public works
& infrastructure

Department:
Public Works and Infrastructure
REPUBLIC OF SOUTH AFRICA

TENDER DOCUMENT

MAIZE BOARD BUILDING PRETORIA: AIR CONDITIONING AND ELECTRICAL INSTALLATIONS: REPAIR AND MAINTENANCE

TENDER NUMBER: H22/007AI

ISSUED BY:

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BOOK 2

5. SCOPE OF WORK

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REPUBLIC OF SOUTH AFRICA

PG-01.1 (EC) SCOPE OF WORKS – (GCC (2010) 2nd EDITION: 2010)

Project title:	**MAIZE BOARD BUILDING PRETORIA: AIR CONDITIONING AND ELECTRICAL INSTALLATIONS: REPAIR AND MAINTENANCE**		
Tender no:	**H22/007AI**	**Reference no:**	

C3. Scope of Works

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C3.1 STANDARD SPECIFICATIONS:

The standard specifications on which this contract is based are the **South African Bureau of Standards Standardized Specifications.**

1. SANS 1200 - Standardised Specifications for Civil Engineering Construction*
2. SANS 0173 - The installation, testing and balance of air-conditioning ductwork*
3. SANS 0147 - Code of practice – Refrigeration systems including plants associated with air-conditioning systems*
4. SANS 193 - Fire dampers*
5. SANS 1424 - Filters for air-conditioning and general ventilation*
6. SANS 10142 - Wiring code*
7. Standard National Standards SANS 10400 – O: Code of Practice for the application of the National Building Regulations.
8. The Occupational Health and Safety Act No 6 of 1983 and/or the relevant regulations as Amended.
9. Local authority by laws and regulations.
10. PW327 - Department of Public Works Specification for Air conditioning and ventilation installation.
11. SANS 10103 - The measurement and rating of environmental noise with respect to annoyance and to speech communication.
12. SANS 10252 Part 1 and 2 - Water Supply and Drainage Installation for Buildings*
13. ASHRAE Standards - American Society of Heating, Refrigeration and Air-conditioning Engineers where applicable.
14. PW 371 - Specification of Materials and Methods to be used.
15. Standard Specifications for Electrical Installations and Equipment pertaining to Mechanical Installations.
16. The National Building Regulation Standard Act 1977 (Act 103 of 1997)
17. SANS 10400- Building Regulations South Africa
18. SANS 10400: O- Lighting and ventilation
19. SANS 1424- Filters for use in air conditioning and general ventilation
20. SANS 10400: XA- Energy usage in buildings
21. SANS 1125- Room air conditioning and heat pumps
22. SANS 10103- The measurement of rating of environmental noise with respect to annoyance and to speech communication.
23. SANS 10252- Water reticulation
24. SANS 1238- Standard Code for air- conditioning and Ventilation Ductwork
25. PW325- Manual for Electrical and Mechanical consulting engineers
26. PW327- Standard specification for air conditioning and ventilations
27. Electricity Regulation Act (ACT 4 OF 2006)

28. SANS 10142-1: The wiring of Premises, Part 1: Low voltage installations
29. SANS 10400- Application of the National Build Act
30. SANS 201- Energy Efficiency in Buildings
31. SANS 10114-1: Interior lighting: Artificial lighting of interiors
32. SANS 10389- Exterior lighting
33. SANS 164- Plugs and sockets-outlets system for household and similar purposes for use in South Africa.
34. SANS 60439: Low- Voltage switchgear and control gear assemblies
35. Department of public works- General electrical specifications part A, B & C.
36. SANA 10310: The protection of structures against lightning
37. SANS 62305- Protection against lightning
38. SANS 10199- The design and installation of an earth electrode
39. SANS 10292: Earthing of low- voltage (LV) distribution systems

C3.2 PROJECT SPECIFICATIONS:

STATUS

The Project Specification, consisting of two parts, forms an integral part of the contract and supplements the Standard Specifications.

Part A contains a general description of the works, the site and the requirements to be met.
Part B contains variations, amendments and additions to the Standardized Specifications and, if applicable, the Particular Specifications.

In the event of any discrepancy between a part or parts of the Standard Specifications and the Project Specification, the Project Specification shall take precedence. In the event of a discrepancy between the specifications, (including the Project Specifications) and the drawings and / or the Bill of Quantities, the discrepancy shall be resolved by the Engineer before the execution of the work under the relevant item.

A: GENERAL

PS-1 PROJECT DESCRIPTION

The project entails the repairs and replacement of the air-conditioning system and electrical infrastructure at the Sefala Building, in Pretoria. The work also includes compilation of operating and maintenance manuals, key site plans as well as training of User Client operators and all maintenance personnel.

NOTE: Repairs and replacement of the air-conditioning system and electrical infrastructure will be carried out within facilities that are occupied by User Client's personnel and associates.

PS-2 DESCRIPTION OF SITE AND ACCESS

Sefala Building is the property of the Department of Public Works. The various installations at the facility were maintained under a maintenance contract, until commencement of this Contract.

The Contractor will be granted access to the installations in phases. As work is being completed by the Construction Project (by others) and handed over to the Department of Public Works and user clients, the Contractor will be given access at which time his work responsibilities shall commence.

Access will be given to completed installations, while other installations may still be incomplete for which no access will be given. Where parts of an installation have been completed, and where such parts, or sub-sets, of an installation is well defined and can be clearly distinguished from the rest of the incomplete installation, access will be given for the part, or sub-sets, only. Remuneration for preventative and breakdown maintenance of the part of the installation, will be pro-rata the tendered rate for the complete installation, based on the scope and size of the completed part of the installation.

PS-3 DETAILS OF CONTRACT

All work forming part of this Contract is divided into installations. No distinction will be made between maintenance prior to practical completion and maintenance of completed installations for the purpose of this Contract.
The Contractor will have the opportunity at the start of the contract to point out items which are not in perfect working order which in turn will be serviced/corrective maintenance as per the relevant tendered rates. The Contractor must submit a written report of these items within 28 days of the date of site hand over. Failing to submit the report within the allowed time will render any and all defective items part of the Contractor's maintenance responsibly as set out in the relevant Technical and Particular Specifications.

The Contractor will further more at the start of the contract perform annual maintenance on all the installations as per the items listed in the different Technical and Particular Specifications as part of the Contractor's maintenance obligation.

Maintenance of each of these installations will be the responsibility of the Contractor and will be evaluated on a monthly basis by the Engineer. The remuneration for maintenance work and responsibilities will be certified accordingly.

The description of the Works given above is not necessarily complete and shall not limit the work to be carried out by the Contractor under this Contract.

ASSET REGISTER FOR PRETORIA, SEFALA BUILDING

The following infrastructure is a summary of the existing facilities at the various locations involved in the Contract.
The site consist of one building divided into floor levels ranging from the lower ground floor to the seventh floor.

a. Lower ground floor
b. Ground floor
c. First floor
d. Second floor
e. Third floor
f. Fourth floor
g. Fifth floor
h. Sixth floor
i. Seventh floor

PS-4 CONSTRUCTION WORK

The emphasis of this Contract is design, supply, installation and commissioning of the repairs and replacement of the air-conditioning systems and electrical infrastructure.
The items allowed for in the Scope of Works will only be executed upon instruction from the Principal agent when so required and when necessary.

Description of Construction Work

The scope of this contract includes for the supply, delivery, installation and commissioning of the services as described in the pricing data as well as the decommissioning and removal of existing installations where necessary.

Sefala Building facility has one plant room.

Plant Room 1 - new air cooled chilled water system to replace existing plant for a complete HVAC system including repairs on air handling units, fresh air ducting and chilled water piping.

Plant Room 1

Plant room 1 will supply chilled water to air conditioning equipment in seven levels in the Sefala Building. All the existing air conditioning equipment (chillers, pumps, water piping, electrical control panel etc.) will be refurbished or removed and replaced with the new equipment.

The following new equipment will be installed:

- 2 x Chillers
- Piping with valves and insulation
- Instrumentation
- Electrical control panel and wiring

From the heat load requirements, the contractor will be required to install 2x air cooled chillers with 600kW cooling capacity.

The chiller details are:

- Screw or scroll compressor type
- Inverter type (as per load and temperature adjustment) compressor operate in the best efficiency
- Air cooled
- Externally fitted.
- Rated Cooling capacity: 600kW
- Input Current: 380V/50hz/3ph
- Power consumption: 200kW
- EER: 2.9

The chiller will be fitted with plant monitoring system (such as a PLC) for control of the ancillary equipment (pumps etc.). It will monitor running parameters. The monitoring system will have potential expanding for remote unit monitoring and control functions (cellular phone technology (GSM) and possibly connected to an HMI and SCADA system.

The chiller will be equipped with various digital sensors which can collect the unit's operation parameters. It will also have reserve diversified control extension functions, RS485 interface, Modbus, Bacnet, Lonworks protocol. The accessories will be PVC Fill, Eliminators with Spray Distribution System, Special paint coating system to protect the equipment from harsh environment will be applied.

Chilled water pumps:
Three off chilled water pumps will be required as supply/return/standby. Contractor to match final pump flow rate with equipment selected.

Distribution Piping
The chilled water distribution piping is shown on drawings with maximum flow velocity of 1,2m/s. The piping will be mild steel hot dipped galvanised and insulated according to the diameters shown on the drawings.

Water treatment:
Chemical water treatment of the chilled water will be supplied and installed as part of this contract.

MCC Panel:
The Electrical Control Panel will be replaced and will supply and control the following:

- 2x Chillers
- Chilled water pumps
- Supply air fans
- Plant monitoring systems

All as per the electrical detailed specification and drawings

Air Handling Units:
The AHU will be refurbished, filters replaces, coils, heating elements as well as 2x supply fans retuned to good working condition.

The chilled water units provide cooling and electrical elements will provide heating.

Control Valves:
All valves, dampers, sensors and other control valves will be repaired or replaced and be compatible with the control system.

Fresh Air Supply:
Fresh air supply systems will supply outside (fresh) air to all areas where required in terms of SANS 10400, Part O.

Fresh air is supplied via forced air ducted systems at the required rates or 7,5 litres per second per person and/or the required Air Changes per Hour (ACH).

Fresh air is supplied via fresh air intake chamber in the plant room. Electrical controlled actuators control the fresh air volume in take.

Supply air ducting and fans will be reused.

Lastly the work include testing, commissioning, handing-over of all the systems.

Electrical

The Contractor shall be responsible for the design, supply and installation of all equipment and materials necessary for the complete and correct electrical

operation of the mechanical services under normal operation, fire mode and emergency power mode as per the tender document.

Power to the air conditioning and ventilation MCC's and Pumping system control panel will be supplied by the contractor. The contractor will provide power to the air conditioning and ventilation and pumping system from the MCC's in the form of a cable terminated in the MCC's and other panels, including all the terminations at the MCC's and panel, as well as all other terminations of the equipment supplied under this section of work.

The connecting to the various isolators, wiring to all equipment including between the air conditioning units, pumps and indoor fan coil units as well as all control cabling, shall form part of this contract.

The MCC's as provided by the Contractor is detailed in the Electrical Specification and shall include the main switch (isolator), timers, automatic starters, voltmeters, ammeters, kWh (run time) meters, MCB's, relays, Man/Off/Auto control switches, run pilot lights, trip pilot lights, fire tripping relay, etc.

All items of equipment shall be approved by the engineer and of SANS approved quality with regard to design and manufacture and shall be completely satisfactory for operation, control, safety and maintenance under all conditions of service. Uniformity of type and manufacture of switchgear, control gear, fittings and accessories shall be observed throughout the whole of the installation.

A registered qualified Electrician, to SANS 10142 shall carry out all electrical work. All electrical work shall be carried out to comply with the Standard Specification for Electrical installations.

On completion of work, a Certificate of Compliance shall be presented by the Electrician.

Additional work (Part of this contract)

The following work will form part of this contract:

- All electrical work associated with the scope of work
- Provisions of openings in walls, ceilings and windows complete with timber frames, etc.
- Making good of chases
- Casting of plinths for equipment

ROUTINE MAINTENANCE WORK

Contractor to allow for servicing of supplied equipment. Four services to be done over a 12 month period.

PS-5 CONSTRUCTION AND MANAGEMENT REQUIREMENTS

The Contractor shall be responsible for minor construction works as part of the replacement of the air-conditioning system, as set out in the Bill of Quantities and as per relevant specification.
The Contractor shall be responsible for all management to do work as indicated in SANS 1200 A.

Liaison

The Mechanical Services subcontractor/s shall, in each case, provide the principal contractor with all necessary information, dimensions, materials, etc., as called for in the specification, in good time.

It is essential that the Mechanical Services subcontractor/s works in close collaboration with the principal contractor to ensure that where his services run in proximity with other services, there are no clashes.

Failure to comply with the above may mean that corrective measures will have to be taken to correctly position the equipment. Any abortive work resulting will be entirely to the Mechanical Services subcontractor/s's account.

Supervisory Staff and Identification

All work done on site shall at all times be under the direct and full time supervision of a contracts manager.
Full particulars of the site organisation, complete with names of officials the Tenderer proposes to allocate to this project are to be submitted with this tender.

Whilst on the site, all staff and labourers employed by the Mechanical Services subcontractor/s shall wear distinctively marked clothing bearing the name of the Mechanical Services subcontractor/s or his identification logo.

Setting out of works

The Mechanical Services subcontractor/s shall be responsible for marking out and setting out of all equipment and plant.

The position of equipment and plant indicated on the drawings are to be taken as approximate. All final dimensions must be checked on site before preparation of manufacturing drawings and the fabrication of ducting and piping. The exact position for fixing shall be obtained by site measurements.

In case of doubt, decisions shall be obtained from the engineer or representative/agent.
Where beams, stanchions or other obstructions interfere with the straight running of pipes or ducts, suitable offsets shall be provided or alternatively changes in the section of the particular duct made, all in accordance with good engineering practice.

Erection of Equipment

The subcontractor shall be responsible for the erection and installation of all equipment supplied by him under the subcontract.

In addition, the subcontractor shall be responsible for the care and maintenance of all equipment after erection is completed until the first delivery of the specific section of the works. He shall ensure that the proper enclosure of all equipment is maintained at all times, that access doors and covers are opened only when necessary to work on the equipment and replaced afterwards, that the paint finish on all items is effectively protected and that all unused cable and conduit entries are effectively sealed.

CONSTRUCTION PROGRAMME

When drawing up his construction programme, the Contractor shall take into account the time for completion for the corrective maintenance work of each installation as indicated in Clause 5.5.1 as amended in Part 1 of the Contract Data.

If the programme submitted by the Contractor in terms of Clause 5.6.1 of the General Conditions of Contract, has to be revised because the Contractor is falling behind in his programme, he shall submit a revised programme of how he intends to regain lost time to ensure practical completion of corrective maintenance work of each installation, and completion of the Works within the periods stipulated Part 1 of the Contract Data or within a granted extension of time and also to ensure that other contractors have access to the site to start their work on the dates as shown in the original programme. Proposals to increase the tempo of work must incorporate positive steps to increase production either by more labour and plant on the Site, or by using the available labour and plant in a more efficient manner.

Instructions by the Engineer to expedite progress shall not be the subject of additional compensation to the Contractor unless the instruction explicitly states that the Contractor is entitled to additional compensation and cites the amount of such compensation or the basis on which it is to be determined.

Failure on the part of the Contractor to submit or to work according to the programme or revised programmes shall be sufficient reason for the Engineer to take steps as set out in Clause 9.2 of the General Conditions of Contract as amended in Part 1 of the Contract Data.

The approval by the Engineer of a programme shall have no contractual significance other than that the Engineer will be satisfied if the work is carried out according to the programme. The said approval shall not limit the right of the Engineer to instruct the Contractor to vary the programme if necessary. The Contractor is also referred to Clause PS 8 and Clause PS 12 when preparing this programme.

NOTE:

For reasons of limited access, it may not be possible to carry out the corrective maintenance work on some of the installations in parallel with corrective maintenance work on other installations

The Contractor shall organise his work in such a manner as to cause the minimum inconvenience to the User Client's personnel and operations.

PS-6 SITE FACILITIES AVAILABLE

PS 6.1 CAMPSITE AND STORE ROOM

A Site Establishment area is available and will be indicated to the Contractor. The Contractor must provide his own establishment facilities on site.

None of the existing service buildings may be used for storage. The Contractor must provide his own storeroom facilities for the duration of the Contract.

The facilities completed by the Contractor must comply with the South African National Building Regulations and Standards in all aspects.

PS 6.2 WATER, ELECTRICITY AND SEWERAGE

(a) Water supply

Water will be available free of charge but wastage will not be tolerated. Water will be available at specific points not necessarily adjacent to working areas. The Contractor must make his own arrangements for water supply to the working areas. The Contractor must supply his own standard fittings to couple up at the points where water is available.

The usage of water by the Contractor will be measured. The Contractor shall supply metering devices. In case of water shortages the Contractor will be responsible to make his own arrangements until such water shortages are resolved and reinstated to the Contractor.

In the event that water is not available on site, the Contractor shall supply at his own cost water for testing of wet services and where necessary preventative maintenance.

(b) Electrical power supply

Electrical power supply is available on the Site and will be free of charge. The Contractor must make his own arrangements for a connection to the electrical power supply. The Contractor will be responsible, at his own cost, for the distribution of electricity for construction and domestic use. The usage of electricity by the Contractor will be measured. The Contractor shall supply metering devices.

Note: The Employer shall not be held responsible for any losses or inconvenience due to a disruption in the supply of water and/or electricity.

PS 6.3 PARKING FACILITIES

Parking facilities are available on the Site.

PS 7 SITE FACILITIES REQUIRED

PS 7.1 GENERAL

The Engineer and/or his representative will use the existing facilities available.

The Contractor shall provide on the Site, for the duration of the repair phase and for the exclusive use of the Engineer and/or his Representative (as applicable), the various facilities described hereunder. The duration of the repair phase is stated in Part 1 of the Contract Data. All such facilities shall be provided promptly on the commencement of the Contract and failure on the part of the Contractor to provide any facility required in terms of this specification shall constitute grounds for the Engineer to withhold payment of the Contractor's Preliminary and General items until the facility has been provided or restored, as the case may be.

