

# TENDER DOCUMENT

Project:

## ADMIN 2<sup>ND</sup>, 3<sup>RD</sup> AND 4<sup>TH</sup>

CAPE PENINSULA UNIVERSITY OF TECHNOLOGY – ADMINISTRATION BUILDING

Service:

## HVAC INSTALLATION

### FIXED PRICE CONTRACT

Issue/Revision	Issue 1	Revision 1	Revision 2
Remarks	Issued for tender		
Date	Refer to Main Contract		
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Signature			
Checked by	Leslie Green		
Signature			
Authorised by	Leslie Green		
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| DESIGN | ENGINEERING | PROJECT MANAGEMENT | PROPERTY & FACILITIES

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# **PART ONE**

## **DETAILED TECHNICAL SPECIFICATION**

### **1.1 SITE LOCATION**

The site is the existing Engineering Building located at District six campus, Cape Town.

### **1.2 LIST OF DRAWINGS**

The specification documentation shall include the tender drawings:

#### ADMIN BUILDING

J086-30 Rev 1	3 <sup>RD</sup> AND 4 <sup>TH</sup> CONTROL SCHEMATIC
J086-30-01 Rev 1	2 <sup>ND</sup> FLOOR LEVEL
J086-30-02 Rev 1	3 <sup>RD</sup> FLOOR LEVEL
J086-30-03 Rev 1	4 <sup>TH</sup> FLOOR LEVEL

### **1.3 DESCRIPTION OF WORK**

This specification calls for the supply, delivery, installation, testing, commissioning, handover, guarantee and twelve months free maintenance of the new air conditioning system required to serve the areas on the first and fifth floor level ; as detailed in the accompanying drawing(s), at the Engineering Building.

The air conditioning contractor shall be responsible for offloading at site, hoisting, fixing in positioning all the equipment required to complete the installation. This shall include the provision of all labour and materials, contractor's equipment and everything whether of temporary or permanent nature, setting in operation and leaving the new system in complete working order.

### **1.4 PROGRAMME**

A site inspection can be arranged on request. All costs entailed by the mentioned site visit will be for the contractor's account. Work on site shall commence after appointment is made, and this will be confirmed closer to the date.

Completion dates will be advised once appointment is finalised with the winning Tenderer. The air conditioning and ventilation installations shall be physically complete and capable of supplying permanent air conditioning and ventilation by these dates.

The entire air conditioning and ventilation installation must be commissioned, tested and Taken Over by the Engineer as per Principal Contract Programme.

The AC contractor shall be required within TWO WEEKS after acceptance of his Tender, to submit to the Engineer for his approval a Programme showing the order in which the Works will be executed. Such Programme shall show the times for the preparation of all drawings, ordering and delivery times promised by the suppliers for each major item of Plant, manufacturing and delivery times for all manufactured items, installation times and the programmed dates for testing and commissioning the Plant.

The Programme shall be prepared in consultation with the Principal Contractor and the execution of the Works shall be programmed so as to keep pace with the Building Programme (where applicable).

The air conditioning contractor shall submit TWO copies of his Programme to the Engineer for approval. After submission to and approval by the Engineer of such Programme, the contractor shall adhere to the order of procedure and method stated therein unless he obtains the written permission of the Engineer to vary such order or method. The submission to and approval by the Engineer of such Programme shall not relieve the contractor of any of his duties or responsibilities under the contract.

The times required for the submission of Drawings, are as follows:

Builder's Work Drawings	within <b>TWO WEEKS</b>
Shop Drawings	to commence within <b>THREE WEEKS</b>

## **1.5 WORK BY OTHERS**

Builder's Work shall be included in this contract and all such work, as later herein specified shall be carried out by the AC contractor in accordance with the Drawings and details provided by the Engineer or as provided herein.

This shall include:

- All equipment plinths, bases and plantrooms
- All plant enclosures
- All penetrations through walls, slabs, ceilings and steelwork
- Making good of all openings after installation of ductwork and equipment
- Waterproofing of all duct or piping entries to building through roofs, walls or the structure
- Undercutting doors and installing door grilles supplied by Air Conditioning contractor

Plumbing Works forms part of this contract:

- Water supply points terminating in valves
- Drain points.
- All as indicated on drawings.
- Any other relevant

Electrical Works:

Mains incoming power supplies to air conditioning plants made off to isolators

- Wiring to air conditioning plants (outdoor and indoor) and Change over signal
- Wall boxes and conduit in brick walls or partitions for air conditioning controls.

**NOTE:**

1. All final terminations in the air conditioning panels by the air conditioning contractor.
2. All air conditioning panels to be top-entry type.
3. Power distribution from air conditioning plantroom distribution boards to ceiling variable volume outlets is by the air conditioning contractor.

**POWER SUPPLIES BY ELECTRICAL CONTRACTOR**

1. Voltage 400/230V 5%

## 1.6 NOTES ON DRAWINGS

### 1.6.1 Tender Drawings

The Drawings accompanying this Specification shall be deemed to indicate the general layout and requirements only and are not Shop Drawings.

### 1.6.2 Architectural and Structural Drawings

The contractor shall ensure that he is in possession of all information required for the installation of the Works and shall, if necessary, obtain copies of all relevant Architectural and Structural Drawings from the Architect and Structural Engineer.

### 1.6.3 Builder's Work Drawings

Builder's Work Drawings shall indicate the location and extent of all foundations, bases, openings, timber frames and all other Builder's Work and the capacities and/or dimensions of all electrical and water supply points, the method of terminating such supplies and the position of the connection points, the position and dimensions for all water drainage connections and any other work to be provided by others for the Works, as detailed in these Specifications.

The Drawings shall be drawn to scale and in sufficient detail to enable the Builder to execute the work without any misunderstanding.

Within a reasonable period after receiving such Drawings, the Engineer shall signify his approval, or otherwise, and one signed copy of the approved Drawing shall be returned to the sub-Contractor.

When approved, the following number of copies of each such Drawing shall be delivered to each of the following:

Project Manager	1 Copy
Quantity Surveyor	1 Copy
Main Contractor	3 Copies
Architect	2 Copies
Structural Engineer	1 Copy
Electrical Engineer	1 Copy

#### 1.6.4 Shop Drawings

The contractor shall submit to the Engineer, for approval within the time stipulated hereof duplicate copies of all Shop Drawings as required for the manufacture and installation of the Works or as the Engineer may reasonably require.

All Shop Drawings for work outside of plantrooms shall be drawn to a scale of not smaller than 1:50 and all Drawings of work within plantrooms shall be drawn to a scale of not smaller than 1:25. All details shall be drawn to a scale to show the detail required.

Within a reasonable period after receiving such Drawings, the Engineer shall signify his approval, or otherwise, in writing and one signed copy of each approved Drawing shall be returned to the contractor.

The contractor shall not, unless otherwise directed by the Engineer, in writing, commence with any work prior to the approval of the relative Shop Drawings. Work installed prior to the approval of Shop Drawings shall be liable to rejection by the Engineer and removal and/or replacement by the sub-Contractor, at his cost, if it is considered by the Engineer to deviate from the Specification.

The contractor shall also supply copies of all approved Drawings in accordance with the requirements (Operating and Maintenance Instructions) of the Specification.

Drawings approved as above described shall not be departed from except as authorised by the Engineer.

The Engineer shall have the right at all reasonable times, to inspect at the factory of the contractor, **all** Drawings of any portion of the Works.

#### 1.6.5 Mistakes in Drawings

Any expense resulting from an error or omission in or from delay in delivery of the Drawings, shall be borne by the Subcontractor.

The contractor shall be responsible for any discrepancies, errors, or omissions in the Drawings and other particulars supplied by him, whether such Drawings and particulars have been approved by the Engineer or not, provided that such discrepancies, errors, or omissions are not due to inaccurate information or particulars furnished in writing to the contractor by the Engineer or the Architect. The Employer shall be responsible for Drawings and information supplied in writing by the Engineer or the Architect and for the details of special work by either of them.

## 1.7 DESCRIPTION OF THE AIRCONDITIONING AND VENTILATION SYSTEMS

### 1.7.1 ADMIN BUILDING 2<sup>ND</sup> FLOOR LEVEL

All offices and lecture classrooms shall be served with variable refrigerant flow (VRF) indoor and outdoor units (heat pump).

Fresh air shall be provided and by means of axial flow fan where applicable, as indicated on the drawings.

The indoor units shall comprise a mix of midwall indoor units and ceiling mounted cassette, and high static ducted units where specified and as shown on drawings.

The indoor units shall be served by a modular, air cooled, variable refrigerant flow (VRF) condensing unit. This unit will be as indicated on the drawing.

The interconnecting refrigerant piping will be run in the ceiling void, the respective soffits and through pipe risers chased into walls. Control cables are to connect the indoor and outdoor units.

