controller will be mounted either in the office upstairs, or in the passage on the ground floor and each sensor's transmitter and all alarm strobe lights shall be connected to the controller.

The sensor shall be suitable for up to 8 channels with provision for an expansion unit in the future, if required. The controller shall be suitable for 3-wire transmitter connections. The controller shall have a polycarbonate housing and be suitable for wall mounting.

It shall have a 7 inch colour LCD touchscreen for the graphic user interface. It shall have 3 LED's for master indicators (green for normal, red for alarm, and yellow for fault or warning).

It shall have an audible alarm ≥70dB at 1m, with a common reset / mute operation. The unit language for the display shall be English.

The unit shall be equipped with a 24V DC power supply, or alternatively be able to accept a 220V 50Hz AC input. The unit shall be able to operate in temperatures -10°C up to 55°C at a relative humidity of 95%. It shall be rated IP65.

It shall be suitable to accept eight 3-wire 4-20mA inputs as well as RS485 Modbus connections. It shall have 12 minimum 1.7A@30V DC or 250V AC outputs, as well as four powered alarm and three common alarm outputs.

It shall have a 22.2V 2600mAh Li-Ion back-up battery to provide a backup of at least 30 minutes. Configuration, events and data shall be logged in the unit/

Remote monitoring shall be possible through Modbus TCP, Modbus RTU and/or Ethernet.

26.5 Oxygen Sensor Remote Alarm

Remote strobe alarms will be positioned at the three doors leading from the passage (ground and first floors) as well as the office. Integration with the access control doors can be provided if necessary, through the controller whereby access controlled doors can be unlocked in case emergency services requires access to rooms.

Audible flashing or strobe alarms shall be connected to the oxygen sensing controller system, and all strobes and audible alarms shall sound when the oxygen level sensed by any sensor in the HIP room drops below 19.5% or rise above 23.5%. This shall indicate that the HIP room should not be accessed without proper PPE. The doors shall under no circumstances be prevented from being opened to allow access by emergency personnel.

The remote alarm unit shall be either 24V DC or 250V AC rated and be suitable for connection to the oxygen sensing controller.

The alarm output shall be 100dB(A) at 1m. the flash rate shall be 1Hz. The unit shall be able to operate in temperatures of -10°C up to 55°C. The strobe light lens colour shall be red and shall have automatic sounder synchronization. The tone shall be set such that it is not confused with any evacuation, fire or other tones already in use at the CSIR Building 16.

26.6 Training

The Contractor shall provide training to the client on the configuration, operation and maintenance of the oxygen sensors, controller and alarm interface.

26.7 Oxygen sensing Equipment

The following sensors / instrument equipment shall be installed:

Table 6: Instruments to be installed:

Equipment Description	Location / Position of equipment
Oxygen Sensor	Refer to the design / tender drawing: (12964-EE-101: Oxygen Sensor Layout)
Oxygen Sensor Controller	Refer to the design / tender drawing: (12964-EE-101: Oxygen Sensor Layout)
Oxygen Sensor Audible Alarm	Refer to the design / tender drawing: (12964-EE-101: Oxygen Sensor Layout)

27 TECHNICAL DATA SCHEDULE

The trade name and/or catalogue numbers of all equipment forming part of the tender offer must be submitted. This information schedule must be fully completed by the Contractor.

27.1 Cables

- (a) Manufacturer :
- (b) Type :
- (c) Complies with Spec? : (Yes/No)

27.2 Labelling system for cables

- (a) Manufacturer :
- (b) Type :

27.3 Cable trays

- (a) Manufacturer :
- (b) Type :

27.4 Cable trunking

- (a) Manufacturer :
- (b) Type :

27.5 Wall-mounted isolators

27.5.1 Flush-mounted double pole

- (a) Manufacturer :
- (b) Type (No of pins) :
- (c) IP rating :

27.5.2 Flush-mounted triple pole

- (a) Manufacturer :
- (b) Type (No of pins) :
- (c) IP rating :

27.5.3 Surface mounted double pole

- (a) Manufacturer :
- (b) Type (No of pins) :
- (c) IP rating :

27.5.4 Surface mounted triple pole

- (a) Manufacturer :
- (b) Type (No of pins) :
- (c) IP rating :

27.6 Light switches

- (a) Manufacturer :
- (b) Current rating :
- (c) Weather proof type: manufacturer :
- (d) Weather proof type IP rating :

27.7 Switched socket outlets

- (a) Manufacturer :
- (b) Current rating :

27.8 Telephone outlets

- (a) Manufacturer :
- (b) To spec :(yes/no)