PS 7.2 OFFICE ACCOMMODATION

The Contractor shall provide within its own site establishment facilities, a suitably furnished office or other venue capable of comfortably accommodating a minimum of twelve (12) persons at site meetings. The Engineer shall be allowed free use of such venue for conducting any other meetings concerning the Contract at all reasonable times.

At the onset of the contract the Engineer will identify the site at which the meeting venue is to be provided.

Irrespective the type of material of which the venue is constructed, the Contractor shall ensure that the temperature inside the venue is always between 20ºC and 24ºC.

The site meeting venue shall further comply with and be furnished in accordance with the requirements of Subclause 3.2 of SANS 1200 AB. The Contractor shall maintain the venue/office(s) in accordance with the requirements of Subclause 5.2 of SANS 1200 AB.

Such a venue accommodation shall be provided within the Contractor's site establishment facilities.

PS 7.3 CARPORTS (NOT REQUIRED)

The Contractor shall provide on Site *one (1)* carport with parking for two vehicles for the exclusive use of the Engineer, in accordance with requirements of Subclause PSAB 3.3 of the Project Specifications. At the onset of the contract the Engineer will identify the site at which the carport is to be provided.

PS 7.4 SITE MEETING VENUE

The Engineer and/or his representative will use the existing facilities available at Sefala Building.

PS 7.5 CONTRACT NAME BOARDS

The Contractor shall provide, erect and maintain 1 (one) contract nameboards at such position and location as are directed by the Engineer, in accordance with the requirements set out in SANS 1200 (as amended) and according to the nameboard drawing contained in the document.

The Contractor shall before ordering or manufacturing any such contract nameboards obtain the Engineer's written approval in respect of all names and wording to appear on the contract nameboards.

PS 7.6 TELEPHONE FACILITIES

The Contractor shall, in accordance with the requirements of Subclause PSAB 4.1 of the Project Specifications, provide on-site, the following telephone facilities for the use of the Engineer and his Representative:

(a) Telkom telephones

(i) Number of separate telephone lines (numbers): **Nil**

(ii) Number of telephone handsets required: **Nil**

(b) Cellular telephones

Not required

PS 7.5 COMPUTER FACILITIES (NOT REQUIRED)

The Contractor shall provide new computer facilities together with the specified software installed, for the exclusive use of the Engineer and his staff, in accordance with the requirements of SANS 1200 (as amended).

PS 7.6 TELEFAX FACILITIES

Not required

PS 7.7 ELECTRICITY SUPPLY FOR THE ENGINEER (NOT REQUIRED)

PS 7.8 HOUSING FOR ENGINEER'S REPRESENTATIVE (NOT REQUIRED)

The Engineer will provide housing for the Engineer's representative. The housing and the relevant services and local authority rates and charges shall be paid for by the Contractor on the written instruction of the Engineer, from an amount included in Schedule 1 of the Bill of Quantities for this purpose.

The Contractor is entitled to a percentage of the value of each payment to the Engineer to cover his expenses in this regard. (See payment item PSA 8.14)

PS 7.9 CALL CENTRE (NOT REQUIRED)

A call centre has been established by the Employer to log, route and monitor incoming breakdown calls.

The call centre is administered centrally and is responsible for the routing of breakdown calls on each contract at the installation. The call centre is operational 24 hours per day, 365 days per year. The Contractor shall be responsible for the fixed and variable call costs incurred by the call centre for a relevant contract. The Contractor shall be reimbursed from an amount included in the Bill of Quantities, on written instruction of the Engineer. Operating costs of the call centre will be calculated, based on the number of breakdowns logged per contract, and invoiced on a monthly basis.

The Contractor is entitled to a percentage of the value of each payment in relation to the call centre to cover his expenses in this regard (see payment item PSA 8.12).

PS 8 REQUIREMENTS FOR ACCOMMODATION OF TRAFFIC

Requirements for the accommodation of traffic shall be in accordance with Clause 8.1.of the GCC (2010). Where road surfaces and other components of roads are repaired, the Contractor shall plan his work in such a way that existing traffic volumes are accommodated on the same road until work is complete. No service roads shall be constructed for purposes of accommodation of traffic during corrective maintenance,

PS 9 OCCUPATIONAL HEALTH AND SAFETY

The Contractor shall be required to comply with the Occupational Health and Safety Act 85 of 1993, Construction Regulations 2014 and related regulations. Non-compliance with these regulations, in any way whatsoever, will be adequate reason for suspending the Works.

The proposed type of work, materials to be used and hazards likely to be encountered on this Contract are detailed in the Scope of Work, Pricing Data and Drawings. The Employers' health and safety specifications of the regulations will be issued separately.

The Contractor shall in terms of subclause 2.5.1 provide a comprehensive health and safety plan detailing his proposed compliance with the regulations, for approval by the Employer.

The Contractor shall at all times be responsible for full compliance with the approved plan as well as the Construction Regulations and no extension of time

will be considered for delays due to non-compliance with the abovementioned plan or regulations.

A payment item is included in the Bill of Quantities to cover the Contractor's cost for compliance with the OHS Act and the abovementioned Construction Regulations 2014.

Access to the Works will be given after OHS Plan is approved.

PS 10 ADVERSE WEATHER CONDITIONS

Adverse weather conditions shall be managed in terms of additional Clause 2.2, included in the Contract Data.

PS 11 FEATURES REQUIRING SPECIAL ATTENTION

PS 11.1 INSTALLATIONS AT FACILITIES

The installations at all facilities shall be carefully checked for damage and all damages shall be listed and discussed with the Engineer before commencement of corrective maintenance and maintenance work. The Contractor shall present copies of all correspondence in this regard for discussion at the following site meeting.

PS 11.2 SECURITY

(a) Restrictions on movement and limited access

The Contractor's personnel, vehicles and equipment will be restricted to areas of construction only. The Contractor shall comply with any requirements that the Engineer may have in this regard and shall take note that for security reasons the access to some areas, may be limited.

(b) Security check on personnel

The Employer may require the Contractor to have his personnel or a certain number of them security-classified, if so required by any competent authority.

In the event of the Employer or any competent authority requiring the removal of a person or persons from the site for security reasons, the Contractor shall do so forthwith and the Contractor shall thereafter ensure that such person or persons are denied access to the site and/or to any documents or information relating to the work. In such circumstances the Contractor shall indemnify the Employer and the Engineer and shall hold the Employer and the Engineer harmless against any and all claims of whatever nature arising.

c) Access cards to security areas

Should the work fall within a security area, the Contractor must obtain from the Engineer access cards for his security-cleared personnel and employees who work within such an area. The Contractor must comply with any regulations or instructions issued from time to time, concerning the safety of persons and property, by the BCOCC or SA Police services.

PS 11.3 SITE TO BE KEPT CLEAN

During progress of the work and upon completion thereof, the Site of the Works shall be kept and left in a clean and orderly condition. The Contractor shall store materials and equipment for which he is responsible in an orderly manner, and shall keep the Site free from debris and obstructions.

All redundant materials, rubbish and waste arising from the work must be removed from the Site at the Contractor's cost and the site and buildings left clean and tidy.

PS 11.4 FACILITIES TO OTHER CONTRACTORS

In addition to the requirements of Clause 4.8.1 of the General Conditions of Contract the Contractor must make allowances for other Contractors on the Site. This may involve adapting his programme to accommodate the work of other contractors and ensuring access to their sites along prescribed routes over the Site of this Contract.

PS 11.5 SUBCONTRACTORS

In addition to the requirements of Clause 4.4 of the General Conditions of Contract as amended in Part 1 of the Contract Data, the Contractor shall be responsible for work carried out by subcontractors on his behalf. The Engineer will not liaise directly with such subcontractors. Problems related to payments, programming, workmanship, etc., shall be the responsibility of the Contractor and the subcontractor, and the Engineer will not become involved.

PS 11.6 SANS SPECIFICATIONS AND CODES OF PRACTICE

All reference in this document to South African Bureau of Standards specifications and codes of practice, or any other standard specifications or codes of practice, including National Building Regulations, shall be deemed to be references to the latest issues of such specifications and codes.

PS 11.7 MATERIALS

The monthly payment for materials brought onto the Site will only be applicable for corrective maintenance work and not for routine maintenance work.

Unless otherwise instructed in writing by the Engineer, all proprietary materials are to be used, mixed, applied, fixed, etc. strictly in accordance with the manufacturer's recommendations.

PS 11.8 BORROW PITS

There will be no designated borrow pits. The Contractor shall utilise the material on Site or import material from commercial sources.

PS 11.9 PROTECTION OF FURNITURE AND EQUIPMENT

Most of the work to be done inside buildings and occupied houses will be carried out in places where there is furniture and other equipment.

The Contractor shall be responsible for moving the furniture and equipment in order to provide working space for his personnel. The programme shall be drawn up in such a way as to keep the movement of furniture and equipment to the very minimum and the Contractor shall be solely responsible for any damage to furniture or equipment.

PS 11.10 TESTING AND QUALITY CONTROL

The Contractor shall engage the services of an approved independent laboratory or other institution as applicable for quality testing, to ensure that his work complies with the Specifications.

No separate payment will be made for such testing, the cost of which will be deemed to be included in the Contractor's rates bid for the items of work that require testing in accordance with the Specifications.

The onus to produce work that conforms in quality and accuracy of detail to the requirements of the Specifications and Drawings rests with the Contractor, and the Contractor shall, at his own expense, institute a quality-control system and provide experienced engineers, foremen, surveyors, materials technicians, other technicians and technical staff, together with all transport, instruments and equipment to ensure adequate supervision and positive control of the Works at all times.

The contractor will be responsible for testing of all equipment prior to leaving the manufacturers (where applicable). Quality control will be the responsibility of the contractor and the engineer will have the right to reject work and material which is not according to this specification.

The cost of supervision and process control, including testing carried out by the Contractor, will be deemed to be included in the rates bid for the related items of work.

The Contractor's attention is drawn to the provisions of the various Specifications regarding the minimum frequency of testing required. The Contractor shall, at his own discretion, increase this frequency where necessary to ensure adequate control.

On completion and submission of every part of the work to the Engineer for examination, the Contractor shall furnish the Engineer with the results of the relevant tests to indicate compliance with the Specifications.

PS-12 CERTIFICATES OF PAYMENT

The statement to be submitted by the Contractor in terms of Clause 6.10.1 of the General Conditions of Contract shall be prepared in accordance with the standard payment certificate prescribed by the Engineer and shall comprise at least two sets of A4-size paper copies.

All costs for the preparation and submission of the statements shall be borne by the Contractor.

Monthly report submitted with the statement for payment to the Engineer for compliance to EPWP requirements. This report shall be submitted in the provided format and electronically (Excel® format) stating the following details of the local labour utilised on the project for the current month:

- Worker's full name
- Worker's ID Number
- Work performed by the worker
- Rate per hour/day
- Hours worked
- Total paid for month

PS-13 CONSTRUCTION IN RESTRICTED AREAS

Working space in certain areas may be restricted. The construction method used in these restricted areas largely depends on the Contractor's Plant. However, the Contractor must note that measurement and payment will be according to the specified cross-sections and dimensions irrespective of the method used, and that the rates and prices submitted will be deemed to include full compensation for difficulties encountered while working in restricted areas. No extra payment nor any claim for payment due to these difficulties will be considered.

PS-14 DRAWINGS

The Contractor will, in terms of Clause 5.9.1 of the General Condition of Contract, be provided free of charge with three paper prints of each drawing issued to him.

All information in the possession of the Contractor that is required by the Engineer's representative to complete the as-built drawings must be submitted to the Engineer's representative before a Certificate of Completion will be issued.

Only figured dimensions shall be used and drawings shall not be scaled unless required by the Engineer. The Engineer will provide the dimensions that may have been omitted from the Drawings.

Schedule of drawings

The contract drawings form an integral part of this Specification and shall be read together with this specification.

Conflict between specifications and drawings

Should there be conflict between the specifications and drawings, then sections shall be considered in the following order of priority:

- Part 2: Project Specification
- Drawings
- Part 1: General Technical Specifications

Should the subcontractor note an inconsistency between the specifications and drawings, he shall be responsible for notifying the engineer or his representative/agent and obtaining clarification or instructions prior to ordering or installing equipment.

As installed records

(a). Extent of Provision:

Unless otherwise indicated, the Contractor shall provide the drawings and documents detailed below.

General layout drawings shall typically be drawn in CAD format to a scale of 1:100 and detailed layout assembly drawings to a scale of 1:50 or larger.

The number and sets of drawings and documents to be supplied shall be as indicated or agreed with the engineer.

(b) Installation, Drawings and Documents:

Installation drawings and documents, including diagrams (electrical circuits and control systems) shall show the detail of the Contractors proposal for the execution of the works and shall include everything necessary to illustrate in detail the arrangement of the various sections of the Works with other details of the installation.

Installation drawings shall include:

General layout drawings showing the location of all equipment including piping, cabling, drainage, instruments, gauges, etc. Detailed layout drawings showing equipment installation and mounting and fastening arrangements. Assembly drawings of factory built equipment and site built assemblies. System diagrams, circuit diagrams for all installation equipment. MCC and panel drawings and wiring diagrams

PS-15 LEGISLATION

(a) Changes in legislation

Reference in the General Conditions of Contract and in any other standard document forming part of this Contract to legislation which has been amended or superseded by other legislation since the most recent publication of such standard document, shall be deemed to be a reference to the amended or replacement legislation.

Such amended or replaced legislation shall be applicable during the Contract Period provided the amendment or replacement occurred more than 28 days before the closing date for bids in terms of Clause 6.8.4 of the General Conditions of Contract as amended in Part 1 of the Contract Data.

PS-16 INSURANCE AMOUNTS

The amounts for which the Contractor must ensure the Works in terms of Clause 8.6 of Part 1 of the Contract Data are stated in the Agreement.

PS-17 TIMES FOR COMPLETION

Times for completion of work to installations as well as the maintenance down-time for different types of breakdowns are given under Clause 5.5.1 of Part 1 of the Contract Data. The time for completion will start on the date of access to an installation.

PS-18 PRACTICAL COMPLETION

(a) The Contractor shall be entitled in terms of Clause 5.14.1 of the General Conditions of Contract to receive a Certificate of Practical Completion when the Works to be executed under the Contract have been completed to the stage where:

(i) all materials which are required to be replaced have been replaced and installed to the satisfaction of the Engineer; and
(ii) all corrective maintenance work have been completed.

(b) The Engineer shall issue to the Contractor and the Employer a Certificate of Completion in terms of Clause 5.14.4 of the General Conditions of Contract except where a thirty day commissioning period, as stated in paragraph (c) below, is applicable.

(c) Where indicated at the end of this paragraph, the issuing of a Certificate of Practical
Completion for a certain installation will be followed by a thirty day commissioning period.
The tasks of the Contractor during the thirty day commissioning period are described in Additional specification SC: General Decommissioning, Testing and Commissioning Procedures. After the completion of the thirty day commissioning period to the satisfaction of the Engineer, a certificate of completion will be issued to the Contractor as described in Clause 5.14.4 of the General Conditions of Contract.

PS-19 PENALTIES

Penalties in terms of Clause 5.13.1 of the General Conditions of Contract for late completion of corrective maintenance work to different installations are given under Clause 5.13.1 of Part 1 of the Contract Data. Payment reductions for exceeding the maintenance down-time for different types of breakdowns are given under the applicable pay items in the Bill of Quantities for Additional specifications SA: General Maintenance. Penalties will run concurrently where applicable.

(a) **Penalty for failing to meet undertakings and/or conditions pertaining to Targeted Procurement for the award of points**

If the bid adjudication points awarded to the Contractor are found to be based on incorrect or false information or the conditions pertaining to the award of points are not met and the Contractor fails to substantiate that such failure is due to a reason acceptable to the Employer as being beyond the Contractor's control, the Contractor shall be liable for and pay to the Employer, and amount determined in accordance with clause 2 and subject to clause 1 both of the Works Information, Part 2 of the Conditions of Bid.

(b) **Payment reduction for non-performance**

If the Contractor shall fail to rectify an emergency maintenance breakdown, an ordinary maintenance breakdown and damage breakdown within the time as stipulated in Additional Specifications SA: General Maintenance, the Contractor shall be liable to the Employer for the sum/sums stated in the Bill of Quantities for Additional Specification SA as a payment reduction for every hour/day down-time counting from the hour/day the breakdown was reported to the Contractor until the day it was corrective maintenance.

These payment reductions will be cumulative and will run concurrently.

Where indicated above that the money will be recovered from the Contractor by means of payment reductions, the fixed negative amounts in the rate column of the Bill of Quantities will be used to reduce payments due to the Contractor.

The imposition of such payment reductions shall not relieve the Contractor from his obligation to complete the Works or from any of his obligations and liabilities under the Contract.

(c) Application of penalties to be accumulative

The imposition of all penalties in terms of this clause shall be accumulative and shall not relieve the Contractor from his obligation to complete the Works or from any of his obligations and liabilities under the Contract.

PS-20 NON-WORKING DAYS AND HOURS

Whenever any special non-working days stated in Clause 1.1.1.12 and Clause 5.8 of Part 1 of the Contract Data fall within the days allowed or stipulated in the Contract in terms of Clause 1.1.1.12 of Part 1 of the Contract Data, such special non-working days shall also be excluded from the calculation of the number of working days concerned.

The Contractor shall not work on any statutory public holidays or on any public holidays declared by the Government to be statutory non-working days, except for work related to operation work, corrective maintenance fatal and emergency breakdowns which influences the functionality of any of the installations.

Working hours might be limited and the Contractor shall work in close cooperation with the User Client and Engineer in this regard. Working hours for the different installations are indicated at the end of this clause where applicable.

The Engineer shall be entitled at any time during the Contract, to vary the normal working hours specified in the Bid documents, including increasing or decreasing the total number of hours per day during which the Contractor may execute the Works or specific portions thereof.