**Ventilation in this area is to be provided by the existing air handling unit and ducting.**

#### **Common Guide Specifications:**

##### **1) Equipment Performance**

- All equipment shall have published performance ratings **certified by ISO 15042, Eurovent, TUV, ANSI/AHRI 1230 with Addendum 1:2010 with a minimum ESEER of 9.15 (Comparison based on 10HP unit in cooling)**

##### **2) Oil Level Sensor**

- The system shall have an **oil level sensor** in the compressor to provide direct oil level sensing data to the main controller. **The system shall only initiate an oil return cycle if the sensed oil level is below oil level target values**

##### **3) Hi-POR (High Pressure Oil Return System)**

- The system shall utilize a **Hi-POR™ (high pressure oil return system)** to ensure a consistent film of oil on all moving compressor parts at all points of operation

##### **4) Dual Sensing SLC (Humidity Sensing):**

- Dual sensing Smart load control operation shall be available at any time during or after system Commissioning for comfort cooling and evaporation temperature control for better energy saving.

##### **5) Compressor Operation:**

- Outdoor Unit shall be capable of maintaining continuous compressor operation under all of the following operating ambient air conditions.
  - a) Operating ambient air conditions  
**Cooling: -10°C DB to 48°C DB / Heating: -25°C WB to 18°C WB**
  - b) **The VRF system shall maintain normal cooling or heating operation at all IDUs while any one IDU is powered down for service. When power is**



**restored to the IDU serviced, normal operation shall be restored with no system shutdown, interruption, reset, or power cycling of the outdoor unit.**

**6) Inverter PCB cooling:**

- Cooling of the inverter PCB shall be conducted by way of high pressure, sub-cooled liquid refrigerant via heat exchanger attached to rear side of inverter PCB.

**7) Ocean Black Fin Corrosion resistance treatment from the factory (UL/TUV certified).**

- The aluminum fins shall have a factory applied **Ocean Black Fin** heat exchanger coating that is comprised of a highly corrosion resistant epoxy resin coating.
- The Black Fin coating shall be certified by Underwriters Laboratories and per ISO 21207.

**8) Cabinet Thickness**

- Outdoor unit cabinet finish shall be made of **SGCC of thickness 1mm** and been tested in accordance with **ASTM B-117 salt spray test procedure for a minimum of 1000 hours.**

**9) Wi-Fi communication:**

- The outdoor unit shall be Wi-Fi enabled and capable to **allow service or maintenance personal access to the complete operating system, via Wi-Fi mobile viewing kit/module, without need of tools other than smart phone or tablet**

Electrical power supply to indoor and outdoor units will be provided within 5 metres of the positions of HVAC equipment and will be via 15 Amp double pole single phase isolators in general with appropriate ad hoc isolators for specific equipment (by others).

**1.7.2 ADMIN BUILDING 3<sup>RD</sup> AND 4<sup>TH</sup> FLOOR LEVEL**

These areas are served by factory fabricated air handling plants located on the 3<sup>rd</sup> and 4<sup>th</sup> floors.

The air handling plants are the variable air volume type.

The air handling plant are connected by means of insulated chilled water piping to the chilled water generating plant.

Conditioned air from the plant is supplied through systems of insulated sheetmetal ducting and distributed through variable volume type diffusers.

The ducting shown in drawing is indicative of the general layout and not actual.

Recirculated air shall be returned to the plant via a return air system. The return air system need to be supplied and installed.

The required quantity of outside air is introduced through louvers and ducted to the plant.

Heating in winter shall be provided by means of reheaters in the duct system.

The plant shall be automatically controlled to provide the required temperature conditions in summer and winter and shall be switched on and off automatically via the BMS.

Master diffusers shall be addressable on the BMS on and off automatically via the BMS

#### **Scope of work 3<sup>rd</sup> and 4<sup>th</sup> floor library**

- Design supply and installation of return air ducting to each air handling unit complete with return air grilles and dampers.
- BMS control system for 3<sup>rd</sup> and 4<sup>th</sup> floor as per schematic.
- Modification of air handling units to accommodate return air and bms systems.
- Disconnect 125Kw (21600 m<sup>3</sup>/hr) chiller from library air supply ducting and connect to office and auditorium air supply ducting. Supply dampers and associated equipment as required.
- Disconnect 161kw chiller (27000m<sup>3</sup>/hr) from offices and auditorium and connect to library air supply ducting. Supply dampers controls and associated equipment as required.

#### **1.7.4 ELECTRICAL SWITCHBOARDS AND WIRING**

Electrical switchboards shall be constructed and wiring carried out in accordance with Part 5 of this specification and the electrical schematics which form part of this documentation.

All switchboards shall be pre-wired and tested prior to delivery to site.

Switchboards shall be wired in such a way as to provide safe sequenced and automatic start up and operation of the systems. All necessary interlock and time delay relays etc. are to be allowed in the price.

The main offer shall be based on the use of Danfoss V.L.T. 6000 variable speed drives for the variable volume unit supply fan motors.

Alternatives may be offered under separate cover.

All wiring from the air conditioning switchboards to all individual components of the air conditioning and ventilation systems is to be carried out as part of the air conditioning contract.

This includes wiring to the variable volume diffusers and their individual reheaters.

Tenderers are to allow in their price for 10% spare capacity on the number of variable volume outlets served by each switchpanel.

#### **1.7.5 CENTRALIZED CONTROLLER**

Allowance shall be made to supply, install, test and commissioning of a Graphic Central Remote Controller. It must act as an advanced air conditioning management system to facilitate complete control of VRF air conditioning equipment, It should be user friendly through its icon display and colour LCD display.

#### **1.7.6 FILTER WASH REQUIREMENTS**

This will to be provided by the client:

### 1.7.7 PAINTING OF DUCTWORK

All ductwork that is exposed to view, i.e. in all the air conditioning plantrooms, refuse rooms, etc., is to be degreased and painted as per the General Technical Specification.

The painting of the exposed ductwork at high level in the trusses in A/C Areas is to be specifically excluded. This will be cleaned and painted by others.

### 1.7.8 **GENERAL**

- All requirements as contained in Part 9 of this specification shall be adhered to.
- Tenderers are to allow for carrying out 12 service and maintenance visits to the plant during the first year of operation and for a full twelve months guarantee as detailed in Part IV.
- Three copies of the Operating and Maintenance Manuals and As Built Drawings, as detailed in Part 9, are required including CD (electronic format of complete manual and as-built drawings).

The tenderer is to note and make provision for the following:

- Two complete set of filters, to be changed prior to the complex opening and 12 months thereafter.
- All flexible ducting carrying conditioned air shall be pre-insulated wiremold available from Europair.
- The following spare parts shall be provided:
  - One set of matched V-belts for each different belt drive.
  - One set of bearings for each different fan size and gland packing for the pump.
  - One pilot bulb for each pilot light.
  - Twelve months supply and chemicals for the Dosing Plant where applicable.
- The instrumentation required at the air handling plants for measuring water pressure and temperature shall comprise SISCO ½" test plug of solid brass into suitably sized welded socket. One SISCO master test kit comprising two 2½" pressure gauges and two 5" stem thermometers, all necessary adaptors and a sturdy carrying case shall be provided.

## 1.8 DESIGN CRITERIA

### 1.8.1 FUNCTIONAL PERFORMANCE

<u>Outside Conditions</u>	Summer Winter	35,0°C db 21 deg°C wb 7,0°C
<u>Inside Conditions</u>	Offices All Other Areas	21, 5°C db 22,5°C db
<u>Control Tolerance</u>	All Areas	Temperature: Approximately 1.5 Deg C Relative Humidity will not be directly controlled but will indirectly be controlled within the range of 40% to 60% by careful selection of the cooling plant.
<u>Altitude</u>		sea level

### NOISE LEVELS

The air conditioning and ventilation systems must be designed to maintain the background noise levels as specified below. The design target should be the first mentioned NR value. If the second NR value is exceeded, then corrective measures must be implemented.

ITEM	AREA	NR LEVEL	DESIGN dBA	MAX dBA
1.	Offices	25-30	30	35
	Boardrooms	30-35	35	40
	Executive Offices	35-40	40	45
	Secretaries and General Offices	25-30	30	35
2.	Meeting Rooms	35-40	30	35
3.	Restaurants	35-40	40	45
4.	Retail Shops	35-40	40	45
5.	Public Concourses	35-40	40	45
6.	Lounges	35-40	40	45
7.	Kitchens	45-50	50	55
8.	Toilets	40-45	45	50
9.	Stairwells/Corridors			
	To service areas	40-45	45	50
	To function areas	35-40	40	45
10.	Plant rooms			
	Air Handling Units	70-75	75	80
	Main Chiller	75-80	80	85
11.	Site Boundary	40-45	45	50

**MEASURES TO REDUCE NOISE AND VIBRATION**

- In plant rooms on the ground floor, all equipment is to be placed on spring mounts with a minimum deflection of 10 mm.
- The chiller is to be placed on inertia bases, equal to the chiller mass, on spring mounts and neoprene strips.
- Piping and ducting to be hung on springs mounts inside Plant rooms and then for a distance of 10 m outside the respective plant room.
- Where attenuators are fixed into walls, canvas collars are to be placed on noise sensitive side.
- Where piping and ducting pass through walls, they are to be wrapped with high density (64 - 103 kg/m<sup>3</sup>) preformed, resin-bonded glass wool of 25 mm thickness and then with thick Builder's plastic. Grouting is then to be done hard-up to the plastic.
- Double hemispherical flexible couplings are to be used on piping connections to chillers, pumps, etc.