27.9 Luminaires

27.9.1 Type A : 1 x 33W LED, 3956 Lumens, 600mm x 600mm x 30mm Panel, 99.9% Efficiency recessed / surface mounted Luminaire, or equal, better or similar approved

- (a) Manufacturer :
- (b) Type :
- (c) Complies with Spec? : (Yes/No)

- 27.9.2 Type A1: 1 x 33W LED, 3956 Lumens, 600mm x 600mm x 30mm Panel, 99.9% efficiency recessed / surface mounted Luminaire, with 1hour battery back-up unit or equal, better or similar approved
- (a) Manufacturer :
- (b) Type :
- (c) Complies with Spec? : (Yes/No)
- 27.9.3 Type D similar : LED 18W Downlight Luminaire - with battery back-up or equal, better or approved
- (a) Manufacturer :
- (b) Type :
- (c) Complies with Spec? : (Yes/No)
- 27.9.4 Type B: 20W LED Series 21 with Prismatic Diffuser Wall Surface Mounted Luminaire or equal, better or similar approved
- (a) Manufacturer :
- (b) Type :
- (c) Complies with Spec? : (Yes/No)
- 27.9.5 Type E: 8W Single Sided Surface mounted emergency escape signage luminaire with 1-hr battery back-up unit or equal, better or similar approved
- (a) Manufacturer :
- (b) Type :
- (c) Complies with Spec? : (Yes/No)
- 27.9.6 Type J: 55W 1050mA WIDE BEAM Bulkhead Surface Mounted or equal, better or similar approved
- (a) Manufacturer :
- (b) Type :
- (c) Complies with Spec? : (Yes/No)
- 27.9.7 Type F: LED FLOOD 215W 700mA, 25661 Lumens, 600mm x 350mm x 100mm Panel, surface mounted Luminaire, Mounted at 5.0m Height or equal, better or similar approved
- (a) Manufacturer :
- (b) Type :
- (c) Complies with Spec? : (Yes/No)

27.10 Photocells

- (a) Manufacturer :
- (b) Installation method :
- (c) Type and IP rating of enclosure :

27.11 Wiring

- (a) Manufacturer :
- (b) Type :
- (c) Complies with Spec : (Yes/No)

27.12 Labeling system for wiring

- (a) Manufacturer :
- (b) Type :

27.13 Distribution boards

Distribution Board

- (a) Manufacturer :
- (c) Complies with Spec : (Yes/No)

27.14 Circuit breakers

- (a) Manufacturer :
- (b) Trade name :
- (c) Port of delivery :
- (d) Minimum fault level :kA

27.15 Isolators

- (a) Manufacturer :
- (b) Trade name :
- (c) Minimum fault level :kA

27.16 Earth leakage units

- (a) Manufacturer :
- (b) Sensitivity rating :
- (c) Minimum fault level :kA

27.17 Contactors

- (a) Manufacturer :
- (b) Type :
- (c) Current rating reference : (e.g. AC3)
- (d) Control voltage :

27.18 Power skirting

- (a) Manufacturer :
- (b) Material :
- (c) Dimensions : (h) x (d)
- (d) Number of compartments :

27.19 UPS:

The delivery, manufacture, supply, testing, delivery, off-loading, connection, installation, commissioning, site testing and guarantee of one (1) x 6kVA UPS system, 230V/230V 50Hz 1ø input / 1ø output, manual and static by-pass and battery temperature sensor.

- (a) Manufacturer :
- (b) Size : kVA
- (c) Dimension :
- (d) Complies with Spec : (Yes/No):
- (e) Deviation from above specification:

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27.20 Generator: 500kVA, 3-phase, 50Hz, 400V prime rated diesel engine and alternator set with 10% overload (8-12hour standby time) standby generator set complete with automatic change-over panel according to specification). Generator bulk fuel tank system (to allow for 8-12-hour standby time) (including fuel pump & minimum 8m fuel pipes / extension hose pipe).

- (a) Manufacturer :
- (b) Size : kVA
- (c) Fuel Tank System (8-12 hour standby time) :hours

- (d) Dimension :
- (e) Complies with Spec : (Yes/No):
- (f) Deviation from above specification:
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27.21 Access Control

- (a) Manufacturer :
- (b) Type :
- (c) Complies with Spec : (Yes/No)

27.1 Oxygen Sensors (Instrument)

- (a) Manufacturer :
- (b) Sensor Type: : (Yes/No)
- (c) Controller: : (Yes/No)
- (c) Remote / Audible Alarm : (Yes/No):
- (d) Complies with Spec : (Yes/No):
- (e) Deviation from above specification:
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SIGNED ON BEHALF OF TENDERER :

NAME IN FULL :

COMPANY :

DATE :