If any variation by the Engineer of the normal working hours specified in the Bid Documents should result in an increase or a decrease in the total number of hours per week during which the Contractor is permitted to execute the Works or any particular portions of Works, then the time allowed in the Contract for the completion of the respective part of the Works to which the varied normal working hours apply shall be adjusted proportionately in relation to:

a) the remaining time allowed for completion of the specific part or parts of the Works; and
b) the extent of the variation in the total normal working hours per week.

B: AMENDMENTS TO THE STANDARD SPECIFICATION:

The following variations and additions to the SANS 1200 Standardised Specifications referred to in the last clause of Portion 1 apply to this Contract. The prefix PS indicates an amendment to SANS 1200. The letters and numbers following these prefixes respectively indicate the relevant Standardised Specification and clause numbers in SANS 1200.

PSA GENERAL

PSA 1 SCOPE

REPLACE SUBCLAUSE 1.1 *WITH THE FOLLOWING:*

"1.1 This specification covers requirements, principles and responsibilities of a general nature that are normally applicable to all Civil Engineering Contracts, as well as the requirements for the Contractor's establishment on the Site."

PSA 2 INTERPRETATIONS

PSA 2.3 DEFINITIONS

(a) General

ADD THE FOLLOWING DEFINITIONS:

"General conditions: The General Conditions of Contract specified for use with this Contract, and the Contract Data.

Specified: As specified in the standardised and standard specifications, the Drawings or the Scope of Work.

Permanent Works: as defined in Clause 1.1.1.22 of the General Conditions of Contract shall for the purpose of this Contract, be regarded as the corrective maintenance work and routine maintenance work as defined in Subclause SA 02.06 of Additional Specification SA: General Maintenance."

(b) Measurement and payment

REPLACE THE DEFINITIONS FOR "fixed charge", "time-related charge" AND "valuerelated charge" WITH THE FOLLOWING:

"Fixed charge: A charge that is not subject to adjustment on account of variation in the value of the Contract price or the Contract Time of Completion.

Time-related charge: A charge, the amount of which varies in accordance with the Time for Completion of the corrective maintenance work, adjusted in accordance with the provisions of the Contract.

Value-related charge: A charge, the amount of which varies pro rata with the final value of the measured corrective maintenance work executed and valued in accordance with the provisions of the Contract."

ADD THE FOLLOWING PARAGRAPH BEFORE THE FIRST PARAGRAPH:

"The Contractor's construction camp shall be fenced off and shall contain all offices, stores, workshops, testing laboratories, toilet facilities, etc. The camp shall always be kept in a neat and orderly condition.

No personnel may reside on the Site. Only one night-watchman may be on the Site after hours."

ADD THE FOLLOWING TO THE SECOND PARAGRAPH:

"One chemical toilet per 10 workmen shall be provided and must be screened from public view and its use shall be enforced.

PSA 2.4 ABBREVIATIONS

(a) Abbreviations relating to standard documents

ADD THE FOLLOWING ABBREVIATION:

"CKS: SANS Co-ordinating Specification."

PSA 3 MATERIALS

PSA 3.1 QUALITY

ADD THE FOLLOWING:

"All manufactured materials supplied shall be new materials unless the contrary is specified. All materials specified in accordance with SANS Specifications shall bear the SANS mark, whether so specified or not."

ADD THE FOLLOWING SUBCLAUSE:

PSA 3.3 ORDERING OF MATERIALS

The quantities set out in the Bill of Quantities have been carefully determined from calculations based on data available at the time and should therefore be considered to be approximate quantities only. Before ordering materials of any kind the Contractor shall check with the Engineer whether or not the scope of the work for which the materials are required is likely to change substantially. No liability or responsibility whatsoever shall be attached to the Employer for materials ordered by the Contractor except when ordered in accordance with written confirmation issued by the Engineer."

PSA 4 PLANT

PSA 4.2 CONTRACTOR'S OFFICES, STORES AND SERVICES

The Contractor shall, where applicable, make the necessary arrangements for the removal of night soil."

PSA 5 CONSTRUCTION

PSA 5.4 PROTECTION OF OVERHEAD AND UNDERGROUND SERVICES

REPLACE THE HEADING AND THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

PSA 5.4 LOCATION AND PROTECTION OF EXISTING SERVICES

PSA 5.4.1 Location of existing services

Before underground or excavation work is carried out, the Contractor shall ascertain the presence and position of all services likely to be damaged or interfered with by his activities. He shall obtain up-to-date plans from the Engineer for this purpose, showing the position of services in the area where he intends to work. As services can often not be reliably located from such plans, the Contractor shall determine the exact position of such services by means of suitable detecting equipment and afterwards by careful hand excavation where necessary in order to expose the services at the positions of possible interference by his activities. This procedure shall also be followed in respect of services not shown on the plans but believed to be present.

All such services, the positions of which have been located at the critical points, shall be designated as 'known' services and their positions shall be indicated on a separate set of Drawings, a copy of which shall be furnished to the Engineer.

While he is occupying the Site, the Contractor shall be liable for all damage caused by him to known services as well as for consequential damage, whether caused directly by his operations or by the lack of proper protection.

PSA 5.4.2 Protection during corrective maintenance and maintenance work

The Contractor shall exercise all the necessary care to prevent damage to known services during corrective maintenance and maintenance work. Where applicable, major excavating equipment and other Plant shall not be operated dangerously close to these services. Where necessary, excavation in close proximity to these services shall be carefully carried out with suitable hand tools, excluding picks wherever their use could damage the services. No additional payment will apply to such more difficult work.

Services left exposed shall be suitably protected from damage.

PSA 5.4.3 Alterations and corrective maintenances to existing services

Unless the contrary is clearly specified or ordered, the Contractor shall not carry out alterations to existing services. When this is necessary, the Contractor shall inform the Engineer, who will either make arrangements for such work to be executed by the owner of the service, or instruct the Contractor to make such arrangements himself.

When existing services are damaged by the Contractor, he shall immediately inform the Engineer, or when this is not possible, the relevant authority, and obtain instructions as to who should carry out corrective maintenances. In urgent cases the Contractor shall take the necessary steps to minimise damage to and interruption of the service. No corrective maintenances of telecommunication cables or electric power lines and cables shall be attempted.

The Employer will accept no liability for damages due to a delay in having such alterations or corrective maintenances affected. The Contractor shall provide all reasonable opportunity, access and assistance to persons carrying out alterations or corrective maintenances of existing services."

ADD THE FOLLOWING SUBCLAUSE:

PSA 5.9 SITE MEETINGS

The Contractor will be required to attend regular site meetings, normally held once a month to discuss general progress, quality of work, problems, claims, payments, etc., but not matters concerning the day-to-day running of the Contract."

PSA 6 TOLERANCES

ADD THE FOLLOWING SUBCLAUSE:

"PSA 6.4 GENERAL

No guarantee is given that the full specified tolerances will be available independently of each other, and the Contractor is cautioned that the liberal or full use of any one or more of the tolerances may deprive him of the full or any use of tolerances relating to other aspects of the work.

Except where the contrary is specified or when clearly not applicable, all quantities for measurement and payment shall be determined from the 'authorised' dimensions. These are specified dimensions or those shown on the Drawings or, if changed, as finally prescribed by the Engineer, without any allowance for the specified tolerances. Except if otherwise specified, all measurements for determining quantities for payment will be based on the 'authorised' dimensions.

If the work is therefore constructed in accordance with the 'authorised' dimensions plus or minus the tolerances allowed, quantities will be based on the 'authorised' dimensions regardless of the actual dimensions to which the work has been constructed.

When the work is not constructed in accordance with the 'authorised' dimensions plus or minus the tolerances allowed, the Engineer may nevertheless, at his sole discretion, accept the work for payment. In such

cases no payment shall be made for quantities of work or material in excess of those calculated for the 'authorised' dimensions, and where the actual dimensions are less than the 'authorised' dimensions minus the tolerance allowed, quantities for payment shall be based on the actual dimensions as constructed."

PSA 8 MEASUREMENT AND PAYMENT

PSA 8.1 MEASUREMENT

PSA 8.1.2 Preliminary and general items or section

PSA 8.1.2.2 Bid sums

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"The Contractor's bid sums under items PSA 8.3 and PSA 8.4 shall collectively cover all charges during the corrective maintenance phase for

- risks, costs and obligations in terms of the General Conditions of Contract, the Contract Data and of this Standardised Specification, except where provision is made in these

Project Specifications to cover compensation for any of these items;

- head-office and site overheads and supervision;
- profit and financing costs;
- expenses of a general nature not specifically related to any item or items of permanent or temporary work;
- providing facilities on Site for the Contractor's personnel, including offices, storage facilities, workshops, ablutions, for providing services such as water, electricity, sewerage, sewage and rubbish disposal, for access roads and all other facilities required, as well as for the maintenance and removal on completion of the Works of these facilities and the cleaning-up of the camp site on completion of the Works; providing facilities for the Engineer and his staff as specified in SANS 1200 AB and in these Project Specifications" and the scope of works in PS 7 and PSAB.

EMPLOYMENT AND TRAINING OF YOUTH WORKERS ON THE EXPANDED PUBLIC WORKS PROGRAMME (EPWP) INFRASTRUCTURE PROJECTS: NATIONAL YOUTH SERVICE (NYS):

The contractor shall comply with all the requirements as set out in the “Additional Specification SL: Employment and Training of Youth Workers on the Expanded Public Works Programme (EPWP)
Infrastructure Projects: National Youth Service (NYS)” as attached to these bills of quantities

The contractor shall liaise and co-ordinate with the employer and the EPWP Training Service Provider with regard to the priority list, the selection of youth workers, and the employment and training of the identified youth workers

The contractor shall avail the services of an adequately qualified foreman specifically for the EPWP-NYS youth workers, to act as their construction supervisor. The foreman will be

responsible for continually monitoring the progress of the youth workers and for addressing questions and issues that may arise from the youth workers

Separate items which will be subject to re-measurement have been included elsewhere in these bills of quantities to cover the direct costs associated with the employment and training of the youth workers. Any additional requirements in respect of the aforementioned specification are deemed to be priced hereunder and no additional claims in this regard shall be entertained

Monthly Reporting

The contractor shall maintain daily records with regard to the workers employed and shall,on a monthly basis, submit a report to the principal agent in the prescribed format. Compulsory indicators such as the project budget, actual project expenditure, number of job opportunities created, demographic characteristics of workers employed, minimum daily wage rate, number of person-days of employment created and number of training person-days, shall be included in said report, all as defined in the "Guidelines for the Implementation of Labour-Intensive Infrastructure Projects under the Expanded Public Works Programme (EPWP)"

Provision for pricing of compliance with the aforementioned is made under this clause and it is explicitly pointed out that all requirements in respect of the aforementioned are deemed to be priced hereunder and no additional claims in this regard shall be entertained

PSA 8.2 PAYMENT

PSA 8.2.1 Fixed-charge and value-related items

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"Payment of fixed charges in respect of item 8.3.1 will be made as follows:

Eighty per cent (80%) of the sum bid will be paid when the facilities have been provided and approved. The remaining 20% will be paid when the corrective maintenance works have been completed, the facilities have been removed and the camp site has been cleared and cleaned.

Payment for the sum bid under item 8.3.2 will be made in three separate instalments as follows:

(a) The first instalment, which is 40% of the sum, will be paid when the Contractor has fulfilled all his obligations to date under this Standardised Specification, the General Conditions of Contract and the Contract Data, and when the value of work certified for payment, excluding materials on Site and payments for preliminary and general items, is equal to not less than 5% of the total value of the corrective maintenance work listed in the Bills of Quantities.

(b) The second instalment, which is 40% of the sum, will be made when the amount certified for payment, including retention monies but excluding this second instalment, exceeds 50% of the corrective maintenance work.

(c) The final payment, which is 20% of the sum, will be made when the corrective maintenance works have been certified as completed and the

Contractor has fulfilled all his obligations to date under this Standardised Specification, the General Conditions of Contract and the Contract Data.

Should the value of the measured corrective maintenance work finally completed be more or less than the Bid Sum for corrective maintenance work, the sum bid under item 8.3.2 will be adjusted up or down in accordance with the provisions of Clause 50 of the General Conditions of Contract as amended in Part 1 of the Contract Data, and this adjustment will be applied to the third instalment. No adjustment will apply to item 8.3.1 in respect of variations in the value of work done or after the finally authorised Time for Completion."

Note: Payment under item 8.3.2 will only be applicable to corrective maintenance work.

PSA 8.2.2 Time-related items

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"Subject to the provisions of Sub clauses 8.2.3 and 8.2.4, payment under item 8.4.1 (time related item) will be made monthly in equal amounts as per the rate tendered per month for the contract period.

PSA 8.3 BILLED FIXED-CHARGE AND VALUE-RELATED ITEMS

REPLACE THE ITEMS WITH THE FOLLOWING:

"PSA 8.3.1 Fixed preliminary and general charges
.....Unit : Sum

PSA 8.3.2 Value-related preliminary and general charges
.....Unit : Sum

The sums bid shall include full compensation for all fixed and value-related preliminary and general charges as described in Subclause PSA 8.1.2.2. Payment will be made as described in Subclause PSA 8.2.1."

PSA 8.4 BILLED TIME-RELATED ITEMS

REPLACE THIS ITEM WITH THE FOLLOWING:

"PSA 8.4.1 Time-related preliminary and general charges:

(a) Pretoria, Sefala Building..... Unit: Month

The sums bid shall include full compensation for all time-related preliminary and general charges as described in Subclause PSA 8.1.2.2. Payment will be made as described in Subclause PSA 8.2.2.

NOTE: The total amount bid for items PSA 8.3.1, PSA 8.3.2 and PSA 8.4.1 shall not exceed 15% of the total amount bid for corrective maintenance work, excluding value-added tax.

PSA 8.6 PRIME COST ITEMS

REPLACE THIS ITEM WITH THE FOLLOWING:

"PSA 8.6 PRIME COST SUMS:

(a) Description of prime cost sum ..... Unit: PC Sum

(d) Charge required by Contractor on subitem (a) above
..... Unit: %

The Prime Cost Sum provided under subitem (a) in the Bill of Quantities will be expended in accordance with Clause 45.2 of the General Conditions of Contract.

The bid percentage under subitem (b) will be paid to the Contractor on the value of each payment made to the Engineer.

PSA 8.8 TEMPORARY WORKS

REPLACE ITEM 8.8.4 WITH THE FOLLOWING:

"PSA 8.8.4 Location and protection of existing services:

PSA 8.8.4.1 Provision of detecting devices for:

(a) Water and sewer pipes
.....Unit : Sum

(b) Electrical and other cables
.....Unit : Sum

The bid sums shall cover the cost of providing and operating suitable equipment for as long as it is needed to locate all the existing services likely to be affected by the construction activities. Alternatively, an approved specialist firm may be employed to carry out the work.

PSA 8.8.4.2 Hand excavation necessary for locating and exposing existing services in all material:

(a) In roadways Unit: m^3

(b) In all other areas..... Unit: m^3

The rates shall cover the cost of excavating by means of hand tools within authorised dimensions, for all precautionary measures to protect the services from damage during excavation and backfilling, and for subsequent backfilling and compacting. Compaction of material in all areas except in roadways shall be to 90% of the modified AASHTO density.

The rate for hand excavation in roadways shall include compensation for compacting excavated or selected backfill material to 93% of modified AASHTO density.

The bid rates shall also include for keeping excavations safe, for dealing with surface and subsurface water, for removing surplus excavated material from the Site, for transporting all material, and for supplying adequate supervision during both excavation and backfilling operations."

ADD THE FOLLOWING ITEMS:

"PSA 8.9 ADDITIONAL TESTS:

(a) Additional tests required by the Engineer ..... Unit :PC Sum

(b) Attendance and profit Unit : %

An amount has been allowed in the Bill of Quantities under subitem (a) to cover the cost of additional tests required by the Engineer. The Engineer will have the sole authority to spend the amount or part thereof.

The bid percentage under subitem (b) will be paid to the Contractor on the value of each payment made to the testing authority.

Note in connection with subitem (a):

The Contractor is responsible for both the cost of normal testing as described in Sub clause PS 8.10 in portion 1 of the Project Specifications and for the cost of any additional test that indicates that the Specifications have not been complied with.

PSA 8.10 SECTIONAL FENCING FOR THE PROTECTION OF THE WORKFORCE Unit : m

The bid rate shall include full compensation for the supply, delivery, initial erection and finally removal from the site of the sectional fencing. The cost to move the fencing will not be paid for separately but shall be deemed to be included in the rate bid.

PSA 8.11 MAINTENANCE MATERIAL:

Supply and deliver maintenance material to the site:

(a) Description of type of service for which material is needed:

(i) Description of specific material ..... Unit: litre, m², m, number
(ii) Etc., for other types of material.

(b) Etc. for other types of service.

The unit of measurement shall be the litre, square metre, metre or number as applicable to each item ordered on the written instructions of the Engineer.

The bid rates shall include full compensation for supplying and delivering to the maintenance store(s) of the Employer on the Site of the Works each item as billed and shall include for all labour, material, waste and, transport.

A complete book keeping system with delivery notes and order "invoices" shall be kept by the Contractor and the cost thereof shall be deemed to be included in the rates bid for the various items.

The rates bid will be fixed for the full duration of the corrective maintenance and maintenance phases and shall be applicable to any quantity "ordered" irrespective of size, contents, volume of container or the number. The actual square metre size of the "ordered" items will be calculated to two decimal points for payment purposes. No "rounding-off" to the nearest square metre quantity will be allowed. It is expected that the maintenance material will be ordered in small quantities throughout the duration of the Contract."

PSA 8.12 CALL CENTRE (NOT REQUIRED)

(a) Call centre operating costs for breakdown calls logged ..... Unit: PC Sum

(b) Charge required by contractor on subitem (a) above ..... …….Unit: %

An amount has been allowed in the Bill of Quantities under subitem (a) to cover the cost of administrating breakdown calls logged through the call centre. The call centre will submit to the contractor a monthly invoice for breakdown calls logged and monthly subscription. The Contractor will be responsible for prompt payment of the invoice received from the call centre.

The bid percentage under subitem (b) will be paid to the Contractor on the value of each payment pertaining to the call centre to cover his expenses in this regard.

Payment to the Contractor will only become due upon submission of proof of payment to the Engineer.