DUCT DESIGN AIR VELOCITY

<b>NR LEVEL</b>	<b>TERMINAL DUCTS</b>	<b>BRANCH DUCTS</b>	<b>MAIN DUCTS</b>	<b>ATTENUATOR PASSAGES</b>
45	5	7.1	10	20
40	4	6	8	20
35	3.5	5	7.1	16
30	2.8	4	5.7	12.5
25	2.2	3.1	4.5	10
20	1.8	2.6	3.6	10

Velocities are indicated in m/s.

Terminal ducts are those onto which grilles and diffusers are connected.

## 1.9 DEFINITIONS & ABBREVIATIONS

Definitions of terms used herein:

**"Provide"** To supply, install, connect and hand over complete and ready for safe and regular operation of particular work referred to unless specifically indicated otherwise.

**"Install"** To erect, mount and connect, complete with all related accessories.

**"Supply"** To purchase, procure, acquire and deliver, complete with all related accessories.

**"Work"** All labour, materials, equipment, apparatus, controls, accessories and other items required for correct and complete installation.

**"Piping"** Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, accessories, drains, insulation and all related items.

**"Wiring"** Conduit, fittings, cables, wire, junction and outlet boxes, switches, cut-outs, socket outlets and all related items.

**"Concealed"** Embedded in masonry or other construction installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces or in enclosed spaces.

**"Exposed"** Not installed underground or concealed as defined above.

**"Indicated", "Shown" or "Noted"** As indicated, shown or noted on drawings and/or specifications.

**"Similar" or "Equal"** Of approved manufacture, equal in weight, size, design and efficiency of performance of the product specified or mentioned by name.

**"Approved", "Satisfactory", "Accepted"** As approved, satisfactory or accepted by the Engineer.

**"SABS"** South African Bureau of Standards.

**"BSI"** British Standards Institution

**"ASHRAE"** American Society of Heating, Refrigeration and Air Conditioning Engineers.

**"ASME"** American Society for Testing Materials

**"ASA"** American Standards Association

**"NBS"** National Bureau of Standards (U.S.A.)

**"NEMA"** National Electrical Manufacturers Association

#### **6.5.44 AUTOMATIC CONTROL SYSTEM AND B.M.S.**

The air conditioning and ventilation systems shall be controlled by a BMS system. The BMS system will be priced by a selected sub-contractor, but the following items must be costed as part of this tender:

- Airflow switches.
- Sockets and wells for sensors.
- Water flow switches and sockets.
- Variable speed motor drives.
- Control valves.
- Condenser Water Bypass Valves.
- Chilled Water Flow Meter.
- Variable volume diffusers including actuators. Power to each diffuser must be included for.
- The supply and installation by all motorised dampers. Actuators by the BMS contractor.

#### **6.6.51 AUTOMATIC CONTROL SYSTEM AND B.M.S.**

Tenderers shall base their main offer on the use of Johnson controls.

Alternatives may be offered for the following systems:-

**LANDIS AND STAefa**  
**ALERTON**

The new BMS shall be connected into the existing network. The existing BMS is already accessible, new workstation interface is required.

The final detailed design, supply, installation, wiring and commissioning of the control system shall be carried out by the specialist controls company.

The Air cooled chiller shall be supplied complete with its own controls. These units must, however be connected to the main BMS via Bacnet protocol.

##### **6.5.53.1 General**

- The pressure drop across all valves must be selected to ensure that the valve will have complete authority over the water flow through the coils, at the specified water quantities.
- The supply of all automatic control valves and their actuators is to be by the controls specialist.
- Installation will be by the air conditioning contractor.
- The cost of all software and programming is to be included in the tender price.



- All control wiring is to be carried out by the controls specialist.
- The equipment and software offered shall be current manufacture. No custom made products shall be allowed.
- Temperature sensors shall have an accuracy of  $\pm 0,2^{\circ}\text{C}$  over their range.
- All digital outputs are to be electrically isolated from the digital controller by interface relays.
- On resumption of power, after a power failure, equipment must start up automatically to the dictates of the start up schedule, at timed intervals.
- All equipment starting at the same time will not be permitted.

#### 6.5.53.2 GENERAL SPECIFICATION

The Heating ventilation and air conditioning sub-contractor shall employ a Controls Specialist Company who is well established in South Africa, is reputable and who shall be responsible for the design, engineering, documentation, supply, installation, commissioning, hand over, guarantee and maintenance of the BMS (Building Management System) and to implement the sequence of operation as shown on the drawings. This Controls Specialist Company shall hereinafter be shown as the BMS Contractor.

The sub-contractor's main tender offer shall be based on Johnson Control BMS system.

Work includes

#### **BMS CONTRACTOR SHALL PROVIDE: -**

- A fully integrated building management system (BMS), preferable UL listed, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, including colour graphic workstation.
- Complete temperature, pressure etc. control system to be DDC as specified herein.
- All wiring, conduit, panels for all temperature, humidity, pressure, etc. controls.
- All final electrical connections to each stand-alone Application Specific controller and DDC Controller. Pick up power from the nearest MCC ( Motor Control Centre) of ACDB (Electrical Distribution Board).
- BMS Contractor shall be responsible for all electrical work associated with the BMS control system.

1) Perform all wiring in accordance with all local and national codes. In particular:

- a) SABS codes of Practice for Wiring of Premises.
- b) The Occupational Health and Safety Act.

c) National Building Regulations Specifications and Codes of Practice issued by the SABS and British Standard Institute.

2) The HVAC contractor shall provide 220 volt, 10 amp circuits and circuit breakers from normal and/or emergency power panels for the DDC systems.

3) Surge transient protection shall be incorporated in the design of the system to protect electrical components in all DDC Controllers, Application Specific Controllers and operator's workstations.

4) All low voltage control wiring throughout the building whether exposed or concealed shall be run in steel conduit. Any exceptions must be approved by the Engineer prior to installation.

**2. THE HVAC CONTRACTOR WILL PROVIDE.**

- a. The installation of all wells and openings for water monitoring devices such as flow switches, flow sensors etc as required by the BMS contractor.
- b. Installation of control valve bodies.
- c. All package unit and chiller controls.
- d. Installation of damper actuators and ensure free movement of these dampers.
- e. Installation of smoke dampers; outdoor air, exhaust air and vent dampers; with adjacent access doors where required.

**B. GENERAL PRODUCT DESCRIPTION:**

1. The building management system (BMS) shall integrate multiple building functions including equipment supervision and control, alarm management, energy management and historical data collection.
2. The building management system shall consist of the following:
  - a. Stand-alone DDC Controllers.
  - b. Stand-alone Application Specific Controllers (ASCs).
  - c. Portable operator's terminal(s).
  - d. Personal computer operator workstation(s).
3. The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, DDC Controllers, Application Specific Controllers and operator devices.
4. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. Each DDC Controller shall operate independently by performing its own specified control, alarm management, operator I/O and data collection. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

5. DDC Controllers shall be able to access any data from, or send control commands and alarm reports directly to, any other DDC Controller or combination of controllers on the network without dependence upon a central processing device. DDC Controllers shall also be able to send alarm reports to multiple operator workstations without dependence upon a central processing device.

### **QUALITY ASSURANCE**

- A. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.

Locally produced substitutes may be offered only as alternatives to the main offer.

- B. Install system using competent workmen who are fully trained in the installation of temperature control equipment.
- C. All electronic equipment shall conform to the requirements of Governing Radio Frequency Electromagnetic Interference.
- D. Design and build all system components to be fault-tolerant.
  1. Satisfactory operation without damage at 110% and 85% of rated voltage and at plus 3 Hertz variation in line frequency.
  2. Static, transient and short-circuit protection on all inputs and outputs.
  3. Network-connected devices to be A.C. coupled or equivalent so that any single device failure will not disrupt or halt network communication.
  4. All real time clocks and data file RAM to be battery-backed for a minimum 72 hours and include local and system low battery indication.
  5. It must be possible to receive and print out alarms at a central location even when the operator's workstation at that location is non-operational or taken out of service for periodic maintenance.

### **SUBMITTALS**

Before the BMS Contractor is appointed by the **AC** Contractor the proposed BMS Contractor must submit a copy of this specification showing whether their system conforms with each clause and if not they must submit a detailed schedule of deviations together with a full description of how their system accomplishes the specific requirement.

The engineer reserves the right to reject the proposed BMS Contractor if there are any deviations to the specification.