PSA 8.13 OCCUPATIONAL HEALTH AND SAFETY…….Unit: sum/month

The bid rate shall include full compensation to the Contractor for compliance with all the requirements of the Occupational Health and Safety Act 85 of 1993, Construction Regulations 2014 and related regulations. Non-compliance with these regulations, in any way whatsoever, will be adequate reason for suspending the Works.

The proposed type of work, materials to be used and hazards likely to be encountered on this Contract are detailed in the Scope of Work, Pricing Data and Drawings. The Employers' health and safety specifications (subclause 4.1.1) of the regulations will be issued separately.

The Contractor shall at all times be responsible for full compliance with the approved plan as well as the Construction Regulations and no extension of time will be considered for delays due to non-compliance with the abovementioned plan or regulations.

PSA 8.14 HOUSING FOR THE ENGINEER'S REPRESENTATIVE (NOT REQUIRED)

(a) Housing for Engineer's representative…….Unit: PC Sum

b) Charge required by contractor on subitem (a) above ..... Unit: %

The Engineer will provide housing for the Engineer's representative. The housing and the relevant services and local authority rates and charges shall be paid for by the Contractor on the written instruction of the Engineer, from an amount included in Section 1200 A of the Bill of Quantities for this purpose.

The Contractor is entitled to a percentage of the value of each payment to the Engineer to cover his expenses in this regard. (See payment item PSA 8.6)

PSAB ENGINEER'S OFFICE

PSAB 3 MATERIALS

PSAB 3.1 NAME BOARDS

"The Contractor shall supply and erect at locations approved by the Engineer, the number of contract nameboards specified in Portion 1 of the Project Specifications, which, unless otherwise specified in the Contract, shall comply with the recommendations for the standard board of the South African Association of Consulting Engineers, with regards to size, painting, decorating and detail, and the requirements described hereunder."

OR

The Contractor shall supply the number of overlays specified in Portion 1 of the Project Specifications.

PSAB 3.2 OFFICE BUILDING(S)

*REPLACE THE WORDS: "*as scheduled" *IN PARENTHESIS IN THE FIRST LINE OF SUBCLAUSE 3.2 OF SANS 1200 AB WITH:* "as specified in Portion 1 of the Project
Specifications";

AND REPLACE SUBCLAUSE 3.2(j) OF SANS 1200 AB WITH THE FOLLOWING:

"(j) a heater and fan / air-conditioning unit both of such capacity that the inside of the office(s) is always at a temperature of between 20ºC and 24ºC."

ADD THE FOLLOWING SUBCLAUSE IN CLAUSE 3:

"PSAB 3.3 CAR-PORT (NOT REQUIRED)

The Contractor shall construct the number of carports indicated in Portion 1 of the Project Specifications, for the sole use of the Engineer and his staff. Each car-port shall be constructed so that the vehicle parked under it is always protected against the direct rays of the sun. The carport area shall be at least

36 m^2 and the floor shall be covered with a layer of crushed stone to alleviate dusty and muddy conditions. The carport(s) shall be positioned so as to provide easy and convenient access to the Engineer's office."

Where it is specified in Portion 1 of the Project Specifications that the Contractor shall provide computer equipment on site for the exclusive use of

PSAB 4 PLANT

PSAB 4.1 TELEPHONE (NOT REQUIRED)

REPLACE THE WORDS: "Department of Post and Telecommunications" *WITH* "Telkom" *AND ADD THE FOLLOWING AT THE END OF SUBCLAUSE 4.1 OF SANS 1200 AB:*

"In addition to a Telkom telephone and subject to satisfactory transmission and reception quality in the vicinity of the Site, the Contractor shall provide the number of cellular telephones and associated service contracts from a reputable cellular service provider, as specified in Portion 1 of the Project Specifications, for the exclusive use of the Engineer and his staff."

ADD THE FOLLOWING NEW SUBCLAUSES TO CLAUSE 4 OF SANS 1200 AB:

"PSAB 4.2 COMPUTER EQUIPMENT

the Engineer and his staff, such computer hardware and software shall comply with the specifications set out in Subclauses PSAB 4.2.1 and PSAB 4.2.2 hereunder.

PSAB 4.2.1 Computer hardware

(a) Computers

Not required

(b) Printers (not required)

Printers shall, unless otherwise approved by the Engineer, be (Black and White) laser printers.

All computer hardware shall be provided complete with the requisite connecting cables and all inter-facing devices and software necessary for its efficient operation as an integral system.

PSAB 4.2.2 Computer software (not required)

The following software shall be properly installed on the computer, and the original licence agreements and disks shall be provided to the Engineer for safekeeping:

(a) Microsoft Windows® 8 Professional 64-bit

(b) MS-Office 2013 Professional

REPLACE THE CONTENTS OF SUBCLAUSE 5.4 OF SANS 1200 AB WITH THE FOLLOWING:

PSAB 4.3 TELEFAX FACILITIES (NOT REQUIRED)

Subject to the availability of Telkom lines, the Contractor shall provide and install in the Engineer's office referred to in Subclause PSAB 3.2, one plain paper fax machine for the exclusive use of the Engineer and his staff. The Contractor shall provide all consumables such as paper, and ink and toner cartridges as may be necessary for the proper operation of the fax machine.

PSAB 4.4 SURVEY EQUIPMENT

The Contractor shall provide on-site and make available for the exclusive use of the Engineer and his staff, the survey equipment listed in Portion 1 of the Project Specifications.

All survey equipment provided by the Contractor shall be in good condition, properly calibrated and fit for the purpose.

In addition to survey equipment provided by the Contractor for the exclusive use of the Engineer and his staff, the Contractor shall make available for use by the Engineer, the further survey equipment listed in Portion 1 of the Project Specifications, at all times when such is reasonably required by the Engineer and his staff for the purposes of the Contract."

PSAB 5 CONSTRUCTION

PSAB 5.4 TELEPHONE

PSAB 5.4.2 Cellular telephones

The Contractor shall advise the cellular service provider of any faults which develop in the cellular telephone service and/or the cellular telephone handsets and shall, in such circumstances , arrange for the earliest possible restoration of the said service.

The costs of any necessary corrective maintenances and/or the replacement of components to the handsets of the cellular telephones shall be for the Contractor's account.

The Contractor shall ensure that all accounts for cellular phone calls and the respective service contracts are promptly paid."

ADD THE FOLLOWING NEW SUBCLAUSES TO CLAUSE 5 OF SANS 1200 SB:

"PSAB 5.6 COMPUTER EQUIPMENT

All computer equipment provided shall be kept fully serviceable at all times by the Contractor. The Contractor shall have any defective equipment corrective

maintenance or replaced at his own cost within 12 hours after notification by the Engineer's staff.

The Contractor shall further provide at his own cost, all paper and black ink cartridges and other consumables reasonably required by the Engineer.

PSAB 5.7 TELEFAX FACILITIES

The Contractor shall advise Telkom promptly of any faults which develop in the telephone line service for the fax machine and shall, in such circumstances , arrange for the earliest possible restoration of the said service.

The Contractor shall promptly arrange for any corrective maintenance to or replacement of the fax machine as may prove necessary, and shall ensure that all accounts pertaining to the fax machine are promptly paid.

The Contractor shall further provide at its own cost, all paper, ink cartridges, toner kits and other consumables required for the operation of the fax machine.

PSAB 5.8 SURVEY EQUIPMENT

All survey equipment provided by the Contractor shall be kept fully serviceable at all times by the Contractor. The Contractor shall have any defective equipment corrective maintenance or replaced at his own cost within 24 hours after notification by the Engineer's staff.

Where required by the Engineer, the Contractor shall at his own cost, promptly arrange for the re-calibration of survey equipment provided.

public works
& infrastructure
Department:
Public Works and Infrastructure
REPUBLIC OF SOUTH AFRICA

SPECIFICATION

FOR THE

MECHANICAL INSTALLATIONS

OF A

REPAIR AND MAINTENANCE SERVICE

FOR

DEPARTMENT OF AGRICULTURE, FORESTRY AND FISHERIES

MAIZE BOARD BUILDING

PRETORIA

TECHNICAL SPECIFICATION

PAB ELECTRICAL INSTALLATIONS

CONTENTS

PAB 01 SCOPE

PAB 01.01 This specification comprises all aspects regarding the construction and installation of the building electrical systems for the upgrade of the air conditioning and ventilation systems. The systems include:

(i) Upgrade of the main supply cable to plant rooms
(ii) All supply cables to the new equipment as well as existing equipment currently connected to the existing control panels
(iii) Motor Control Centres and related low voltage cables
(iv) Small power and fixed appliances as per the existing
(v) Earthing system for the new installation

PAB 01.02 This specification shall form an integral part of the Sefala Building contract document and shall be read in conjunction with other Additional Specifications included in the Bid Document.

PAB 02 STANDARD SPECIFICATIONS, REGULATIONS, CODES AND ADDITIONAL SPECIFICATIONS

PAB 02.01 The latest edition, including all amendments up to date of tender of the following specifications, publication and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof.

PAB 02.02 SANS SPECIFICATIONS

General	Distribution and meter boards	LV cables and conductors	Lighting system	Earthing and lightning protection system	Small power installation	
					Power outlets	Conduits, powerskirting, cable trays and ducting
SANS 10142	SANS 152		SANS 10114	SANS 03	SANS 152	SANS 950
SANS 10160	SANS 156	SANS 10198	SANS 163	SANS 10199	SANS 164	SANS 1065
SANS 10400	SANS 172	SANS 1411	SANS 1012		SANS 1084	SANS 1085
SANS 1222		SANS 1507	SANS 1084	**Speed Drives**	SANS 1239	
			SANS 1250			
			SANS 1279	SANS61800		
			SANS 1777			
			SANS 10114			

PAB 02.03 **OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993: CONSTRUCTION REGULATIONS, 2003 AS PROMULGATED IN GOVERNMENT GAZETTE NO 25207 AND REGULATION GAZETTE NO 7721 OF 18 JULY 2003**

PAB 02.04 **MANUFACTURER'S SPECIFICATIONS AND INSTALLATION INSTRUCTIONS**

PAB 02.05 **ADDITIONAL REQUIREMENTS**

Equipment and material installed shall be new and unused.

Luminaires, control gear, isolators and power outlets shall bear the SANS stamp. The Contractor shall ensure that all safety regulations and measures are applied and enforced during repair and maintenance work on cabling, wiring, distribution boards, luminaires, power points and fixed appliances.

PAB 03 TEST AND INSPECTION FOLLOWING COMPLETION OF CONSTRUCTION WORK

PAB 03.01 All systems are to be checked by the Contractor prior to commissioning. Copies of all checks for each installation shall be presented to the Engineer for approval before commissioning takes place.

PAB 03.02 It is the responsibility of the Contractor to provide all labour, accessories and properly calibrated and certified measuring instruments necessary to record the following parameters:

PAB 03.02.01 continuity of ring final circuit conductors

PAB 03.02.02 continuity of protective conductors, including main and supplementary equipotential bonding

PAB 03.02.03 earth electrode resistance

PAB 03.02.04 insulation resistance

PAB 03.02.05 polarity

PAB 03.02.06 earth fault loop impedance

PAB 03.02.07 operation of residual current devices

PAB 03.02.08 phase voltage

PAB 03.02.09 current per phase

PAB 03.03 The Contractor is responsible for the arrangement of such tests. He shall give at least 72 hours notice to the Engineer prior to the test date.

PAB 04 QUALITY ASSURANCE SYSTEM

PAB 04.01 Following formal approval of his Quality Assurance system by Engineer, the Contractor shall implement the approved QA system.

PAB 04.02 Records of this QA system shall be kept throughout the duration of the contract and shall be submitted to the Engineer as required by the Engineer.

PAB 05 COMMISSIONING OF INSTALLATION

PAB 05.01 On completion of the repair work, the contractor shall check and put all systems into operation.

PAB 05.02 All commissioning shall be performed by the Contractor, to the satisfaction of the Engineer. The Contractor shall confirm in writing that all systems have been repaired according to specification and are fully operational.

PAB 05.03 All installations shall be energised for a minimum continuous period of 96 hours immediately prior to the Engineer's Practical Completion inspection to verify lamp stability and reliability of power reticulation

PAB 06 QUALITY SPECIFICATION FOR MATERIAL AND EQUIPMENT

PAB 06.01 TESTS

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 installations will be inspected and the Contractor

shall make good, to the satisfaction of the Representative/Agent, any defects which may arise.

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 installations at completion.

PAB 06.02 NOTICES AND FEES

The Contractor shall give all notices required by and pay all necessary fees, including any inspection fees, which may be due to the local Supply Authority.

On production of the official account, only the net amount of the fee charged by the Supply Authority for connection of the installation to the supply mains, will be refunded to the Contractor by the Engineer.

PAB 06.03 SCHEDULE OF FITTINGS

In all instances where schedule of light, socket outlet and power points are attached to or included on the drawings, these schedules are to be regarded as forming part of the specification.

PAB 06.04 QUALITY OF MATERIALS

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

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

Materials wherever possible, must be of South African manufacture.

PAB 06.05 CONDUIT AND ACCESSORIES

The type of conduit and accessories required for the service, i.e. whether the conduit and accessories shall be of the screwed type, plain-end type or of the non-metallic type and whether metallic conduit shall be black enamelled or galvanised, is specified in Part 2 of this specification.

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

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

- Screwed metallic conduit and accessories: SABS 1065, parts 1 and 2
- Plain-end metallic conduit and accessories: SABS 1065, parts 1 and 2
- Non-metallic conduit and accessories: SANS 950.

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

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

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

For light and socket outlet circuits, the conduit used shall have an external diameter of 20mm. In all other instances the sizes of conduit shall be in accordance with the "Wiring Code" for the specified number and size of conductors, unless otherwise directed in part 2 of this specification or indicated on the drawings.

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

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

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

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

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

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

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

PAB 06.06 CONDUIT IN ROOF SPACES

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

Nail or crampets will not be allowed.

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

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

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

PAB 06.07 SURFACE MOUNTED CONDUIT

The conduit installation shall be surface mount as there is no building work on this contract. Conduit installed on the surface must be plumbed or levelled and only straight lengths shall be used.

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

No threads will be permitted to show when the conduit installation is complete, except where running couplings have been employed.
Running couplings are only to be used where unavoidable, and shall be fitted with a sliced couplings as a lock nut.

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

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

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

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

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

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

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

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

PAB 06.08 CONDUIT IN CONCRETE SLABS

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

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

Draw-boxes, expansion joint boxes and round conduit boxes are to be provided where necessary. Sharp bends of any nature will not be allowed in concrete slabs.

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

All boxes, etc., are to be securely fixed to the shuttering to prevent displacement when concrete is cast. The conduit shall be supported and secured at regular intervals and installed as close as possible to the neutral axis of concrete slabs and/or beams.

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

PAB 06.09 FLEXIBLE CONNECTIONS FOR CONNECTING UP OF MACHINES, ETC

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

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

Aluminium and zinc alloy connectors will not be acceptable.

PAB 06.10 WIRING

Except where otherwise specified in Part 2 of this specification, wiring shall be carried out in conduit throughout. Only one circuit per conduit will be permitted.

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

Unless otherwise specified in Part 2 of this specification or indicated on the service drawings, the wiring of the installation shall be carried out in accordance with the "Wiring Code". Further to the requirements concerning the installation of earth conductors to certain light points as set out in the "Wiring Code", it is a specific requirement of this document that where plain-end metallic conduit or non-metallic conduit has been used, earth conductors must be provided and drawn into the conduit with the main conductors to all points, including all luminaires and switches throughout the installation.

Wiring for lighting circuits is to be carried out with 2,5mm² conductors and a 2,5mm²earth conductor. For socket outlet circuits the wiring shall comprise 4mm² conductors and a 2,5mm²-earth conductor. In certain instances, as will be directed in Part 2 of this specification, the sizes of the aforementioned conductors may be increased for specified circuits. Sizes of conductors to be drawn into conduit in all other instances, such as feeders to distribution boards, power points etc., shall be as specified elsewhere in this specification or indicated on the drawings. Sizes of conductors not specified must be determined in accordance with the "Wiring Code".

The loop-in system shall be followed throughout, and no joints of any description will be permitted.
The wiring shall be done in PVC insulated 600/1000 V grade cable to SABS 150.

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

PAB 06.11 SWITCHES AND SOCKET OUTLETS

All switches and switch-socket outlet combination units shall conform to the Quality Specifications, which form part of this specification.

No other than 16 A 3 pin sockets are to be used, unless other special purpose types are distinctly specified or shown on the drawings.

All light switches shall be installed at same positions to existing.

PAB 06.12 SWITCHGEAR

Switchgear, which includes circuit breakers, iron-clad switches, interlocked switchsocket outlet units, contactors, time switches, etc., is to be in accordance with the Quality Specifications which form part of this specification and shall be equal and similar in quality to such brands as may be specified.

For uniform appearance of switchboards, only one approved make of each of the different classes of switchgear mentioned in the Quality Specifications shall be used throughout the installations. Contractor to note that all switchgear to match existing and any other type shall be approved by site representative and/or engineer

PAB 06.13 SWITCHBOARDS

All boards shall be in accordance with the types as specified, be constructed according to the detail or type drawings and must be approved by the Engineer before installation.

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

Any construction or standard type aboard proposed, as an alternative to that specified must have the prior approval of the Engineer.

All busbars, wiring, terminals, etc., are to be adequately insulated and all wiring is to enter the switchgear from the back of the board. The switchgear shall be mounted within the boards to give a flush front panel. Cable and boxes and other ancillary equipment must be provided where required.
Clearly engraved labels are to be mounted on or below every switch. The working of the labels in English, is to be according to the lay-out drawings or as directed by the

Engineer's representative and must be confirmed on site. Flush mounted boards to be installed with the top of the board 2,0m above the finished floor level.

PAB 06.14 WORKMANSHIP AND STAFF

Except in the case of electrical installations supplied by a single-phase electricity supply at the point of supply, an accredited person shall exercise general control over all electrical installation work being carried out.

The workmanship shall be of the highest grade and to the satisfaction of the Engineer.

All inferior work shall, on indication by the Engineer's inspecting officers, immediately be removed and rectified by and at the expense of the Contractor.

PAB 06.15 CERTIFICATE OF COMPLIANCE

On completion of the service, a certificate of compliance must be issued to the Engineer's Representative/Agent in terms of the Occupational Health and Safety Act, 1993 (Act 85 of 1993).

PAB 06.16 EARTHING OF INSTALLATION

Main earthing

The type of main earthing must be as existing or required by the supply authority if other than the Engineers, and in any event as directed by the Engineer's representative, who may require additional earthing to meet test standards.

Alternatively or additionally earth rods or trench earths may be required as specified or directed by the Engineer's authorised representative.

Installations shall be effectively earthed in accordance with the "Wiring Code" and to the requirements of the supply authority. All earth conductors shall be stranded copper with or without green PVC installation.

Sub-distribution boards

A separate earth connection shall be supplied between the earth busbar in each subdistribution board and the earth busbar in the Main Switchboard. These connections shall consist of a bare or insulated stranded copper conductors installed along the same routes as the supply cables or in the same conduit as the supply conductors. Alternatively armoured cables with earth continuity conductors included in the armouring may be utilised where specified or approved.

Sub-circuits
The earth conductors of fall sub-circuits shall be connected to the earth busbar in the supply board in accordance with SANS 10142.

Non-metallic Conduit

Where non-metallic conduit is specified or allowed, the installation shall comply with the Engineer's standard quality specification for "conduit and conduit accessories".

Standard copper earth conductors shall be installed in the conduits and fixed securely to all metal appliances and equipment, including metal switch boxes, socket-outlet boxes, draw-boxes, switchboards, luminaires, etc. The securing of earth conductors by means of self-threading screws will not be permitted.

Flexible Conduit

An earth conductor shall be installed in all non-metal flexible conduit. This earth conductor shall not be installed externally to the flexible conduit but within the conduit with the other conductors. The earth conductor shall be connected to the earth terminals at both ends of the circuit.

Connection

Under no circumstances shall any connection points, bolts, screws, etc., used for earthing be utilised for any other purpose. It will be the responsibility of the Contractor to supply and fit earth terminals or clamps on equipment and materials that must be earthed where these are not provided.

Unless earth conductors are connected to proper terminals, the end shall be tinned and lugged.

PAB 07 INSTALLATION TECHNICAL DETAILS

PAB 07.01 NOTICES

The Contractor shall issue all notices and make the necessary arrangements with relevant authorities as may be required with respect to the installation.

PAB 07.02 ELECTRICAL EQUIPMENT

All equipment and fittings supplied must be in accordance with the attached quality specification, suitable for the relevant supply voltage, and frequency and must be approved by the Engineer's representative.

PAB 07.03 DRAWINGS

The drawings generally show the scope and extent of the proposed work and shall not be held as showing every minute detail of the work to be executed.

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

PAB 07.04 BALANCING OF LOAD

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

PAB 07.05 SERVICE CONDITIONS

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

PAB 07.06 SWITCHES AND SOCKET OUTLETS

The installation of switches and socket outlets must conform to clause PAB.06.11 of this specification.

PAB 07.07 EARTHING AND BONDING

The Contractor will be responsible for all earthing and bonding of the building and installation. The earthing and bonding is to be carried out strictly as described in clause PAB 09.16 of this specification and to the satisfaction of the Engineer's representative.

PAB 07.08 MAINTENANCE OF ELECTRICAL SUPPLY

All interruptions of the electrical supply that may be necessary for the execution of the work, will be subject to prior arrangement between the Contractor and the user Engineer and the Engineer's representative.

PAB 07.09 EXTENT OF WORK

The work covered by this contract comprises the complete electrical installation, in working order, as shown on the drawings and as per this specification, including the supply and installation of equipment and also the installation of such equipment supplied by the Engineer.

PAB 07.10 SUPPLY AND CONNECTION

The supply at the existing MCC is 400/230 Volt 50Hz.

The Contractor will be responsible for the supply and installation from MCC to new blowers and any other low-tension distribution board. The size and length of the cable is listed in the Schedule of Cables and measured in the Bills of Quantities.

PAB 07.11 CONDUIT AND WIRING

Conduit and conduit accessories shall be galvanised screwed conduit or galvanised plain end conduit in accordance with SANS 162, 763 and 1007 respectively.

All conduits, regardless of the system employed, shall be installed strictly as described in the applicable paragraphs of clauses 4 to 8 of Part 1 of the specification. Wiring of the installation shall be carried out as directed in clause 9 part 1 of this specification.

Where plain end conduit is offered all switches and light fittings must be supplied with a permanent earth terminal for the connection of the earth wire.

Lugs held by switch fixing screws or self tapping screws will not be acceptable.

PAB 07.12 POWER POINTS

Allow for the installation of power points and equipment as listed in the schedule, indicated on the drawings and described below:

PAB 07.13 CABLES

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

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

The cable-trenches shall be excavated to a depth of 1m deep below ground level and shall be 450mm wide for one to three cables, and the width shall be increased where more than three cables are laid together so that the cables may be placed at least two cable diameters apart throughout the run. The bottom of the trench shall be level and clean and the bottom and sites free from rocks or stones liable to cause damage to the cable.

The Contractor must take all necessary precautions to prevent the trenching work being in any way a hazard to the personnel and public and to safeguard all structures, roads, sewage works or other property on the site from any risk of subsidence and damage.
In the trenches the cables shall be laid on a 75mm thick bed of earth and be covered with a 150-mm layer of earth before the trench is filled in.

All joints in underground cables and terminations shall be made either by means of compound filled boxes according to the best established practice by competent cable jointers using first class materials or by means of approved epoxy-resin pressure type jointing kits. Epoxy-resign joints must be made entirely in accordance with the manufacturer's instructions and with materials stipulated in such instructions. Low tension PVCA cables are to be made off with sealing glands and materials designed for this purpose which must be of an approved make. Where cables are cut and not immediately made off, the ends are to be sealed without delay.

The laying of cables shall not be commenced until the trenches have been inspected and approved. The cable shall be removed from the drum in such a way that no twisting, tension or mechanical damage is caused and must be adequately supported at intervals during the whole operation. Particular care must be exercised where it is necessary to draw cables through pipes and ducts to avoid abrasion, elongation or distortion of any kind. The ends of such pipes and ducts shall be sealed to approval after drawing in of the cables.

Backfilling (after bedding) of the trenches is to be carried out with a proper grading of the material to ensure settling without voids, and the material is to be tamped down after the addition of every 150mm. The surface is to be made good as required.

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

Earth continuity conductors are to be run with all underground cables constituting part of a low tension distribution system. Such continuity conductors are to be stranded bare copper of a cross-sectional area equal to at least half that of one live conductor of the cable, but shall not be less than 4mm² or more than 70mm². A single earth wire may be used as earth continuity conductor for two or more cables run together, branch earth wires being brazed on where required.

PAB 07.14 LAYING, JOINTING AND MAKING OFF OF ELECTRICAL CABLES

[The requirements specified hereafter, are aimed essentially at high tension cable but are also valid for low tension cable, where applicable.]

The use of the term "Inspector" includes the Engineer or inspector of the Engineer or an empowered person of the concerned supervising professional team.

No cable is to be laid before the cable trench is approved and the soil qualification of the excavation is agreed upon by the Contractor and inspector.

After the cable has been laid and before the cable trench is back-filled the inspector must ensure that the cable is properly bedded and that there is no undesirable material included in the bedding layer.

No cable jointing will be permitted on this contract.

PAB 07.15 DISTRIBUTION BOARDS

The Contractor shall supply and install the distribution boards as indicated on the drawings and listed in the distribution Board Schedule. All distribution boards shall comply with this specification, and be approved by the Engineer's representative.

The following types of distribution boards are required for the service:

- Surface Mounted Distribution Panels (Namely: Motor Control Centre)

PAB 07.16 SCHEDULE OF DISTRIBUTION BOARDS

The front panels of normal supply, standby power and no-break supply sections shall be painted in distinctive colours as follows:

Normal supply : Light Orange, colour B26 of SANS 1091.
Standby power : Signal Red, colour A11 of SANS 1091.
No-break supply : Dark Violet, colour F06 or Olive Green, Colour H05 of SANS 1091.

Indicated is the probable fault level rating (kA) of the busbars. Refer to the Summary of Switchgear and Circuits for the minimum fault level rating of specified equipment.

BOARD	TYPE	PANEL	FAULT LEVEL	LOAD
FULL BUILDING MCC-1	Floor standing with doors	Normal power		

PAB 07.17 SCHEDULE OF CABLES, CONDUIT AND WIRING

Supply, install and connect the following cable, conduit and wiring:

FROM	TO	SIZE AND TYPE	LOAD (kW)
Main DB	MCC 1		
MCC1 Normal/ Standby	Chiller 1		
MCC1 Normal/ Standby	Chiller 2		
MCC1 Normal/ Standby	2x Supply fans		
MCC1 Normal/ Standby	3x Chilled water pumps		
MCC1 Normal/ Standby	AHU		

PAB 08 INSTALLATION DETAILS AND MEASUREMENT AND PAYMENT

PAB 08.01 INSTALLATION DESCRIPTION

Air condition plantroom upgrades supply power, MCC panels and related distribution cables

PAB 08.02 SCOPE OF WORK

1. Plant room
    - Decommission and disconnect existing MCCs to accommodate new works;
    - Supply and install new MCCs to feed new chiller units and associated equipment
    - Mechanical equipment as supplied by others
    - Supply and replace existing field equipment power and control cables

PAB 08.03 CABLE INSTALLATION

PAB 08.03.01 All low voltage 400V cables shall have stranded copper conductors, shall be of the 600/1 000V PVC/SWA/PVC/ECC type.

PAB 08.03.02 Tenderers are to note that some cables will be installed in trenches or routed in ceiling wire ways

PAB 08.03.03 Cables running on surfaces of walls shall be routed inside galvanised steel piping or cable ladders.

PAB 08.04 DISTRIBUTION BOARDS

PAB 08.04.01 Existing Distribution Boards

(a) Tenderers shall note that, all distribution boards shall remain safe at all times. Adequate provision for the installation of temporary 3mm Perspex faceplates shall be allowed in the tender rates.

PAB 08.04.02 New Distribution Boards

(a) The distribution board requirements are as shown on the schematic drawings. Note the 6 kA minimum fault level.

(b) Electrical Contractors are advised to order the distribution board and equipment from a reputable manufacturer, as inferior boards will not be accepted.

(c) It shall further be noted that late approval of drawings and distribution boards due to non-compliance with the specification will not relieve the Electrical Contractor from his obligations to complete the installation according to programme. No claims for delays or extension of time in this regard, will be entertained.

(d) All phase, neutral and earth busbars shall be adequately sized to accept all present as well as future circuits and connections.

(e) Door hinges shall be of good quality. The steel door shall be padlockable.

(f) The distribution board shall be powder coated

(g) The front face panel shall be secured by means of catches.
Catches with slots or square key formats will not be acceptable.

PAB 08.05 CONDUIT

PAB 08.05.01 Conduit work under open roof structures, along service passages and inside plant rooms shall be done on the surface in a rectangular grid pattern. Galvanized steel hospital saddles shall be used on all exposed conduit. Caddy clamps shall be used on roof purlins. Maximum spacing of saddles and clamps shall be 750 mm.

PAB 08.05.02 External draw box covers shall be sealed with white silicone after the installation has been completed.

PAB 08.05.03 Chasing on any concrete work will not be allowed.

PAB 08.06 OUTLETS

PAB 08.06.01 General

For the power installation, the Contractor shall be responsible for: -

(a) Supply and installation of isolators for equipment, motors including wiring, earthing and bonding.
(b) Final connection between isolator and equipment/motor.
(c) Supply and replacement of 16A switch socket outlets.
(d) Wiring of all circuits back to the DB with SABS approved wire as specified in the schedule of quantities.
(e) Labelling of all outlets as specified.
(f) Testing and commissioning of all circuits.

PAB 08.06.02 Isolators

(a) Isolators shall be good quality as approved by the engineer.
(b) The isolators shall be the water resistant, surface mounted type installed in a non-corrosive enclosure

(c) The enclosure shall bear a permanently fixed (screwed) engraved label indicating the DB and circuit number.

PAB 08.07 WIRING

PAB 08.07.01 Surfix or Norse cable shall not be accepted on this project.

PAB08.07.02 All circuits shall be wired from fresh unused coils of red, white, blue and black conductors. The colours of conductors shall correspond to the phase from which that circuit is fed. The use of insulation tape to indicate phases will not be accepted.

PAB 08.07.03 Wiring shall not be drawn into conduit until the conduit installation has been completed, fitted with bushes and all moisture and debris have been removed.

PAB 08.07.04 Joints of any kind will not be permitted in wiring. No more than 2 single or 1 three phase circuit may be drawn into any 20mmø conduit.

PAB 08.08 EARTHING AND BONDING

PAB 08.08.01 The electrical contractor is to ensure that the installations covered in this document are effectively earthed and bonded in accordance with the requirements of the SANS 0313.

PAB 08.08.02 Particular attention shall be paid to motor bonding and earthing.

PAB 08.08.03 The earth conductor linking adjacent or back-to-back socket outlets shall not be cut. The conductor must be kept continuous and be doubled at the intermediate earth terminals.

PAB 08.09 LABELLING OF CIRCUITS

PAB 08.09.01 All conductors shall be marked by suitable cable markers indicating the circuit (e.g. P1 or G1 on both line and neutral conductors).

PAB 08.09.02 The label shall indicate the supply DB and circuit number (e.g. DB-M-P5).

PAB 08.10 INSPECTIONS

PAB 08.10.01 The Electrical Engineer's or Client's representative will inspect the installation at any time. All inferior, unsuitable, unacceptable or rejected work shall, if indicated by the inspecting officers or the Engineer, be removed and shall be rectified by the electrical contractor at his own expense. Under no circumstances will these inspections relieve the electrical contractor of his obligations in terms of the document nor will these inspections be regarded as final approval of the works or portions thereof.

PAB 08.10.02 Where inspections are requested by the Contractor, the Electrical Engineer's or Client's inspection shall only be carried out after the Contractor has carried out his own preliminary inspection to ensure that the Works are completed and comply with the documents. The Electrical Engineer's or Client's inspection shall therefore not be regarded as supervision, fault listing, quality assurance or site management.

PAB 08.10.03 Servicing of Distribution boards and cabling

(a) Service distribution boards: inspect and clean the distribution boards, treat the enclosure for moisture ingress and corrosion.
(b) Check for rigidity and fastening of equipment trays, panels, doors and handling devices.
(c) Check locking mechanism and fit padlock. All padlocks shall be of local manufacture with brass bodies and 75 mm chrome shackles. Three keys (with pvc labels) shall be provided for each lock.
(d) Replace damaged or missing faceplates, doors, mounting frames, handles, thumb catches, etc.
(e) Check operation of distribution board equipment and meters, replace if faulty or damaged with an approved type.
(f) Remove all obsolete equipment and meters.
(g) Check and fasten wiring and cable terminations.
(h) Re-arrange wiring and equipment to give a neat installation.
(i) Trace outgoing circuits.
(j) Fit labelling and blank face-plate covers.
(k) Replace the distribution boards if required and replacement is approved by Engineer. Check earth bar and earth continuity, record.
(l) Label all wiring and cabling with PVC markers.
(m) Replace all circuit breakers that are rated below 5 kA.

PAB 08.10.04 Power outlets and fixed appliances

Note: All power outlets shall have steel faceplates with permanent glued labels.

(a) Inspect all power outlets and verify earthing.
(b) Check contact points and tighten screws.
(c) Replace missing screws and covers for outlet and draw boxes.
(d) Replace missing, faulty or damaged socket outlets and plugs.
(e) Check conditions and operation of local isolators and control switches for fixed equipment and replace if faulty, damaged or missing.
(f) Check earthing of fixed appliances and test for earth continuity.
(g) Inspect cable and wireways.
(h) Check for rigidity and fastening of the cable ducts, ladders, ducting, powerskirting and surface conduiting, fasten or replace if loose or damaged, check earthing and test for earth continuity.

PAB 08.11 MEASUREMENT AND PAYMENT

PAB 08.11.01 Service distribution board No

The unit of measurement shall be the number of distribution kiosks or boards opened and serviced as specified.

The tendered rate shall include full compensation for the opening of the distribution board or kiosk, internal cleaning of the enclosure, cleaning of equipment and meters, removal of obsolete distribution board equipment, re-arrangement of equipment and wiring, treatment of the enclosure for moisture ingress and corrosion, vermin protection, fastening and / or replacement of wiring, tracing of outgoing circuits, labelling of outgoing wiring and mcb's and cable terminations and earth testing.

The tendered sum shall further include for replacement of damaged, missing or faulty distribution board switchgear, meters, face plates, mounting frames, handling devices, doors, labelling with engraved labels, neutral bars, earth bars etc. All downstream circuit breakers shall be rated at 6 kA fault level.

PAB 08.11.02 Supply and install distribution board No

The unit of measurement shall be the number of distribution boards supplied and installed.

The tendered rate shall include full compensation for the supply and installation of an epoxy painted new enclosure, mounting frames, plates, equipment, meters, labelling etc.

The tendered sum shall further include for wiring of the board, cable termination, cable labelling, remedial builders work and earth testing.

PAB 08.11.03 Supply and install cabling m

The unit of measurement shall be the linear length of cable supplied and installed.

The tendered rate shall include full compensation for the supply, handling, installation and termination of the specified type of cable.
This rate shall further include for the supply of all cable ties, clamps and other material necessary to ensure that the installation conforms to the specification.

PAB 08.11.04 Supply and install wiring m

The unit of measurement shall be the linear length of conductors supplied and installed.

The tendered rate shall include full compensation for the supply, handling, installation, pulling in conduit and termination of the specified type of conductor.

This rate shall further include for the supply of all cable ties, labelling, and other material necessary to ensure that the wiring conforms to the specification.

PAB 08.11.05 <u>Jointing and termination of cables</u> No

The unit of measurement shall be number of cable joints or terminations.