## PRODUCTS

### Networking Communications

- A. The design of the BMS shall network operator workstations and stand-alone DDC Controllers. The network architecture shall consist of two levels, a high performance peer-to-peer network operating at a up to 19000 baud as well as DDC Controller specific local area networks.
- B. Access to system data shall not be restricted by the hardware configuration of the building management system. The hardware configuration of the BMS network shall be totally transparent to the user when accessing data or developing control programs.
- C. Peer-to-Peer Network Level:
  - 1. Operator workstations and DDC Controllers shall directly reside on a network such that communications may be executed directly between DDC Controllers, directly between workstations and between DDC Controllers and workstations on a peer-to-peer basis.
  - 2. All operator devices either network resident or connected via dial-up modems shall have the ability to access all point status and application report data or execute control functions for any and all other devices via the peer-to-peer network. Access to data shall be based upon logical identification of building equipment. No hardware or software limits shall be imposed on the number of devices with global access to the network data.
  - 3. Network design shall include the following provisions:
    - a. Provide high-speed data transfer rates for alarm reporting, quick report generation from multiple controllers and upload/download efficiency between network devices. System performance shall insure that an alarm occurring at any DDC Controller is displayed at workstations and/or alarm printers within 5 seconds.
    - b. Support of any combination of DDC Controllers and operator workstations directly connected to the peer-to-peer network. A minimum of 64 devices shall be supported on a single network.
    - c. Message and alarm buffering to prevent information from being lost.
    - d. Error detection, correction and retransmission to guarantee data integrity.

- e. Synchronisation of real-time clocks, to include automatic daylight savings time updating between all DDC Controllers shall be provided.
- D. DDC Controller Local Area Network (LAN)
- 1. This level communication shall support a family of application specific controllers and shall communicate bi-directionally with the peer-to-peer network through DDC Controllers for transmission of global data.
  - 2. A maximum of 32 application specific controllers may be configured on individual DDC Controller LANs to insure adequate global data and alarm response times.
- E. Telecommunication Capability:
- 1. Auto-dial/auto-answer communications shall be provided to allow DDC Controllers to communicate with remote operator stations and/or remote terminals on an intermittent basis via telephone lines.
  - 2. Auto-dial DDC Controllers shall automatically place calls to workstations to report alarms or other significant events.
    - a. DDC Controllers shall be able to store a minimum of 10 phone numbers of at least 20 digits. Retry a single primary number at a fixed interval until successful.
    - b. The auto-dial program shall include provisions for handling busy signals, "no answers" and incomplete data transfers. Provide as a minimum 3 secondary numbers when communications cannot be established with the primary device.
  - 3. Operators at dial-up workstations shall be able to perform all control functions, all report functions and all database generation and modification functions as described for workstations connected via the network. Routines shall be provided to automatically answer calls from remote DDC Controllers over telephone lines shall be completely transparent to an operator.
    - a. An operator shall be able to access remote buildings by selection of any facility by its logical name. The workstation dial-up program shall store the phone numbers of each remote site, so the user shall not be required to remember or manually dial telephone numbers.
    - b. A PC workstation may serve as an operator device on a network, as well as a dial-up workstation for multiple auto-dial DDC Controllers on networks. Alarm and data file transfers handled via dial-up transactions shall not interfere with network activity, nor shall network activity keep the workstation from handling incoming calls.
  - 4. Dial-up communications shall make use of TELKOM approved modem

## DDC Controller

- A. Stand-alone Controllers shall be microprocessor-based with a minimum word size of 16 bits. They shall also be multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules.  
Controller size shall be sufficient to fully meet the requirements of this specification.
- B. Each DDC Controller shall have sufficient memory, a minimum of 1,25 megabyte, to support its own operating system and databases, including:
1. Control processes.
  2. Energy Management applications.
  3. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
  4. Historical/trend data for points specified.
  5. Maintenance support applications.
  6. Custom processes.
  7. Operator I/O.
  8. Dial-up communications.
  9. Manual override monitoring.
- C. Each DDC Controller shall support:
1. Monitoring of the following types of inputs, without the addition of equipment outside the DDC Controller cabinet
    - a. Analogue inputs
      - 1) 4-20 mA
      - 2) 0-10 Vdc
      - 3) 100 k ohm Thermistors
      - 4) 1000 ohm RTDs
    - b. Digital inputs
      - 1) Dry contact closure
      - 2) Pulse Accumulator
      - 3) Voltage Sensing
  2. Be capable of providing the following control outputs without the addition of equipment outside the DDC Controller cabinet:-
    - a. Digital outputs (contact closure).
    - b. Direct control of proportional electronic actuators and control devices.Analogue outputs:-
    - 1) 4-20 mA

2) 0-10Vdc

- D. DDC Controllers shall provide at least two RS-232C serial data communication ports for operation of operator I/O devices such as industry standard printers, operator terminals, modems and portable laptop operator's terminals. DDC Controllers shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers or terminals.
- E. Where required the operator shall have the ability to manually override automatic or centrally executed commands at the DDC Controller via local, point discrete, on-board hand/off/auto operator override switches for digital control type points and gradual switches for analogue control type points. These override switches shall be operable whether the panel processor is operational or not.
  - 1. Switches shall be mounted either within the DDC Controllers key-accessed enclosure, or externally mounted with each switch keyed to prevent unauthorised overrides.
  - 2. DDC Controllers shall monitor the status of all overrides and inform the operator that automatic control has been inhibited. DDC Controllers shall also collect override activity information for reports.
- F. DDC Controllers shall provide local **LED** status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Graduated intensity **LEDs** or analogue indication of value shall also be provided for each analogue output. Status indication shall be visible without opening the panel door.
- G. Each DDC Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all panel components. The DDC Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.
- H. Isolation shall be provided at all peer-to-peer network terminations as well as all field point termination's to suppress induced voltage transients consisted with **IEEE** Standards 587-1980.
- I. In the event of the loss of normal power, there shall be an orderly shutdown of all DDC Controllers to prevent the loss of database or operating system software. Nonvolatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.
- J. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.
- K. Should DDC Controller memory be lost for any reason, the user shall have the capability of reloading the DDC Controller via the local RS-232C port, via telephone line dial-in or from a network workstation PC.

## DDC Controller resident software features

### A. General:

1. All necessary software to form a complete operating system as described in this specification shall be provided.
2. The software programs specified in this Section shall be provided as an integral part of DDC Controllers and shall not be dependent upon any higher level computer for execution.

### B. Control Software Description:

1. The DDC Controllers shall have the ability to perform the following pre-tested control algorithms:
  - a. Two-position control.
  - b. Proportional control.
  - c. Proportional plus integral control.
  - d. Proportional, integral, plus derivative control.
  - e. Control loop tuning.
2. Control software shall include a provision for limiting the number of times each piece of equipment may be cycled within anyone-hour period.
3. The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
4. Upon the resumption of normal power, each DDC Controller shall analyse the status of all controlled equipment, compare it with normal occupancy scheduling and turn equipment on or off as necessary to resume normal operations.

### C. DDC Controllers shall have the ability to perform any or all the following energy management routines:

1. Time-of day scheduling.
2. Calendar-based scheduling.
3. Holiday scheduling.
4. Temporary schedule overrides.
5. Start-Stop Time Optimisation.
6. Automatic Daylight Savings Time Switch over.
7. Night setback control.
8. Peak demand limiting.
9. Temperature-compensated duty cycling.
10. Fan speed control.
11. Heating/cooling interlock.
12. Supply air temperature reset.
13. Chilled water reset.
14. Condenser water reset.



All programs shall be executed automatically without the need for operator intervention and shall be flexible enough to allow user customisation. Programs shall be applied to building equipment as described in the Sequence of Operations.

- D. DDC Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.

1. It shall be possible to use any of the following in a custom process:

- a. Any system measured point data or status.
- b. Any calculated data.
- c. Any results from other processes.
- d. User-defined constants.
- e. Arithmetic functions (+, -, \*, /, square root, exp, etc).
- f. Boolean logic operators (and/or, exclusive or, etc).
- g. On-delay/off-delay/one-shot timers. ' - '

2. Custom processes may be triggered based on any combination of the following:

- a. Time interval.
- b. Time-of-day.
- c. Date.
- d. Other processes.
- e. Time programming.
- f. Events (e.g. point alarms).

3. A single process shall be to incorporate measured or calculated data from any and all other DDC Controllers on the network. In addition, a single process shall be able to issue commands to points in any and all DDC Controllers on the network.

4. Processes shall be able to generate operator messages and advisories to operator I/O devices. A process shall be able to directly send a message to a specified device or cause the execution of a dial-up connection to a remote device such as a printer or pager.

5. The custom control programming feature shall be documented via English language descriptors.

- E. Alarm management shall be provided to monitor and direct alarm information to operator devices. Each DDC Controller shall perform distributed, independent alarm analysis and filtering to minimise operator interruptions due to non-critical alarms, minimise network traffic and prevent alarms from being lost. At no time shall the DDC Controllers ability to report alarms be affected by either operator or activity at a PC workstation, local I/O device or communications with other panels on the network.