The tendered rate shall include full compensation for the cost for providing the kits, complete with compound, ferrules and cable lugs, the cost for cutting the cable, handling and fitting kits and the cost of testing the joints and terminations. Position of joints shall be indicated on as-built drawing

PAB 08.11.06 <u>Supply and install padlocks</u> No

The unit of measurement shall be number of padlocks supplied and installed.

The tendered rate shall include full compensation for the ordering, supply and installation of the 75 m locally manufactured padlocks and locking devices as well as fitting each of the three keys with purpose-made pvc labels.

PAB 08.11.07 <u>Excavate in all materials for trenches, backfill, compact and dispose of surplus material</u> m^3

The unit of measurement shall be the cubic meter of material excavated in trenches.

The tendered rate shall include full compensation for clearing and grubbing the trench areas, for excavating the trench, preparing the bottom of the trench, separating material unsuitable for backfill and dealing with any surface or subsurface water.

The tendered rate shall furthermore cover the cost of installing the sand bed and sand cover, backfilling, compacting and disposing of the surplus material.

PAB 08.11.08 <u>Termination of the low voltage cable</u> No

The unit of measurement shall be the number of low voltage cable terminations.

The tendered rate shall include full compensation for providing the cable glands and shrouds, the cost for handling, fitting and cutting the cable.

PAB 08.11.09 <u>Supply and install earth continuity conductor</u> m

The unit of measurement shall be the linear length in meter of the earth continuity conductor supplied and installed.

The tendered rate shall include full compensation for procuring, furnishing and laying the specified earth continuity conductor.

PAB 08.11.10 Termination and connect earth continuity conductor No

The unit of measurement shall be the number of earth continuity conductors terminated and connected.

The tendered rate shall include full compensation for supplying all the material required to terminate and connect the earth continuity conductors and the connecting thereof to the earth bars, including label tags.

PAB 08.11.11 Supply and installation of circuit breakers No

The unit of measurement shall be the number of circuit breakers supplied and installed.

The tendered rate shall include full compensation for the supply and installation of the specified type and size of circuit breaker, including printed PVC labelling.

PAB 08.11.12 Supply and installation of isolators No

The unit of measurement shall be the number of isolators supplied and installed.

The tendered rate shall include full compensation for the supply and installation of the specified isolator, including printed PVC labelling.

PAB 08.11.13 Supply and install contactors No

The unit of measurement shall be the number of contactors supplied and installed.

The tendered rate shall include full compensation for the supply and installation of the specified type of contactor, including engraved labelling on rear tray.

PAB 08.11.14 Supply and install switching timers No

The unit of measurement shall be the number of switching timers supplied and installed.

The tendered rate shall include full compensation for the supply and installation of the specified type of switching timer, including labelling.

PAB 08.11.15 Supply and install earth leakage units No

The unit of measurement shall be the number of earth leakage units supplied and installed.

The tendered rate shall include full compensation for the supply and installation of the specified type of earth leakage units, including labelling.

PAB 08.11.16 Supply and install fuses No

The unit of measurement shall be the number of fuses supplied and installed.

The tendered rate shall include full compensation for the supply and installation of the specified type of fuse, including engraved label indicating fuse rating.

PAB 08.11.17 Supply and install surge arrestors No

The unit of measurement shall be the number of surge arrestors supplied and installed.

The tendered rate shall include full compensation for the supply and installation of the specified type of surge arrestors, with visual indication.

PAB 08.11.18 Supply wire marker kit No

The unit of measurement shall be the number of specified wire marker kits supplied.
The tendered rate shall include full compensation for the procurement and delivery of the cable marker kit as specified.

PAB 08.12 SMALL POWER AND FIXED APPLIANCES

PAB 08.12.01 Supply and install socket outlet No

The unit of measurement shall be the number of socket outlets supplied and installed.

The tendered rate shall include full compensation for the removal of the existing socket outlet and the supply and installation of the specified type of socket outlet.

All socket outlets shall be supplied complete with cover plates and boxes where required. The tendered rate shall therefore include for the supply of the cover plates and fixing screws where applicable. Outlet face plate shall be fitted with an engraved, label as per standards, cost of, which is included in the rate.

PAB 08.12.02 Supply and install isolator No

The unit of measurement shall be the number of isolators supplied and installed.

The tendered rate shall include full compensation for the supply and installation of the specified type of isolator or control unit.
The tendered sum shall further include for the provision of 4 wire, 3 phase connections to the fixed appliance. Isolator face plate shall be fitted with an engraved label as per standards, cost of, which is included in the rate.

PAB 08.12.03 Replace plug tops No

The unit of measurement shall be the number of plug tops replaced.

The tendered rate shall include full compensation for the supply and installation of the required type of plug top.

PAB 08.12.04 Supply and install conduit m

The unit of measurement shall be the linear meter of conduit supplied and installed.

The tendered rate shall include full compensation for the supply and installation of the specified type and size of conduit, including all fixing accessories.

PAB 08.12.05 Supply and install wiring channel m

The unit of measurement shall be number of linear meter of wiring channel replaced.
The tendered rate shall include full compensation for the supply and installation of the specified type of wiring channel with 6 x 60 mm fasteners, including the cover and all the necessary accessories.

PAB 08.12.06 Supply and install connections to fixed appliances No

The unit of measurement shall be number of connections made.

The tendered rate shall include full compensation for the supply and installing of the connections to the fixed appliances.

PAB 08.12.07 Service socket outlet No

The unit of measurement shall be the number of socket outlets opened and serviced.

The tendered rate shall include full compensation for the servicing of the socket outlet, internal cleaning of the enclosure, inspection of the contact points, switching mechanism, if applicable, earthing, etc. Outlet face plate shall be fitted with an engraved, label as per standards, cost of, which is included in the rate.

The tendered sum shall further include for replacement of any missing outlet covers and fixing screw and earth testing.

PAB 08.12.08 Service isolator No

The unit of measurement shall be the number of isolators opened and serviced.

The tendered rate shall include full compensation for the servicing of the isolator, internal cleaning of the enclosure, inspection of the contact points, switching mechanism, earthing and connections to the fixed appliance. Isolator face plate shall be fitted with an engraved label as per standards, cost of, which is included in the rate.

The tendered sum shall further include for replacement of any damaged or missing outlet covers and fixing screw, connections to appliances including earth continuity testing.

PAB 08.12.09 Replace power skirting m

The unit of measurement shall be the linear metre of power skirting supplied and installed.

The tendered rate shall include full compensation for the removal of the existing power skirting, the supply and installation of the specified type and size of powerskirting including all accessories.

PAB 08.12.10 Supply and install Pratley boxes No

The unit of measurement shall be the number of Pratley boxes supplied and installed.

The tendered rate shall include full compensation for the supply and installation of the specified type of Pratley box.

PAB 08.12.11 Supply and install draw boxes No

The unit of measurement shall be the number of draw boxes supplied and installed.

The tendered rate shall include full compensation for supplying and installing the draw boxes including cover plates where no equipment is installed in the box.

PAB 08.12.12 Supply and install draw box cover plates No

The unit of measurement shall be the number of draw box cover plates supplied and installed.

The tendered rate shall include full compensation for the supply and installation of the specified type and size of cover plates for draw boxes including the fixing screws.

PAB 08.12.13 Replace "stop-start" local control panel No

The unit of measurement shall be the number of "stop-start" local control panels supplied and replaced.

The tendered rate shall include full compensation for the supply and installation of "stop/start" local control panel including emergency stop button and 32A 3 pole contactor in an IP55 polycarbonate enclosure. The rate shall include an engraved label indicating load and supply DB.

PAB 08.12.14 Provide Certificate of Compliance sum

The unit of measurement shall be a sum for all Certificate of Compliance obtained from local authorities and issued to the Engineer for all the buildings under the installation.

The tendered rate shall include full compensation for the testing and all associated equipment to complete the Certificate of Compliance and certification thereof.

PAB 08.13 EARTHING AND BONDING

PAB 08.13.01 Supply and install earthing and bonding for the installation

Lump sum

The tendered lump sum shall include full compensation for the provision of all material required for the earthing and bonding of the installation in accordance with the specification.

PAB 08.13.02 Testing of the earth installation by a specialist contractor

Lump sum

The tendered lump sum shall include full compensation for the testing of the earth installation by a specialist contractor approved by the Engineer.

PAB 08.14 INSPECTION OF ELECTRICAL INSTALLATION

PAB 08.14.01 Inspection of building general electrical installation sum

The unit of measurement shall be the sum for the building inspected prior to commencement of the repair work phase.

The tendered sum shall include the visual and functional inspection and testing of all lights, switches, small power points and fixed appliances, to determine the extent of repairs or replacements required.

The rate shall further include the preparation of a schedule of items requiring repairs or replacement, for approval by the engineer.

PAB 09 MAINTENANCE OF THE INSTALLATION

PAB 09.01 Monthly maintenance responsibilities for each installation including all units and components as specified, shall commence with access to the site. A difference shall be made in payment for the maintenance prior to and after practical completion of repair work. The contractor will as part of his maintenance obligations service all the equipment as part of his maintenance obligations at the start of the contract.

Maintenance responsibilities of the completed installation shall commence upon the issue of a certificate of practical completion for repair work, and shall continue for the remainder of the contract period.

PAB 09.02 The following maintenance actions will be required under this contract:

PAB 09.02.01 Routine Preventative Maintenance

PAB 09.02.02 Corrective Maintenance

PAB 09.02.03 Breakdown Maintenance

These actions are defined in the Additional Specification SA – General Maintenance.

PAB 09.03 The maintenance schedules and frequency of maintenance activities shall be developed under the maintenance control plan which will be instituted by the Contractor. The Contractor's responsibility in this regard is specified in the Additional Specification SA – General Maintenance.

PAB 09.04 SCOPE OF ROUTINE PREVENTIVE MAINTENANCE

The routine maintenance work to be performed and executed shall include, but not be limited to the items listed below. These actions and findings shall be logged and reported on the relevant approved schedules and reports.

PAB 09.04.01 Monthly maintenance

(a) Check operation of protective and monitoring devices.
(b) Verify operation of switching elements and meters.
(c) Check lamp operation
(d) Measure phase voltages and currents in distribution boards and record values in Record book
(e) Inspect and repair the following:

(i) any visible damage to the installation
(ii) setting of protective and monitoring devices
(iii) ensure presence of diagrams, instructions and similar information
(iv) ensure upkeep of the labelling of the distribution board, equipment, cabling and wiring
(v) ensure presence of Nosa-type engraved labelling on face plates or bodies of light switches, socket outlets and isolators.

PAB 09.04.02 Annual maintenance

(a) Service all luminaires, distribution boards, socket outlets, isolators, light switches, etc.

(b) Carry out all tests listed under section PAB 03 above and record values in the Record book

(c) Witnessed testing of all earth leakage protection units on all socket outlet units.

(d) Visually inspect the following and repair if required:

(i) connection of cables and conductors including earthing and bonding.

(ii) presence of appropriate devices for isolation and switching.

(iii) correct connection of socket outlets, light switches, isolators, lampholders, etc.

PARTICULAR SPECIFICATION

PEI SCADA AND CONTROL EQUIPMENT

PEI 1 QUALITY CONTROL AND SCOPE

The scope of supply of the control and instrumentation works of this contract shall be for the supply, delivery, safe storage on site before installation, installation, testing and commissioning of the process monitoring and control instrumentation systems as listed in the bill of quantities.

The scope of supply shall include the following:

- The supply and installation of field instrumentation/ equipment.
- The supply and installation of power and signal cabling between the equipment, motor starters and the relevant motor control centres and PLC Panel.
- Supply and installation, software programming and system integration of all PLC's and the SCADA system.
- Supply and installation of fully programmed SCADA system for monitoring and control of air condition plantrooms process. The Mechanical Engineer will provide control philosophy for the entire system and the specialist contractor to provide a complete and fully operational system
- Supply and installation of instrument power distribution panels.
- Supply, installation and commissioning of the Industrial Ethernet communication system integrating each plantroom with the Plant Manager's control office.

PEI 2 STANDARD SPECIFICATIONS

The latest edition, including all amendments up to date of tender, of the following specifications, publications, and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

SANS 61326: 2003	Electrical equipment for measurement, control and laboratory use - EMC requirements
SANS 61326-1: 2007	Electrical equipment for measurement, control and laboratory use - EMC requirements Part 1: General requirements

SANS 61326-2-1: 2009		Electrical equipment for measurement, control and laboratory use - EMC requirements Part 2-1: Particular requirements – Test configurations, operational conditions and performance criteria for sensitive test and measurement equipment for EMC unprotected applications
SANS 61326-2-3:2009		Electrical equipment for measurement, control and laboratory use - EMC requirements Part 2-3: Particular requirements – Test configuration, operational conditions and performance criteria for transducers with integrated or remote signal conditioning
SANS 60529: 2013	-	Degrees of protection provided by enclosures (IP Code) (Replaced withdrawn SABS 1222).
SANS 60044-3: 2004		Instrument transformers Part 3: Combined transformers

PEI 2.1 Occupational health and safety act of 1993

All regulations and statutory requirements as lay down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) shall be adhered to.

PEI 2.2 Manufacturers' specifications, codes of practice and installation instructions

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions, and codes of practice.

PEI 2.3 Municipal regulations, laws, and by-laws

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

PEI 2.4 As-built information and operating and maintenance manuals

The Contractor shall be responsible for the compilation of an inventory and operating and maintenance manuals.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals.

PEI 3 PLC AND SCADA SYSTEMS

The PLC, HMI and SCADA software shall be programmed in such a manner that no password protected function blocks be utilised in the development of the operating code. Complete access to all elements within the programming code is required for all the PLC's, HMI's and the SCADA system. All passwords protecting the set points and other controls shall be property of Department of Public Works and Infrastructure (DPWI) after commissioning of the system
Standard OEM provided function blocks may be used for motors, analogue values, PID blocks and digital drives.

PEI 3.1 PLC System

All plant areas PLC's shall be based on the latest modular equipment and pre-programmed and supplied with each Chiller unit.

PEI 3.2 PLC Programming

- The software programming package must be provided and licensed to DPWI as from the time of installation.
- The access to the software for viewing programming or any required intervention may not be restricted by password protection or any other means. This is applicable to all the software, any part thereof and any associated or complementary system.
- Standard programming functions blocks for a specific application from the relevant supplier must be used where possible in accordance with IEC611313. Where this is not possible or practical programming should be done in accordance with current industry standards, standard good practice and IEC61131-3 as a guideline.

PEI 3.3 PLC Diagnostics

The PLC shall include extensive diagnostics that include the following:

- Memory operation
- Controller failure
- Communications
- Report communication statistics, a number of attempts verse number of retries etc
- Report the operating condition of both primary and backup or redundant systems

PLC diagnostic displays, the Contractor shall develop PLC diagnostic and information displays for the chilled water system SCADA system process HMI. The diagnostic displays shall follow the HMI/PLC variable naming convention and display the

following for each PLC. The displays shall include a summary overview display and detailed display of each PLC.

- PLC failure.
- Battery failure.
- Loss of communication.

PEI 3.4 Human Machine Interface (HMI) & SCADA System

Each area equipped with a PLC shall be equipped with a 15 inch HMI. The HMI shall be mounted on the front of the PLC panel. The Contractor shall be responsible for the development of all HMI screens software and the translation of the operational philosophy into the control programme to enable operation of the plant from the HMI. The contractor present an FDI to the consultants with screen downloads prior to loading it to the plc/hmi/scada systems during a HAZOP meeting.

PEI 3.5 SCADA Systems

The Contractor shall be responsible for the supply, installation, and development of an SCADA system enabling each plant visualisation and control. The developed multiscreen must provide monitoring and control of the complete plant from the SCADA system. Work must include but not limited to design, furnishing, installing, programming, testing, documenting, training and stating up process instrumentation and control applications software for a complete system. The SCADA system must conform to the following points:

3.5.1 Mimic screens provided for the SCADA shall be the equivalent of the main PLC HMI where possible. If this is not possible the Mimic screens for the SCADA shall be similar to the sample's provided by DPWI. In both cases subject to all the other conditions as detailed in this section.

3.5.2 Minimum SCADA PC requirements:

- Processor: i7, 2.1 GHz
- Operating System: Windows 10 Professional, with the latest service packs.
- Memory : 8 GB RAM
- Hard Disk: SSD 500 GB minimum.
- Display: 27 Inch Monitor, with 1920x1080 or higher-resolution video adapter and monitor.
- Network Card: Minimum 100Mb/s.
- Other software requirements: NET Framework 3.5. Microsoft SQL Server 2008 Express. Microsoft Excel 2010.

3.5.3 The system shall be an industrial type stand-alone floor standing desk with all items built-in on racks below the monitoring desk. The access to the software for viewing programming or any required intervention monitoring may not be restricted by password protection or any other means. This is applicable to all the software any part thereof and any associated or complementary system. However, the access of all control related programming and changing of set points shall be restricted by means

of the password to prevent unnecessary changes to the aeration control philosophy. All passwords shall be the sole property of DPWI and shall be handed to the client upon compression of commission stage.

3.5.4 The SCADA system shall have a means of storing historic data that may be recalled and reviewed at a later stage. This data shall be archived and exported from the SCADA system as .CSV file (Comma Separated Variable). These may include set point deviations, critical/emergency alarms, every action/event that occurs within BACS, LCPs and field instruments.

3.5.5 Alarm functions shall also be integrated into the system by graphical display within their respective location on the mimic display. These shall have the capability to be tied into auto-paging and auto-phone-dialling features that will automatically notify operating personnel of the problem. Alarms that are self-cleaning due to the small set-point deviation or non-critical process change may not be necessary for auto phone-dialling. Provision for diagnostic functions shall also be provided

Functional Elements

- The system shall comply with the following functionality and capabilities. All complies with specification PFM - Motor Control Centres and Automation
- Shall communicate and mimic the Chiller LCP with all elements and all information which is displayed on the Chiller LCP HMI shall be duplicated to the Control SCADA computer.
- Field instruments information such as status, input / outputs, normal and abnormal conditions.
- Field instruments such as valve actuators, flow transmitters/meters, sensors etc.
- Shall not be confused when a single plant item is switched between Manual and Automatic mode
- Shall comply with any drawings issued by client/engineer. Any discrepancies shall be brought to the engineer's attention before approval of final delivery of the system.
- A GSM system will be allowed for to be fitted to the PLC and transmit selected alarms and status to the Facilities Management cellular phone(s).