1. All alarm or point change reports shall include the point's English language description and the time and date of occurrence.
  2. The user shall be able to define the specific system reaction for each point.  
Alarms shall be prioritised to minimise nuisance reporting and to speed operator response to critical alarms. A minimum of six priority levels shall be provided for each point. Point priority levels shall be combined with user definable destination categories (PC, printer, DDC Controller, etc.) to provide full flexibility in defining the handling of system alarms. Each DDC Controller shall automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point. .
  3. Alarm reports and messages will be directed to a user-defined list of operator devices or PCS.
  4. In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 200 character alarm message to more fully describe the alarm condition or direct operator response.
  5. Each DDC Controller shall be capable of storing a library of at least 50 alarm messages. Each message may be assignable to any number of points in the Controller.
  6. In dial-up applications, operator-selected alarms shall initiate a call to a remote operator device.
- F. A variety of historical data collection utilities shall be provided to manually or automatically sample, store and display system data for points as specified in the I/O summary.
1. DDC Controllers shall store point history data for selected analogue and digital inputs and outputs:  
  
Any point, physical or calculated may be designated for trending. Any point, regardless of physical location in the network, may be collected and stored in each DDC Controllers point group. Two methods of collection shall be allowed: either by a pre-defined time interval or upon a pre-defined change of value. Sample intervals of 1 minute to 7 days shall be provided. Each DDC Controller shall have a dedicated RAM-based buffer for trend data and shall be capable of storing a large number of data samples.
  2. Trend data shall be stored at the DDC Controllers and uploaded to the workstation when retrieval is desired. Uploads shall occur based upon either user-defined interval, manual command or when the trend buffers are full.  
All trend data shall be available for user in 3rd party personal computer applications.
  3. DDC Controllers shall also provide high resolution sampling capability for verification of control loop performance. Operator-initiated automatic and manual loop tuning algorithms shall be provided for

operator-selected PID control loops. Provide capability to view or print trend and tuning reports.

a. In automatic mode, the controller shall perform a step response test with a minimum one-second resolution, evaluate the trend data, calculate the new PID gains and input these into the selected LOOP statement.

b. For troubleshooting in manual mode, the operator shall be able to select variables to override default values. Calculated PID gains shall then be reviewed before they are inserted into the selected LOOP statement.

c. Loop tuning shall be capable of being initiated either locally at the OOC controller, from a network workstation or remotely using dial-in modems. For all loop tuning functions, access shall be limited to authorised personnel through password protection.

- G. DDC Controllers shall automatically accumulate and store run-time hours for digital input and output points.
1. The totalisation routine shall have a sampling resolution of one minute or less.
  2. The user shall have the ability to define a warning limit for run-time totalisation. Unique, user-specified messages shall be generated when the limit is reached.
- H. DDC Controllers shall automatically sample, calculate and store consumption totals on a daily, weekly or monthly basis for user-selected analogue and digital pulse input type points.
1. Totalisation shall provide calculation and storage of accumulations of up to 99, 999, 9 units (eg kW, kWh, liters, etc).
  2. The totalisation routine shall have a sampling resolution of one minute or less.
  3. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.
- I. DDC Controllers shall have the ability to count events such as the number of times a pump or fan system is cycled on and off. Event totalisation shall be performed on a daily, weekly or monthly basis.
1. The event totalisation feature shall be able to store the records associated with a minimum of 9, 999, 9 events before reset.
  2. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.

## **APPLICATION SPECIFIC CONTROLLERS (ASC)**

A. Each DDC Controller shall be able to extend its performance and capacity through the use of remote application specific controllers (ASCs)

B. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor.

## **PERSONAL COMPUTER OPERATOR INTERFACE/WORKSTATION HARDWARE**

A. The existing BMS is already accessible via various work stations. Additional workstations are to be provided.

## **WORKSTATION OPERATOR INTERFACE**

A. Basic Interface Description:

1. Operator workstation interface software shall minimise operator training through the use of English language prompting, English language point identification and industry standard PC application software. The software shall provide, as a minimum, the following functionality:-

- a) Graphical viewing and control of environment.
- b) Scheduling and override of building operations.
- c) Collection and analysis of historical data.
- d) Definition and construction of dynamic colour graphic displays.
- e) Editing, programming, storage and down loading of controller databases.

- a) Level 5 = All privileges
- b) A minimum of 50 unique passwords, including user initials, shall be supported.
- c) Operators will be able to perform only those commands available for their respective passwords. Menu selections displayed shall be limited to only those items defined for the access level of the password used on log-on.
- d) The system shall automatically generate a report of log-on/log-off time and system activity for each user.
- e) User-definable automatic log-off timers of from 5 to 60 minutes shall be provided to prevent operators from inadvertently leaving devices online.

2. Provide a graphical user interface which shall minimise the use of a typewriter style keyboard through the use of a mouse or similar pointing device and "point and click" approach to menu selection. Users shall be able to start and stop equipment or change set points from graphical displays through the use of a mouse.

- a) Provide functionality such that all operations can also be performed using the keyboard as a backup interface device.

b) Provide additional capability that allows at least 10 special function keys to perform often-used operations.

3. The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. The mouse shall be used to quickly select and switch between multiple applications. This shall be accomplished through the use of Microsoft Windows.

Provide functionality such that any of the following may be performed simultaneously, and in any combination, via user-sized windows:

- a) Dynamic colour graphics and graphic control.
- b) Alarm management coordinated with DDC Controllers.
- c) Time-of-day scheduling.
- d) Trend data definition and presentation.
- e) Graphic definition.
- f) Graphic construction.

4. Multiple-level password address protection shall be provided to allow the user/manager to limit workstation control, display and data base manipulation capabilities as he deems appropriate for each user, based upon an assigned password.

a) A minimum of five levels of access shall be supported:-

1) Level 1 = view all applications, but perform no database modifications.

2) Level 2 = Custodial privileges plus the ability to acknowledge alarms.

3) Level 3 = All privileges except system configuration.

4) Level 4 = All configuration privileges except passwords.

5. Software shall allow the operator to perform commands including, but not limited to, the following:

- a) Start-up or shutdown selected equipment.
- b) Adjust set points.
- c) Add/modify/delete time programming.
- d) Enable/disable process execution.
- e) Lock/unlock alarm reporting for points.
- f) Enable/disable totalisation for points.
- g) Enable/disable trending for points.
- h) Override PIO loop set points.
- i) Enter temporary override for points.
- j) Define holiday schedules.
- k) Change time/date.
- l) Automatic daylight savings time adjustments.
- m) Enter/modify analogue alarm limits.
- n) Enter/modify analogue warning limits.
- o) View limits.
- p) Enable/disable demand limiting for each meter.
- q) Enable/disable duty cycle for each load.

6. Reports shall be generated and directed to displays, printers or disk. As a minimum, the system shall allow the user to easily obtain the following types of reports:-
  - a) A general listing of all points in the network.
  - b) List of all points currently in alarm.
  - c) List of all points currently in override status.
  - d) List of all disabled points.
  - e) List of all points currently locked out.
  - f) DDC Controller trend overflow warning.
  - g) List all weekly schedules.
  - h) List of holiday programming.
  - i) List of limits and headbands
7. Summaries shall be provided for specific points, for a logical point group, for a user selected group or groups or for the entire facility without restriction due to the hardware configuration of the building automation system. Under no conditions shall the operator need to specify the address of the hardware controller to obtain system information.

#### B. Scheduling:

1. Provide a graphical spreadsheet-type format for simplification of time-of-day scheduling and overrides of building operations. Provide the following spreadsheet graphic types as a minimum:-
  - a) Weekly schedules.
  - b) Zone schedules.
  - c) Monthly calendars.
2. Weekly schedules shall be provided for each building zone or piece of equipment with a specific occupancy schedule. Each schedule shall include columns for each day of the week as well as holiday and special day columns for alternate scheduling on user-defined days. Equipment scheduling shall be accomplished by simply inserting occupancy and vacancy times into appropriate information blocks on the graphic. In addition, temporary overrides and associated times may be inserted into blocks for modified operating schedules. After overrides have been executed, the original schedule will automatically be restored.
3. Zone schedules shall be provided for each building zone as previously described. Each schedule shall include all commendable points residing within the zone. Each point may have a unique schedule of operation relative to the zone's occupancy schedule, allowing for sequential starting and control of equipment within the zone. Scheduling and rescheduling of points may be accomplished easily via the zone schedule graphic.
4. Monthly calendars for a 24-month period shall be provided which allow for simplified scheduling of holidays and special days in advance. Holidays and special days shall be user-selected with the pointing device and shall automatically reschedule equipment operation as previously defined on the weekly schedules.

### C. Collection and Analysis of Historical Data.

1. Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals or changes of value, both of which shall be user-definable. Trend data may be stored on hard disk for future diagnostics and reporting.

2. Trend data report graphics shall be provided to allow the user to view all trended point data. Reports may be customised to include individual points or pre-defined groups of at least 6 points. Provide additional functionality to allow any trended data to be transferred easily to an off-the-shelf spreadsheet package such as Lotus 1-2-3. This shall allow the user to perform custom calculations such as energy usage, equipment efficiency and energy costs and shall allow for generation of these reports on high-quality plots, graphs and charts .

3. Provide additional functionality that allows the user to view trended data on trend graph displays. Displays shall be actual plots of both static and/or real-time single graph, with colour selection and line type for each point being user-definable. Displays shall include an 'X' axis indicating elapsed time and a 'Y' axis indicating a range scale in engineering units for each point. The 'Y' axis shall have the ability to be manually or automatically scaled at the user's option. Different ranges for each point may be used with minimum and maximum values listed at the bottom and top of the 'Y' axis. All 'Y' axis data shall be colour-coded to match the line colour for the corresponding point.

- a) Static graphs shall represent actual point data that has been trended and stored on disk. Exact point values may be viewed on a data window by pointing or scrolling to the place of interest along the graph. Proved capability to print any graph on the system printer for use as a building management and diagnostics tool.
- b) Dynamic graphs shall represent real-time point data. Any point or group of points may be graphed, regardless of whether they have been redefined for trending. The graphs shall continuously update point values. At any time the user may redefine sampling times or range scales for any point. In addition, the user may pause the graph and take "snapshots" of screens to be stored on the workstation disk for future recall and analysis. As with static graphs, exact point values may be viewed and the graphs may be printed.

### D Dynamic Colour Graphic Displays --<sup>1</sup>

1. Colour graphic floor plan displays and system schematics for each piece of mechanical equipment, including air handling units, chilled water systems, shall be provided by the BMS contractor to optimise system performance analysis and speed-up alarm recognition. To accomplish this, the user shall be able to build graphic displays that

include point data from multiple DDC Controllers including Application Specific Controllers.

#### E System Configuration and Definition

1. All temperature and equipment control strategies and energy management routines shall be definable by the operator. System definition and modification procedures shall not interfere with normal system operation and control.
2. The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection or text-based commands.
3. Dynamic temperature, humidity, flow, pressure etc values and status indication shall be shown in their actual respective locations and shall automatically update to represent current conditions without operator intervention.
4. The windowing environment of the PC operator workstation shall allow the user to simultaneously view several graphics at a time to analyse total building operation or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.
5. Graphic generation software shall be provided to allow the user to add, modify or delete system graphic displays.
  - a) The BMS contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (eg fans, cooling coils, filters, dampers, etc) complete mechanical systems (e.g. constant volume-terminal reheat, VAV, etc) and electrical symbols.
  - b) The graphic development package shall use a mouse or similar pointing device in conjunction with a drawing program to allow the user to perform the following:-
    - 1) Define symbols.
    - 2) Position and size symbols.
    - 3) Define background screens.
    - 4) Define connecting lines and curves.
    - 5) Locate, orient and size descriptive text.
    - 6) Define and display colours for all elements.
    - 7) Establish correlation between symbols or text and associated system points or other displays.
  - c) Graphical displays can be created to represent any logical grouping of system points or calculated data based upon building function, mechanical system, building layout or any other logical grouping of points which aids the operator in the analysis of the facility.



2. The system shall be provided complete with all equipment and documentation necessary to allow an operator to independently perform the following functions:
  - a) Add/delete/modify stand-alone DDC Controller panels.
  - b) Add/delete/modify operator workstations.
  - c) Add/delete/modify application specific controllers.
  - d) Add/delete/modify points of any type and all associated point parameters and tuning constants.
  - e) Add/delete/modify alarm reporting definition for points.
  - f) Add/delete/modify control loops.
  - g) Add/delete/modify energy management applications.
  - h) Add/delete/modify time and calendar-based programming.
  - i) Add/delete/modify totalisation for points.
  - j) Add/delete/modify historical data trending for points.
  - k) Add/delete/modify custom control processes.
  - l) Add/delete/modify any and all graphic displays, symbols and cross-reference to point data.
  - m) Add/delete/modify dial-up telecommunication definition.
  - n) Add/delete/modify all operator passwords.
  - o) Add/delete/modify alarm messages.
  
3. Definition of operator device characteristics, DDC Controllers individual points, applications and control sequences shall be performed using instructive prompting software.
  - a) Libraries of standard application modules such as temperature, humidity and static pressure control may be used as "building blocks" in defining or creating new control sequences. In addition, the user shall have the capability to easily create and archive new modules and control sequences as desired via a word processing type format. Provide a library of standard forms to facilitate definition of point characteristics. Forms shall be self-prompting and incorporate a fill-in-the-blank approach for definition of all parameter. The system shall immediately detect an improper entry and automatically display an error message explaining the nature of the mistake.
  - b) If programming must be done with the PC workstation off-line the BMS contractor shall provide at least 2 operator workstations.
  - c) Inputs and outputs for any process shall not be restricted to a single DDC Controller, but shall be able to include data from any and all other network panels to allow the development of network-wide control strategies. Processes shall also allow the operator to use the results of one process as the input to any number of other processes (cascading).
  - d) Provide the capability to backup and store all system databases on the workstation hard disk. In addition, all

database changes shall be performed while the workstation is on-line without disrupting other system operations. Changes shall be automatically recorded and down loaded to the appropriate DDC Controller. Similarly, changes made at the DDC Controllers shall be automatically uploaded to the workstation, ensuring system continuity. The user shall also have the option to selectively download changes as desired.

- e) Provide context-sensitive help menus to provide instructions appropriate with operations and applications currently being performed.

4. It must be possible to use a word processing and/or spreadsheet program such as WINDOWS WORD or EXCEL while the operating software is on line so that alarms and system events continue to be received.

#### Field Devices

- A. All devices and equipment shall be of the same manufacture.
- B. Temperature Sensors.
- C. Humidity Sensors.
- D. Pressure Differential Pressure Sensors.
- E. Dampers Operators.
- F. Automatic Control valves.
- G. Differential Pressure Switch.
- H. Electronic-to-Pneumatic Transducers.

#### INSTALLATION

All extra-low voltage BMS cables shall be run in screened twisted pair cables. They shall be drawn into conduit or trunking and protected as agreed with the engineer to suit the various environmental, social and mechanical locations. Cable specifications shall meet the manufacturers requirements, particularly respecting over-all resistance and capacitance limits. Where possible no joints will be allowed in cables, where these prove necessary the cables shall be jointed using an approved housing, securely fixed and having cable securing clamps. Any such connecting boxes shall be shown on the record drawings. No BMS data cable shall be installed in the same conduit as any power cable nor affixed within 25mm if surface/tray mounted. Where cables are run in trunking or with others clipped to tray of a similar type they shall be identified either by colour of labels every 2m.

Care shall be taken to ensure that the manufacturer's recommendations with respect to earthing data cables and DDC Controllers are obeyed.

Each BMS field device shall be identified (internally on space temperature and humidity sensors) with a common code used on points and wiring schedules, parts lists, Control strategy, MCP and installation diagrams/drawings.

Where a device is fitted with Auto/Man/Off switches, a common circuit shall monitor their auto condition, which shall cause an alarm when any switch is moved from the auto position

All BMS cables shall be suitably with sleeves at the terminations. These shall be recorded on the installation diagrams and wiring schedules.

Sensors, actuators, switches and all field devices shall be mounted according to the manufacturer's instructions. All will be installed with clearance to allow for servicing and the conduit connected by methods to allow easy replacement.

The VAV units are all fitted with speed-controllers and the control system provided is to be fully compatible with the equipment.

The supply temperature for these units is reset by a signal received from the room temperature controllers. Up to 20 room thermostats per air handling unit may be installed.

The room variable air volume diffusers are to be controlled as shown on the schematic drawings. Setpoint adjustment and temperature indication shall be via the BMS.

The controller must incorporate a remote sensor complete with manual set point adjustment. The controller must have facilities to limit the effective set point adjustment at the sensor from zero to  $\pm 5$  deg C with respect to the set point as set via the Operator's Terminal.

The controller must be able to modulate up to 4 VAV diffuser actuators of 3 VA capacities each and switch via an adjustable time proportioning signal up to 43 kW heaters via a 24 vac, 3 VA relay/contractor installed at each diffuser. Where more than 3 slave units are required per master then the necessary relays must be included to cater for this requirement.

Selected diffuser controllers will provide room temp feedback to the air conditioning unit controllers to off-set the respective supply temperatures .

The minimum requirements for the BMS monitoring and control of the VAV diffuser controls are:-

- a) Temperature indication
- b) Set point adjustment
- c) Damper position indication

Where DDC Controllers switch circuits having potentially different mains voltage supply feeds, extra low voltage relay circuit shall be employed. A notice shall be fixed inside the outstation detailing how all mains feeds into it can be isolated. Consideration shall be given to employing an extra low voltage control circuit for motor starter and contractor coils and shall be mandatory where MCP with separate cubicles for motor starters are employed.

In each riser cupboard and Plantroom through which network cables pass and not having an outstation a loop of cable will be made to allow future system expansion.

Network cable will be supplied with at least two spare pairs to allow for future system expansion.

## **COMMISSIONING**

The BMS specialist shall be responsible for the full commissioning of his system and any other controls equipment supplied by him. Commissioning shall be in accordance with the "CIBSE Commissioning Code; Series C, Automatic Controls".

All safety interlocks, overrides and fail-safe conditions are to be operational prior to starting the plant.

Sensors shall be checked to ascertain accuracy within limits, pressure switches checked for switch points and hysteresis.