PEI 3.6 SCADA/HMI Application Software Design

Develop a SCADA software design to convey plant accurate information to site staff so they can make informed process control decisions and provide the platform to execute the control decisions. The following outlines key objectives in designing the SCADA HMI graphics.

- Easily navigated menus
- Touch screen control or mouse operated display
- Accurate representation of system
- Represent control option in an easily understood manner

- Develop help screens to provide additional information to assist the operations staff understands the control options where complex operations are required.
- Where possible, the design overview must display similar to the physical layout of the plant
- Provide administrator access to process and alarm set-points, including the following
    - Process alarm
    - Critical equipment controls set-points
    - Process timer set-points
    - Sequence set-points for volume, level, time, etc

The designer must ensure that the graphic displays are organized into a consistent homogeneous hierarchy.

The following briefly describes the intent of each of the four levels of display.

1. Level 1—System Overview(s):
    - The system overview(s) show major processes and facilities.
    - These overview displays shall show the essential process data, such as alarm status, and major equipment status on a system-wide basis, but provide no equipment or system control.
    - The system overview(s) display provide the means to see each system such as the entire plant (plantroom associated elements only) or all filters for a given plant on a physical layout map.

2. Level 2—Unit Process Overviews:
    - Unit process overviews are full sized screens.
    - The unit process overviews show primary process data on unit processes, unit operations, equipment status, or system status, etc. As a general rule no control strategies are implemented through the unit operations overviews. The unit operations overview provides the means to page to control displays.
    - The general rule is to show enough status and system data information that gives operations staff a good general feel on how the individual processes are currently operating. It also provides a launching pad to access control information associated with the individual processes.
    - Examples of unit process overviews are individual pump stations, individual chemical systems, and storage facilities.

3. Level 3—Control Displays:
    - Control displays can be full screen or pop-up windows and are used for system level control and equipment level control.

- Control displays provide the means to monitor and provide supervisory control of specific process operations such as pump stations, specific pumps, compressor, etc. Depending on th complexity of the specific process there may be several levels of displays. Control of each piece of equipment on individual unit operation control displays is possible.
- Supervisory Control System:

  The objective of the SCS design approach is to implement all supervisory control of the system and its process and control strategies from the control displays. The control strategies include the following functions:

  - System level control, such as control loops, and sequences, etc.
  - Equipment level control, such as a pump start/stop control.
  - Detailed monitoring of sequence steps and general information messages for status.
  - Important alarm messages.
  - Paging between related displays.
  - Paging between related processes.
- Pop-Up Windows:
  - Pop-up windows provide the capability to control systems and equipment without cluttering the overview or control display. The following illustrates the configuration of a typical pop-up window.
  - The typical pop-up window provides the following functions:
    - Status monitoring of equipment being controlled.
    - Operating mode.
    - Manual mode selection.
    - Start/Stop control in manual.
    - Auto mode selection.
    - Failure reset.
    - Equipment description.
    - Control for displaying the equipment number.

4. Level 4—Data Entry and Trend Displays:

- Data entry displays are designed specifically for data entry purpose. Operators enter process set-points, equipment control setpoints (such as lead-lag pump start/stop setpoints), alarm setpoints, etc.

Upon completion of the draft design parameters, the software supplier shall set up a meeting with the Client and Engineer at least two weeks in advance for review / discussions / changes / approval and to ensure graphic programming and display preferences are understood and agreed upon before starting final programming and configuration.

Design products and topics to be discussed and finalized:

- SCADA integration.
- Time synchronization.
- Tag group naming convention.
- SCADA and historian tag naming conventions.
- Overview HMI displays design.
- Generation and testing of standard HMI screen resolutions. Test graphics at different resolutions on all types of displays to be provided to ensure screen resolution selected is acceptable for field panels, client machine displays, and large screen displays.
- Process graphics.
- Display paging and navigation.
- Dynamic Objects: Chillers, Pumps, valves, gates, compressors, etc.
- Equipment controls through popup windows.
- Loop control through popup windows.
- Display philosophy, organization, and operation.
- General data entry through the SCADA HMI.
- Use of tool tips.
- Colour graphic standards, symbol standards, etc.
- Dynamic Objects: Chillers, Pumps, compressors, valves, gates, controller faceplates, process indicators, indicators with alarms, data entry, controller face plate, dampers, aerator, chemical feed pump, mixers.
- Security.
- Alarm Management: Operation of the alarms, alarm areas, alarm filtering, including GSM support
- Trending.
- Historical data storage and retrieval.
- Variable naming conventions.

- Scripting.
- Tag group file naming convention.
- Display files naming convention.

The design and requirements of SCADA software shall not be limited to above information only. Contractor shall discuss with Client and Engineer with relevant items he wishes to include in the system

PEI 3.7 Ethernet Backbone System

Communication between the PLC's, HMI's and the SCADA system shall be by Industrial Ethernet. The Ethernet link between the areas of the plant and the control room shall be achieved by Cat 6 or higher cable.

- Profinet / Modbus / Bacnet network protocol to communicate between Chiller LCP and Control SCADA Computer.
- Data communication shall be provided between the PLC's, located in each LCP, and the Control SCADA computer. This compatible interface shall be the responsibility of the systems integrator; however, the Manufacturer shall actively participate in this compatible interface
- Each area equipped with a PLC shall be equipped with an Ethernet switch. The Ethernet switch must have a mix of copper ports (and fibre ports if necessary)
- The communication and network protocol required is Industrial Ethernet. Communication between the PLC and all local intelligent devices including motor protection units, variable frequency drives, and HMI screens must be Industrial Ethernet (Profinet or otherwise proposed).
- All wires must be enclosed in trunking and where possible equipment mounted on din-rail.
- Field cabling shall be bottom entry via removable gland plates.
- The PLC cabinet shall be equipped with a removable chassis plate. The PLC racks shall be installed on this chassis plate. All PLC input and output circuits, including spares, shall be wired to the marshalling terminals.
- The PLC equipment and the cable marshalling must be in separate panels.
- All power supply terminals shall be fused with blown fuse indication.
- All digital inputs shall be 24VDC unless otherwise specifically sated elsewhere.
- All digital outputs shall be relay outputs.
- The terminals, wiring, and cabling for the digital and the analogue I/O must be installed in separate wire ways.
- All the PLC I/O, including spares, must be digital via fibre optics.
- All wiring diagrams and shop drawings shall be submitted to engineer for approval before building commences

PEI 3.8 Uninterruptible Power Supply (UPS)

Each PLC shall be supplied via an uninterruptible power supply. The power supply shall be capable of maintaining the supply to the PLC and associated instrumentation for a period of one hour.

The UPS must be a transformer based unit with extendible battery capability as detailed by the electrical specification.

PEI 3.9 Software Testing and Approval

All PLC, HMI and SCADA software shall be developed in accordance with the issued functional specification. Allowance must be made for factory acceptance testing (FAT) of the complete control system. This shall include testing of all interlocking, sequencing, alarms, trending, totalising and network functionality.

All IO shall be simulated during the FAT. PLC CPU's must be used during the FAT with interconnection as per the proposed network layout.

PEI 4 TESTING AND COMMISSIONING

PEI 4.1 Test to be performed

- All instrumentation shall be subject to the commissioning tests as described in the applicable specification
- The operating point of each pump, fan, chiller and all equipment shall be determined off site, and shall be confirmed and calibrated on site through the commissioning of instrumentation.
- Efficiency tests shall be performed

PEI 4.2 Process operating points of control

During the day 1 commissioning tests the duty point of mechanical equipment shall be determined by observing the following:

- Flow rates calculated from manual measurements compared to automatic gauging
- Manual level measurements of tanks compared to automatic tank gauging,
- Dissolved oxygen concentration, Oxidation Reduction Potential and pH, as determined by instrumentation against calibrated hand-held equipment.
- Electric motor power consumption (Amps and Voltage).

If no efficiency tests are required, then the motor power consumption shall be calculated from the voltage and current measurements obtained during the commissioning test.

The Contractor shall supply the necessary adaptors, fittings and pressures gauges, hand held field instruments to measure the accuracy of installed instrumentation.

PEI 5 PROJECT PARTICULARS

Project particular detail shall be included in the Pipe and Instrumentation Diagrams, and detailed in the Bill of Quantities.

PEI 6 MEASUREMENT AND PAYMENT

PEI 6.1 Supply, delivery, and installation of equipment ..... Unit: number

The unit of measurement shall be the number of instruments and other equipment units supplied, delivered and installed.

The tendered rates shall include full compensation for the design, manufacture, patent rights, pre-delivery testing and test certificates, transport for delivery to site and off-loading, including all handling of the equipment. The equipment shall include the following:

- The hardware complete with power supply
- Electrical power supply cables
- Installation of the mounting assemblies
- Configuration of controllers, timers and devices for automation of equipment ▪ Junction boxes
- Routing and fastening of the power cable up to the isolator box
- All required installation materials, labour and consumables to render a complete and working installation.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

PEI 6.2 Supply, delivery, and installation of software ..... Unit: number

The unit of measurement shall be the number of software packages supplied, delivered and installed.

The tendered rates shall include full compensation for the design, program, patent rights, pre-delivery testing and test certificates, transport for delivery to site and installing, including all configuration handling of the software.

PEI 6.3 Testing and commissioning of equipment… ……Unit: number

The unit of measurement shall be the number of instrumentation units tested and commissioned.

The tendered rates shall include full compensation for the site handling and positioning of the equipment, including the fastening of the equipment in its designated position.

The tendered rates shall include full compensation for all preliminary tests, efficiency tests if required and commissioning tests. Commissioning tests shall comply with the section dealing with testing and commissioning.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

PEI 6.4 **Compilation of wiring diagrams** ..... Unit: number

The unit of measurement shall be the number of wiring diagrams compiled.

The tendered rates shall include full compensation for drawing, printing, computer time and any other associated costs necessary for the compilation of a wiring diagram.

PEI 6.5 **Reconditioning of telemetric systems** ..... Unit: number

The unit of measurement shall be the number of telemetric systems reconditioned.

The tendered rates shall include full compensation for replacement of components and materials and for tools, transport, site handling and labour necessary for the complete reconditioning/repair of all components of the telemetric system.

PEI 7 DOCUMENTATION

PEI 7.1 Document Requirement List

SECTION	DESCRIPTION	REQUIRED (YES OR NO)	WHEN REQUIRED
DESIGN	BASIC DESIGN DRAWINGS & INFORMATION	YES	ORDER + 3 WEEKS
	CONTROL PHILOSOPHY	YES	ORDER + 6 WEEKS
	FUNCTIONAL SPECIFICATION	YES	ORDER + 6 WEEKS
	INSTRUMENTATION LIST	YES	ORDER + 6 WEEKS
	LOOP DRAWINGS	YES	ORDER + 6 WEEKS
	SCHEMATIC DRAWINGS	YES	ORDER + 6 WEEKS
	LAYOUT DRAWINGS	YES	ORDER + 6 WEEKS
	QUALITY CONTROL PLAN	YES	ORDER + 3 WEEKS
QUALITY CONTROL	MANUFACTURING PROGRAM	YES	ORDER + 6 WEEKS
	TEST CERTIFICATE	YES	DATA BOOK
CERTIFICATES OF INSPECTION	PERFORMANCE TEST CERTIFICATE	YES	DATA BOOK
	VENDORS CERT. OF CONFORMANCE	YES	DATA BOOK
	NONCONFORMITY / CONCESSION REPORTS	YES	DATA BOOK
	OPERATING / MAINTENANCE MANUAL	YES	DATA BOOK
MANUALS	DATA BOOK	YES	DELIVERY
	DRAWINGS	YES	AS BUILT
	CONTROL PHILOSOPHY	YES	AS BUILT
	FUNCTIONAL SPECIFICATION	YES	AS BUILT
	PROGRAMS	YES	AS BUILT

PEI 7.3 Test Certificate Example

Item Name:				
Document no:		Drawing No:		
Tag No:		Model No:		
Equipment No:		Serial No:		
Test Description:		Manufacturer:		
Test Equipment:		Supplier:		

CHECKS			
Check no:	Item	Checked By	Date:
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

APPROVAL			
Designation:	Name:	Date:	Signature:
Comments:			
Designation:	Name:	Date:	Signature:

Comments:			
Designation:	Name:	Date:	Signature:
Comments:			

Failure to adhere to this requirement will lead to disqualification.

PARTICULAR SPECIFICATION

PFD AIR-CONDITIONING INSTALLATIONS

CONTENTS

PFD 01 SCOPE

PFD 01.01 This specification comprises all aspects regarding the installation of the air conditioning systems. The HVAC systems comprise:

(i) Chillers
(ii) Chilled water pumps
(iii) Chilled water piping
(iv) Fan-Coil Units
(v) Split Air Conditioning Units
(vi) Ventilation systems

PFD 01.02 This specification shall form an integral part of the Department of Agriculture's Sefala Building contract document and shall be read in conjunction with other Additional Specifications included in the Bid Document.

PFD 02 STANDARD SPECIFICATIONS, REGULATIONS, CODES AND ADDITIONAL SPECIFICATIONS

PFD 02.01 The latest edition, including all amendments up to date of tender of the following specifications, publication and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof.

PFD 02.02 SPECIFICATIONS

1. SANS 1200 - Standardised Specifications for Civil Engineering Construction*
2. SANS 1238 - Air-conditioning ductwork*
3. SANS 0173 - The installation, testing and balance of air-conditioning ductwork*

4. SANS 1125 - Room air conditioners*
5. SANS 0147 - Code of practice – Refrigeration systems including plants associated with air-conditioning systems*
6. SANS 193 - Fire dampers*
7. SANS 1424 - Filters for air-conditioning and general ventilation*
8. SANS 10142 - Wiring code*
9. Standard Specification for Electrical Installations and Electrical Equipment pertaining to Mechanical Services ISUE 1X a December 1999*
10. Standard National Standards SANS 10400 – O:2011 – Code of Practice for the application of the National Building Regulations*
11. The Occupational Health and Safety Act No 6 of 1983 and/or the relevant regulations as Amended*
12. Local authority by laws and regulations*
13. PW327 - Department of Public Works Specification for Air conditioning and ventilation installation*
14. SANS 10103 - The measurement and rating of environmental noise with respect to annoyance and to speech communication*
15. SANS 10252 Part 1 and 2 - Water Supply and Drainage Installation for Buildings*
16. SANS 1352 - Heat Pumps installation, repairs and servicing*
17. ASHRAE Standards - American Society of Heating, Refrigeration and Airconditioning Engineers where applicable*
18. PW 371 - Specification of Materials and Methods to be used. Fourth revision, October 1993.**
19. Standard Specification for the Electrical Equipment and Installation for Mechanical Services, Issue VIII December 1984**
20. Standard Electrical Specifications, January 1984, GPS 24-0367**
21. Standard Specifications for Electrical Installations and Equipment pertaining to Mechanical Installations**
22. Department of Public Works – Standard Electrical Specifications**

PFD 02.03 **OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993: CONSTRUCTION REGULATIONS, 2003 AS PROMULGATED IN GOVERNMENT GAZETTE NO 25207 AND REGULATION GAZETTE NO 7721 OF 18 JULY 2003**

PFD 02.04 **MANUFACTURER'S SPECIFICATIONS AND INSTALLATION INSTRUCTIONS**

PFD 02.05 **ADDITIONAL REQUIREMENTS**

Equipment and material installed shall be new and unused.

Luminaires, control gear, isolators and power outlets shall bear the SANS stamp. The Contractor shall ensure that all safety regulations and measures are applied and enforced during repair and maintenance work on cabling, wiring, distribution boards, luminaires, power points and fixed appliances.

PFD 03 SPECIFICATION OF SPECIFIC EQUIPMENT AND MATERIAL

INTRODUCTION

The schedules must only be completed insofar as the equipment and materials required for this particular contract is concerned.

If these schedules are not properly completed by the Tenderer, their tender document will be regarded as incomplete.

Where types, etc. are filled in below and these do not comply with the Specifications, this must be specifically pointed out by the Tenderer. Filling in of types, etc. below does not, if they do not comply, signify that they are acceptable or will be accepted.

The table below show the recommended heating and cooling loads as well as the required parameters of water temperatures, flow rates as well as air flow requirements.

PFD 03.01 **OPERATING CONDITIONS**

The material and equipment shall be suitable for:

- Outside conditions Summer 32,0ºC db / 20,0ºC wb Winter 3,0ºC
- Inside Conditions All Areas 22,0ºC db
- Control Tolerance All Areas Temperature ± 1,5ºC.
- Relative Humidity will not be directly controlled but will be indirectly controlled within the range of 40% to 60% by careful selection of the cooling / heating equipment.
- Altitude 1339 m, Pretoria

PFD 03.02 NOISE LEVELS

The following noise levels, measured at a distance of 1 metre from the air-conditioning and ventilation equipment, shall not be exceeded:

All areas : NR 40

The contractor must ensure that the above noise levels are achieved through careful fan selection and appropriate attenuation.

The contractor will be required to do noise testing in the areas specified.

PFD 03.03 CONTROLS

The following control philosophy will apply to the air conditioning system:

The replacement air-cooled system supplies chilled water to various type air conditioning units throughout the Sefala Building.

The packaged chiller is complete with the chiller control with possible outputs to stop and start the chiller and pumps. It is protected against dry run and low flow conditions. The chiller is self-regulating and control the air supply temperature based plant demand.

The MCC will receive stop/start signals from the chiller and via the MCC plc the ancillary equipment will be controlled.

Stop/start of the chiller plant will be via the MCC plc by the program and displayed on the HMI/SCADA.

The air cooled chiller plant will be protected against dry run of pumps, alarms and set point settings.

All alarms will be noted on the HMI/SCADA as well as a GSM system.

The supply and return air fans will be controlled by the MCC PLC.

The contractor to provide an FDS as well as control philosophy based on the chiller selection at a HAZOP meeting

The ducted split type units at the individual offices are self-contained and controlled locally at the air handling unit.

The following control philosophy will apply to the Air conditioning System:

The packaged chiller is complete with the chiller control with possible outputs to stop and start the chilled water supply and pumps. It is protected against dry run and low flow conditions. The chiller is self-regulating and control the chilled water supply temperature based plant demand.

The MCC will receive stop/start signals from the chiller and via the MCC plc the ancillary equipment will be controlled.

Stop/start of the chiller plant will be via the MCC plc by the program and displayed on the HMI/SCADA.

The air cooled chiller plant will be protected against dry run of pumps, alarms and set point settings.

All alarms will be noted on the HMI/SCADA as well as a GSM system.

The supply and return air fans will be volume controlled by the MCC PLC and necessary pressure and temperature sensors.

The contractor to provide an FDS as well as control philosophy based on the chiller selection at a HAZOP meeting.

The existing control for air distribution including fresh air supply, reheating, zone control and damper system will be replaced but the existing control philosophy will be maintained. This includes dampers and actuators.

The existing fresh air make up and return air plenums allow for recycling and energy management through a damper control system. The system allows for increased outside air intake when the ambient conditions are suitable. Mixing of outside air with return air is managed with damper set conditions. This will be managed by the MCC PLC.

Controllers and all control items shall be housed in a separate cubicle in the electrical control panel/switchboard as supplied by the Mechanical Services subcontractor/s

The performance of sensors, controllers and outputs shall be such that stability is ensured under all operating conditions.

Non-adjustable controllers or controllers with inadequate adjustment facility will not be accepted.

All air-conditioning and ventilation equipment shall start up in the mornings and switch off in the afternoon automatically by means of timers, to comply with operational hours of the facility and shall form an integral part of the MCC controls.

In the case of a fire, a signal to the MCC's must switch off all air conditioning and ventilation equipment. The smoke detection contractor shall allow a fire signal to the MCC's for final connection by the Mechanical Services subcontractor/s to the control terminals.

The whole of the installation shall automatically restart on restoration of power after a power failure. During fire mode the entire air conditioning and ventilation system shall shut down and restart automatically once normal operation has been restored.

PFD 03.04 DESIGN PARAMETERS

Chilled water system will be installed.

The system will include a ducted fresh air supply systems with fans and air filters designed and installed to provide fresh supply to each office in compliance to SANS 10400. A ducted air conditioning system with chilled water will be maintained.

The design parameters will include the following:

- Chilled Water System Design – Parameters
- North and South Facing offices to be taken in consideration
- Occupancy of the building based on:
- mainly daytime 08h00 to 16h00
- 5 days per week
- 2 to 3 persons per office
- Sometimes not occupied
- Sometimes not occupied for the full day

Design range:

- Indoor 22o/23o Celsius
- Minimum 18 Degrees Celsius and
- Maximum 30 Degrees Celsius
- Ability to provide Heating and Cooling
- 50% Relative humidity
- Allowance for outdoor temperature up to 35 Degrees Celsius and 80% relative humidity

Heat Load Calculations:

- Considering the office total floor area and detailed heat load calculations the design loads required are:
- Cooling load total 1200kW

PFD 03.05 EQUIPMENT SPECIFICATION

Chillers: The equipment selected shall consist of a Packaged Air- Cooled Chiller with:

Compressor: screw or scroll complete with motor over-temperature and over-current protection devices. Each compressor is equipped with an oil heater that keeps the oil from being diluted by the refrigerant when the chiller is not running. The compressors are connected in Tandem or Trio configuration on each refrigerant circuit. Each compressor is mounted on rubber anti-vibration mounts for a quiet operation. The unit is delivered with complete oil charge.

Evaporator: The unit is equipped with a direct expansion plate to plate evaporator. This heat exchanger is made of brazed plates and covered with a 20mm closed cell insulation material. The exchanger is equipped with an electric heater for protection against freezing. Evaporator water connections are provided with Victaulic kit.

Condenser: Full body Aluminium “Long Life Alloy” Microchannel coils providing superior resistance to corrosion compared to standard aluminium alloy. Coils’ layout is designed to guarantee optimized heat transfer allowing maximized performances and reduced turbulence to reduce sound emissions.

Circulating pumps where both primary and secondary pump systems will be two pumps with one standby

Air handling unit:

Each office or space requiring HVAC will be fitted with an Air Handling unit connected to the central air supply system.

Wall or ceiling mounted units will have the following functions:

- Air treatment for cleaner air circulation including breakdown of odours, removal of air borne particles.
- Individual remote-control units with timer, Infrared with LCD
- Inverter type for energy savings
- Motion sensors for operating control

Air supply and chilled water piping and fittings

Reticulation

Chilled water piping throughout the floors will be insulated with aluminium cladding for exposed piping inside the building, aesthetics and accessibility for maintenance purposes.

PFD 03.06 ENERGY MANAGEMENT

Occupancy / Motion detection:

Each office may be fitted with a motion / occupancy sensor. The air handling unit will switch off after a rest period if the building is not occupied and switch on when the building is occupied.

Timer at Central Control:

The HVAC system will be set on a 7 day timer to run only during official office hours, but can be reset to operate at any other time is required by management.

Fan Invertor control:

Air handling unit fan speed will vary according to the heat load required, this will convert into electrical operation savings

Seasonal Efficiency:

Plant selection will be based on Seasonal Efficiency.

Seasonal efficiency is a new way of measuring the true energy efficiency of heating and cooling technology, over an entire year. This new measure gives a more realistic indication of the energy efficiency and environmental impact of a system.

The new method of rating energy efficiency is driven by the EU's Energy Related Products (ErP) Directive (the Eco-design Directive) which specifies the minimum Eco-design requirements that manufacturers must integrate into their energy-using products.

Seasonal efficiency demands a new rating system for heating and cooling products, which must be used by all manufacturers. These are:

The Seasonal Energy Efficiency Ratio (SEER) value in cooling

The Seasonal Coefficient of Performance (SCOP) value in heating.

PFD 03.07 ENERGY SAVINGS

Chiller Management:
By uniting advanced software and hardware technologies for greater energy savings during actual operation, both energy savings and comfortable air conditioning can be achieved.

Space Management :
Each office may be fitted with motion sensors with time delays to turn on and turn off air conditioning units depending on occupation.

Central Air conditioning plant and the supply air fan will be Variable Speed controlled and air demand will be managed by return air temperature. When the return air temperature has minimum variance to supply air temperature the chiller will throttle back and the fresh air dampers will open with the actuator to allow outside filtered air into the system. The outside ambient temperature will also be monitored and the best efficiency will be achieved.

Chiller settings:
Further energy saving will be via chiller to be set on a 365 day programme to only operate during attendance hours (but with manual override).

PFD 03.08 ELECTRICAL CONTROL

The chillers are packaged units supplied complete with electrical control. All controls are included. It will be required to provide a Motor Control Centre for each chiller plant to manage the balance of the ancillary equipment.

The current electrical supply in both plant rooms are sufficient in size for the replacement equipment.

PFD 03.09 PLANT REMOTE MONITORING AND CONTROL

Each plant room MCC will be fitted with a Human Machine Interface (HMI) for complete plant control. The HMI will be connected to a plant SACDA system for remote monitoring and control at the Facilities Manager's office.

PFD 03.10 PACKAGED CHILLER UNITS

The packaged unit will be:

- delivered according to specifications
- output is regulated according to cooling demand, therefore it is electrically efficient
- It is fitted with electrical controls and
- Factory assembled and tested thereby reducing site installation time

Factory guarantee and warranties

PFD 03.11 COMMISIONING

On completion, the Contractor will demonstrate the functionality and compliance of the system. The Contractor is responsible for the provision of all testing equipment.

The Subcontractor shall prepare detailed commissioning schedules well in advance of the programmed practical completion inspection date.

The schedules shall make allowance for all measurements that will be required, checking of operational and safety set-points, test results, etc., and shall be submitted to the Engineer for approval prior to the start of commissioning.

The Subcontractor shall submit the completed schedules to the Engineer for checking after commissioning has been completed, and prior to the practical completion inspection.

The Engineer reserves the right to refuse to carry out the practical completion inspection until the Subcontractor has complied with the above stipulations. The Subcontractor shall accept this reserved right by the act of tendering.

Each task in these schedules shall be countersigned by the Subcontractors Commissioning Engineer to ensure that any discrepancies between site and commissioning conditions/data can be clarified.

PFD 03.12 MAINTENANCE AND OPERATING INSTRUCTIONS

Three sets of operating and maintenance manuals shall be prepared by the Subcontractor. These manuals shall be submitted to the Engineer for approval 1 week prior to the programmed date for the practical completion inspection.

The manuals shall be properly bound and titled. Each set shall contain, as a minimum: scope of works, operation, commissioning data, maintenance and as built drawings. Each section may contain sub-sections.
The maintenance and operating instruction will include the name of the supplier, manufacture, serial number, duty ratings and all relevant technical information, including spares list of each piece of equipment and instrument installed.

It will also include comprehensive instructions for the switching on, operation, control, switching off and isolation of each unit of plant and equipment.

Instructions for any precautionary measures necessary. Instructions for servicing, including frequency and materials to be used, to maintain the equipment in good and safe condition

Maintenance and operating instructions shall be indexed and contained in ring binders with stiff covers. The name of the site and contract reference shall be printed on the front and spine with, where more than one volume is necessary, a suitable identification title. The date of completion of the Works shall be included on a flyleaf.

Copies of the manufacturer's data may be incorporated to supplement the descriptions and instructions required above but shall not replace them. Only data relevant to the Works shall be included. Where non-relevant data appears on the same sheet it shall be clearly marked to show that it is not applicable. The data shall be cross referenced within the text and be included in the index. If possible, it shall be contained in ring binders, but where this is not possible, suitably protected box files.

PFD 03.13 INSTRUCTING THE EMPLOYER IN THE OPERATION OF THE SYSTEMS

The Tenderers shall allow for instructing of the Employers representatives and the Engineer in the operation, maintenance and adjustment of the systems.

Instruction shall take place during the warranty period on a date and time to be identified by the Engineer.

PFD 03.14 ELECTRICAL MOTOR CONTROL CENTRE AND PLANT CONTROL EQUIPMENT

The electrical motor control centre and plant control equipment will also be replaced according to the electrical specification.

PFD 03.15 THE DESIGN PARAMETERS WILL ALLOW FOR:

All electronic equipment in control rooms, lecture theatres etc. where minimum heating is required.

HVAC operating hours shall be designed for:
- 24/7/365 and
- Minimum offices

Design range will allow for:
- Indoor 20/ 22 Degrees Celsius
- minimum 18 Degrees Celsius and
- maximum 25 Degrees Celsius
- Mainly cooling
- 50% Relative humidity
- Outdoor temperature up to 35 degree Celsius, 80% relative humidity

Heat load calculations:
- Considering the office total floor area and detailed heat load calculations the design loads required are:
- Cooling load, total 1200kW

PFD 03.16 EQUIPMENT SELECTION

The equipment selected shall consist of a Packaged Air-Cooled Chiller Unit with:

Compressor: screw or scroll complete with motor over-temperature and over-current protection devices. Each compressor is equipped with an oil heater that keeps the oil

from being diluted by the refrigerant when the chiller is not running. The compressors are connected in Tandem or Trio configuration on each refrigerant circuit. Each compressor is mounted on rubber anti-vibration mounts for a quiet operation. The unit is delivered with complete oil charge.

Evaporator: The unit is equipped with a direct expansion plate to plate evaporator. This heat exchanger is made of brazed plates and covered with a 20mm closed cell insulation material. The exchanger is equipped with an electric heater for protection against freezing. Evaporator water connections are provided with Victaulic kit.

Condenser: Full body micro channel coils providing superior resistance to corrosion compared to standard aluminium alloy. Coils' layout is designed to guarantee optimized heat transfer allowing maximized performances and reduced turbulence to reduce sound emissions.

Circulating pumps where both primary and secondary pump systems will be two pumps and one standby.

Air handling unit:
Each office or space requiring HVAC will be fitted with an Air Handling unit connected to the central water chilled system.
Wall or ceiling mounted units will have the following functions:

- Air treatment for cleaner air circulation including breakdown of odours, removal of air borne particles
- Individual remote-control units with timer, Infrared with LCD
- Inverter type for energy savings
- Motion sensors for operating control

Ducting, chilled water piping and fittings

Reticulation
Water/air supply and chilled water piping throughout the building will be insulated with aluminium cladding for exposed piping inside the building, aesthetics and accessibility for maintenance purposes.

PFD 03.17 ENERGY MANAGEMENT / ENERGY SAVING

Packaged Air-cooled Chiller Unit:
The unit will be fitted with internal controls with different stages of cooling.
The Stepped cooling will be done depending on heat load detected and Energy saving is done automatically

Air heating:
The existing system will be used but the control system will be changed to manage the heating process. Electronic temperature sensing and control will be incorporated in the design.

Timer at Central Control:
The HVAC system will be set on a 7-day timer to run when required.

Fan Variable Speed Drive may be introduced for energy saving

Air handling unit Fan speed will vary according to the heat load required, this will convert into electrical operation savings

Electrical control:
It will be required to install a Motor Control Centre which includes a PLC with HMI (Human Machine Interface) for plant monitoring and control.

Figure 1 illustrates a typical Plant Monitoring Controls system

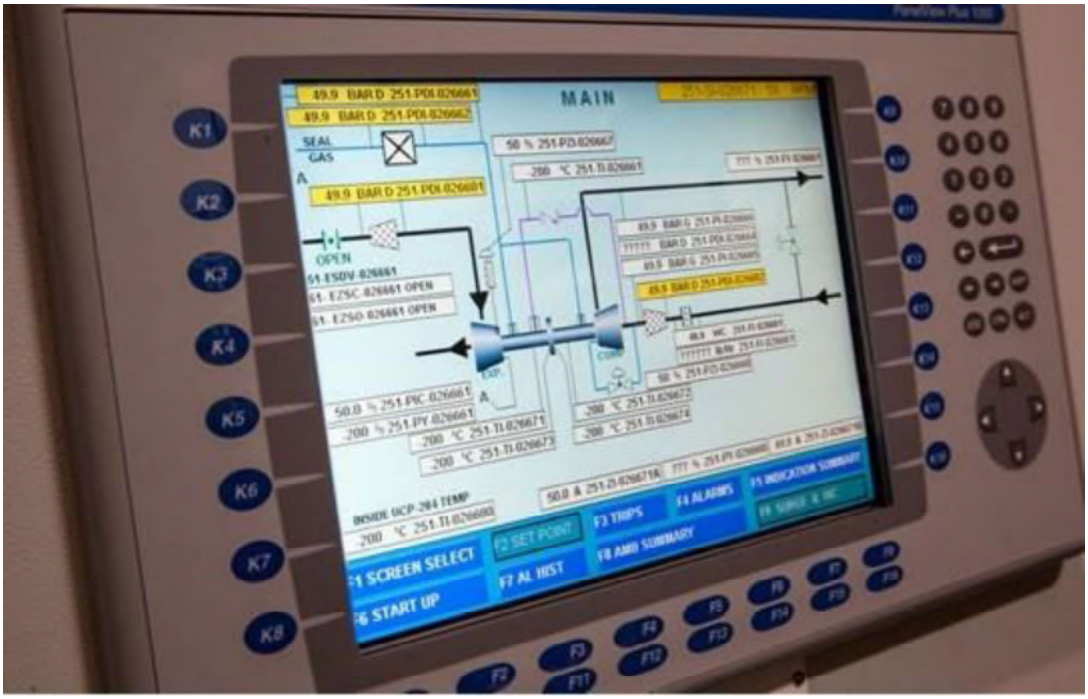

Figure 1 : Plant Monitoring Controls

PFD 03.18 **BUILDING INSTALLATION LOADS**

The heating/cooling loads as well as the equipment weights and power requirements must be shown on the applicable drawings.

PFD 04 **CONTRACT EQUIPMENT SPECIFICATIONS**

The Tenderer is referred to the Standard Specification for Air-conditioning and Ventilation with this specification for full details of all required specifications and need to submit a tender in compliance with the specification.

PFD 04.01 **AIR HANDLING UNITS**

Units shall be of the horizontal type and must be draw or blow through, self-contained. The units will have minimum cooling and heating capacity as specified.

PFD 04.02 ROOM TYPE AIR CONDITIONING UNITS

The room air conditioners shall be of the inverter type heat pump mid-wall split air conditioning units complete with remote control.

PFD 04.03 CONDENSERS

Condensers shall be of the air-cooled type suitable for the capacities specified and suitable for operating in an exposed environment

Further compliance specification can be referenced to this specification.

PFD 04.04 CONDENSER WATER DRAINS

Suitable large bore drainpipes for condenser water will be routed and fitted to be unobtrusive.

Multiple units can drain into a common header drainpipe.

PFD 04.05 DUCTWORK

The installation, testing and balancing of Air-conditioning duct work shall be in accordance with SANS 0173-1980, Fire dampers SANS 193-1972, Air-conditioning ductwork SANS 1238-1979, Filters for air-conditioning and general ventilation SANS 1424-1987.

Construct air ducts according to "Low Velocity Duct Construction Standards" and "High Velocity Duct Construction Standards" (SMACNA), as applicable.

Install ductwork as indicated on the project drawings. All duct dimensions, including dimensions for internally insulated ducts refer to the sheet metal size.

Where changes in duct sizes indicated are necessitated on site, duct sizes must be determined using equivalent diameters (hydraulic diameter) and not cross-sectional area.

Avoid aspect ratios in excess of 4:1 in rectangular ductwork.

Unless otherwise specified ductwork shall be manufactured of galvanised sheet steel using thicknesses as recommended by SMACNA.

Ducts shall be airtight, shall not drum or vibrate when the internal static pressure varies and shall be so constructed that airflow is even without excessive static pressure drop. Construction shall be sturdy.

Isolate all ducts passing through concrete or brick walls from the walls by means of a wooden frame except where ducts pass through a firewall. These ducts shall be fitted with fire dampers as specified in the Standard Specification. Seal all openings where ducts pass through plant room walls by means of intumescent fire proof sealer.