All the necessary test equipment and materials used in commissioning shall be supplied by

the BMS specialist. All test equipment shall have valid test certificates.

Trend graphs will be provided to demonstrate the stable control of the plant. Simulated inputs will be employed to check stability over the design environmental range.

## **EQUIPMENT CONTROLLED/MONITORED BY THE BMS**

The equipment shall be controlled and monitored as per the control schematics, including:

(BMS - Indicates control, BMS(S) - Indicated status indication)

DDC Controller(s) located within the chiller plant electrical panel will provide the control for the a/c plant as shown on the control schematics.

In addition to the BMS being able to reflect the status of all plant controllers, including the position of all valves and actuators, input from all sensors and value of all set points, additional sensors shall be provided for the monitoring of building supply water temperature (1 off) and return chilled water temperature from the secondary systems.

DDC Controller(s) will control the fresh air systems as shown on the control schematic drawings.

Chilled water air handling units are located on the first floor roof of the building.

Stand-alone controllers will provide the control as indicated on the control schematics.

2.2 DETAILED - FIXED PRICE BILL OF QUANTITY					
CAPE PENINSULA UNIVERSITY OF TECHNOLOGY - ADMIN 2ND FLOOR					
VENTILATION AND AIRCONDITIONING INSTALLATION					
			DRAWING No. J086/30/01		
ITEM	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT
2	<b>EQUIPMENT</b>				
2.1	<b>VRF OUTDOOR UNITS</b> Supply, Installation, Testing and Commissioning of air cooled variable refrigerant flow modular type condensing units, each comprising of multiple scroll compressors all inverter driven, full charge of refrigerant gas (R-410a), lubricating oil and all accessories as per the specifications. The condensing units shall be suitable to work on heating/ cooling mode. The condensing units shall be suitable for operation on 400 ± 10% volts, 50Hz, 3 phase AC power supply and the condensing units shall be of following capacities:				
2.1.1	AC Outdoor Unit - OU_1 - (32 kW)	No	1		
	<b>NOTES:</b> The above mentioned outdoor units shall be provided with anti corrosion treatment (bluechem or Equal and Approved). The quoted price shall be inclusive of same.				
2.2	<b>VRF INDOOR UNITS</b> Supply, Installation, Testing and Commissioning of variable refrigerant flow modular type indoor units wired/wireless remote suitable for R410a refrigerant comprising of all accessories as per the specifications. The indoor units shall be suitable to work on cooling as well as heating mode. The minimum Energy Efficiency Ratio shall be as per ASHRAE STANDARDS 90.1 -2001 table 6.2.1B. The indoor units shall be suitable for operation on 220 ± 6% volts, 50Hz, 1 phase AC power supply. Ductable indoor units shall be suitable to handle extent of ductwork as shown in the design drawings and dehumidified air quantity as mentioned in the heat load summary sheet under "Special Conditions". The indoor unit shall be complete with pre filter & remote as per requirement. The indoor units shall be of following capacities:				
	<b>SYSTEM 1 (HEAT PUMP)</b>				
2.23	room 2.01 high static ducted TC 15.1kW, LC 0.6 Kw.	No	1		
2.24	room 2.02 4 way cassette TC 1.9kW, LC 0.1 KW	No	1		
2.24	room 2.03 4 way cassette TC 2kW, LC 0.1 KW	No	1		
2.24	room 2.04 4 way cassette TC 1.9kW, LC 0.1 KW	No	1		
2.24	room 2.05 4 way cassette TC 1.9kW, LC 0.1 KW	No	1		
2.24	room 2.06 4 way cassette TC 1.9kW, LC 0.1 KW	No	1		
2.24	room 2.07 4 way cassette TC 1.9kW, LC 0.1 KW	No	1		
2.24	room 2.08 4 way cassette TC 1.9kW, LC 0.1 KW	No	1		
2.24	room 2.09 4 way cassette TC 1.9kW, LC 0.1 KW	No	1		
2.26	4 way cassette - AC_0.07 - LG ARNU09GTRC4 (6 kW)	No	1		
2.3	<b>AC UNITS CONTROLLERS</b> Supply, install wall mounted wired AC Unit controllers complete with control wiring, wireways and all required accessories				
2.3.1	Wall mounted - Controllers	No			
2.3.2	Cassette Unit - Controllers	No	9		
2.3.3	Ducted Hide Away Unit - Controllers	No	1		

ITEM	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT
<b>2.4</b>	<b>COPPER PIPING (REFRIGERANT PIPING): RETURNABLE INFORMATION</b> Supply, Installation, Testing & Commissioning of high pressure copper refrigerant piping suitable for R 410a refrigerant of suitable size as required and duly insulated with Amaflex or Equal and Approved insulation. External Refrigerant piping shall be in trunking to protect from UV light damage. Piping inside occupied spaces shall be supported using wire mesh basket tray. <b>The cost of trunking, cable trays, fittings and supports to be included in the quoted price.</b> Entire refrigerant piping work be carried out in accordance with the specifications.				
2.4.1	room 2.01 high static ducted TC 15.1kW, LC 0.6 Kw.	m	26		
2.4.2	room 2.02 4 way cassette TC 1.9kW, LC 0.1 KW	m	25		
2.4.3	room 2.03 4 way cassette TC 2kW, LC 0.1 KW	m	45		
2.4.4	room 2.04 4 way cassette TC 1.9kW, LC 0.1 KW	m	52		
	room 2.05 4 way cassette TC 1.9kW, LC 0.1 KW	m	60		
2.4.5	room 2.06 4 way cassette TC 1.9kW, LC 0.1 KW	m	65		
2.4.6	room 2.07 4 way cassette TC 1.9kW, LC 0.1 KW	m	72		
2.4.7	room 2.08 4 way cassette TC 1.9kW, LC 0.1 KW	m	70		
2.4.8	room 2.09 4 way cassette TC 1.9kW, LC 0.1 KW	m	90		
	room 2.10 4 way cassette TC 1.9kW, LC 0.1 KW	m	100		
<b>2.5</b>	<b>HEAT RECOVERY UNIT</b> Supply, Installation, Testing and Commissioning of heat pump or recovery unit (equivalent to Daikin BS Box or Samsung MCU Unit)				
2.5.1	Heat recovery unit:	No	NIL		#VALUE!
2.5.2	Heat Pump Header/Branch:	No	NIL		
2.5.3	Heat recovery unit:	No	NIL		
<b>2.6</b>	<b>CONDENSATE DRAIN PIPES (CPVC)</b> Supply & installation, testing and commissioning of Rigid heavy class CPVC piping complete with fittings, supports as per specifications.				
	50mm dia	m	LOT		#VALUE!
	40mm dia	m	LOT		#VALUE!
	32mm dia	m	LOT		#VALUE!
	25mm dia	m	LOT		#VALUE!
<b>2.7</b>	<b>CENTRALIZED CONTROLLER</b> Central remote Controller : Supply, installation, testing & commissioning of the Graphic central remote Controller. It must act as an advanced air conditioning management system to facilitate complete control of VRF air conditioning equipment, It should be user friendly through its icon display and color LCD display.	No	1		
<b>2.8</b>	<b>VENTILATION FANS</b> Supply, Installation, Testing and Commissioning of <b>Ventilation Fans</b> complete with suitable <b>Sound Attenuators</b> , hanger rods and support brackets, anti-vibration rubber mounts, and all required accessories to successfully operate				
2.8.1	(FAF 0.1)Fan 1 - Fresh Air 680 l/s @ 400Pa (dia 560 inline EA0714 BP14/1.2	No	NIL		#VALUE!
2.8.2	(FAF 0.2)Fan 2 - Fresh Air 220 l/s @ 150Pa TD500-150 SILENT	No	NIL		#VALUE!
	<b>VENTILATION FAN CONTROLLERS</b> Supply and install on/off controllers for ventilation fans complete with control wiring, wireways and all required accessories				
	Fresh Air Fans - Timers	No	NIL		
	Extract Fans - Motion Sensors	No	NIL		
<b>TOTAL CARRIED TO SUMMARY (EQUIPMENT)</b>					<b>#VALUE!</b>

ITEM	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT
ITEM	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT
<b>3.</b>	<b>AIR DISTRIBUTION</b>				
<b>3.1</b>	<b>AIR CONDITIONING DUCTWORK</b> Supply, Installation, Testing of factory fabricated rectangular ductwork complete with fire retardant gaskets, slip on flanges, wire rope suspension arrangement, perforated 'C' channel supports etc. in accordance with the approved shop drawings and specifications.	m <sup>2</sup>	NIL		
	Supply, Installation, Testing of factory fabricated Circular ductwork complete with fire retardant gaskets, wire rope suspension arrangement, l supports etc and all require accessories. In accordance with the approved shop drawings and specifications.	m <sup>2</sup>	NIL		
<b>3.2</b>	<b>DUCT INSULATION</b> Supply and Installation thermal insulation of ducting 50mm FRK Foil Faced Fibreglass insulation	m <sup>2</sup>			
<b>3.3</b>	<b>VENTILATION DUCTWORK</b> Supply, Installation, Testing of factory fabricated rectangular ductwork complete with fire retardant gaskets, slip on flanges, wire rope suspension arrangement, perforated 'C' channel supports etc. in accordance with the approved shop drawings and specifications.	m <sup>2</sup>	NIL		
	Supply, Installation, Testing of factory fabricated Circular ductwork complete with fire retardant gaskets, wire rope suspension arrangement, l supports etc and all require accessories. In accordance with the approved shop drawings and specifications.	m <sup>2</sup>	NIL		
<b>3.4</b>	<b>WEATHER LOUVRES</b> Supply and Installation of Weather Louvres of powder coated /anodised extruded aluminium. Fresh Air @680 l/s - 660 X 660 Fresh Air @220 l/s - 400 x 400	No	NIL		
<b>3.5</b>	<b>FRESH AIR FILTERS</b> Supply and Installation of Fresh Air Filters Fresh Air @680 l/s - 660 X 660 Fresh Air @220 l/s - 400 x 400	No	NIL		
<b>3.6</b>	<b>SUPPLY AIR GRILLS</b> Supply, Installation, Testing & Balancing of duct mounted supply air grills complete with removable key-operated volume control damper. 200 l/s SUPPLY AIR GRILLS	No	NIL		
<b>3.7</b>	<b>RETURN AIR GRILLES</b> Supply and installation of return air grilles complete with OBDs, plenum boxes and insulated flexible ducting maximum 1500mm long RSV 595x1195	No	NIL		
<b>3.8</b>	<b>DISC VALVES</b> Supply, Installation, Testing & Balancing of disc valves complete with metal duct clamps, maximum 1500mm long flexible ducting, fixed air distribution grid, removable key-operated volume control damper. Ø150	No	NIL		
<b>3.9</b>	<b>VOLUME CONTROL DAMPERS</b> Supply, Installation, Testing & Balancing of volume control dampers complete with all required accessories Ø150	No	NIL		
<b>3.10</b>	<b>DOOR GRILLES</b> Supply and installation of door grilles complete with making good after installation 400 x 200	No	NIL		
<b>TOTAL CARRIED TO SUMMARY (AIR DISTRIBUTION)</b>					

ITEM	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT
ITEM	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT
<b>4.</b>	<b>ELECTRICAL INSTALLATION AND BUILDER'S WORK</b>				
<b>4.1</b>	<b>ELECTRICAL ISOLATORS</b>				
	Supply and installation of electrical weather proof isolators complete with all required accessories				
4.1.1	AC Units (single phase)	No	9		
4.1.2	OU Units (3 phase)	No	1		
4.1.3	Fans	No	NIL		#VALUE!
<b>4.2</b>	<b>ELECTRICAL DB</b>				
	Supply and Installation of electrical DB for AC Units and Fans complete with wiring, wireways and all required accessories				
4.2.1	Ventilation and Air Conditioning DB	No	1		
4.2.2	Other (Specify):				
<b>4.3</b>	<b>BUILDER'S WORK</b>				
	Cutting of ceilings for diffusers				
	Making penetrations through walls for weather louvres, ducting and piping complete with making good after installation				
4.3.1	Plinths for Outdoor Units	No	1		
4.3.2	Door Undercut:	No	NIL		
4.3.3	Other (Specify):				
<b>TOTAL CARRIED TO SUMMARY (ELECTRICAL &amp; BUILDER'S WORK)</b>					<b>#VALUE!</b>



2.1 PRICE ON PRELIMINARIES AND GENERALS					
CAPE PENINSULA UNIVERSITY OF TECHNOLOGY - HOTEL SCHOOL GROUND FLOOR					
VENTILATION AND AIRCONDITIONING INSTALLATION					
ITEM	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT
<b>1</b>	<b>BILL 1</b>				
1.1	Clearance of Rubbish		1		
1.2	Retention interest		1		
1.3	Site Establishment & Clearance		1		
1.4	Scaffolding		1		
1.5	Performance Guarantee		1		
1.6	Payment Guarantee		1		
1.7	Staff organisation		1		
1.8	Progress for Measurement		1		
1.9	Attendance for Measurement		1		
1.10	Tests and Site Inspections		1		
1.11	Preparation of Operating and Maintenance Manuals		1		
1.12	As-built Drawings		1		
1.13	12 Months Guarantee & Maintenance		1		
1.14	Programming of the Work		1		
1.15	Testing and Commissioning		1		
1.16	Equipment Submissions for Approval		1		
1.17	Contract Drawings		1		
1.18	Contract Management		1		
1.19	Office Administration		1		
1.20	Van and Car Trips		1		
1.21	Rigging and Crane Hire		1		
1.22	Equipment Labels		1		
1.23	Overtime and Acceleration		1		
1.24	Power for Commissioning		1		
1.25	Client Staff Training		1		
<b>1.26</b>	<b>Other (Specify):</b>				
a)					
b)					
c)					
<b>TOTAL CARRIED TO SUMMARY (EQUIPMENT)</b>					<b>R</b>

## PART TWO

### 2.0 SUMMARY - BOQ (FIXED PRICE CONTRACT)

<b>BILL OF QUANTITY</b>
<b>CAPE PENINSULA UNIVERSITY OF TECHNOLOGY</b>
<b>ADMIN 2ND FLOOR</b>
<b>VENTILATION AND AIRCONDITIONING INSTALLATION</b>

#### SUMMARY OF COSTS

ITEM	DESCRIPTION	AMOUNT (RAND)
1	PRELIMARIES AND GENERAL	R
2	EQUIPMENT	R
3	AIR DISTRIBUTION	R
4	ELECTRICAL & BUILDER'S WORK	R
	<b>SUB-TOTAL</b>	<b>R</b>

	5% CONTIGENCY	R
	TOTAL	R
	ADD 15% VAT	R
	<b>GRAND TOTAL</b>	<b>R</b>

# PART THREE

## NOTICE TO TENDERERS

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### 3.1 UNCERTAINTIES

Uncertainties and doubts as to the meaning and interpretation of items in these documents and drawings shall be referred to the Malatji & Associates for explanation and, if necessary, correction before Tenders is submitted.

### 3.2 ACCEPTANCE OF TENDER

The lowest or any Tender will not necessarily be accepted. Any Tender which does not comply with the requirements stated in these documents may be considered invalid. Tenderers may include with their Tenders any descriptive matter which, if referred to in the Tender, will form part of the Tender. In case of any discrepancy, however, the issued Tender and Contract documents and information completed therein by the Tenderer, will be considered as the valid and binding Tender.

### 3.3 COPYRIGHT

No part of any document enclosed with this enquiry may be copied, photographed or repeated in any manner or by any process, without the written consent of the Malatji & Associates. Copyright is reserved on all designs, specifications, patents and patentable designs, systems and processes contained in the documents and drawings. The person, firm, body or contractor to whom these documents are issued or made available, shall be held responsible jointly and severally, in their personal and corporate capacities for any contravention of this requirement for tendering and/or copyright clause contained in the documents.

### 3.4 ELECTRONIC SUBMISSIONS

Tender(s) shall be submitted electronically to the parties described in Tender Details' page.

### 3.5 SUBMISSION OF TENDERS

Tenders shall be submitted on the Form of Tender accompanied by all the documents issued herewith duly completed. The Tenders will be opened by the Employer or the Employer's Representative in public immediately after the closing time on the date and the place advertised and/or set out in the enquiry. Only Tender prices entered in the Form of Tender will be disclosed.

### 3.6 VALIDITY OF TENDERS

Tenders shall hold good for 45 (forty five) days from the closing date stated in the enquiry. During the validity period Tender prices shall not be altered, amended or withdrawn during that period. The lowest tender will not necessarily be accepted.

The period for which tenders must remain valid is calculated from the closing date of tenders, but does not include it, and in the event of such period expiring on a Sunday, Public Holiday or another day on which the offices are closed, such tenders must remain valid until the closing time of the first day of the office following such expiry date.

### 3.7 SCHEDULES TO BE COMPLETED

All schedules to these documents shall be filled in and completed by Tenderers to the extent indicated in the document. Non-compliance with this requirement may invalidate a Tender.

### 3.8 SCHEDULE OF SUBCONTRACTS

The Tenderer shall state in the Schedule of Proposed Subcontractors the name of any Subcontractors he proposes to employ to assist him to complete the Works and the proposed extent of the Subcontractor's responsibilities.

### 3.9 OTHER OFFERS

If the Tenderer wishes to submit other offers in place of any of the provisions set out in this document, he shall set out details of his proposals in an accompanying letter.

### 3.10 VALUE ADDED TAX

Tenderers shall allow for Value Added Tax in the Tender prices as indicated in the Form of Tender and, if applicable, the Schedule of Quantities. Should the percentage tax be adjusted during the currency of the contract, the increase or decrease will apply only to such materials as have not been purchased at the date of the change.

### 3.11 INSPECTION ON SITE

The Tenderer shall inspect and examine the site and its surroundings and shall satisfy himself before submitting his Tender as to the nature of the ground and sub-soil so far as is practicable, the form and nature of the Site, the quantities and nature of the work and materials necessary for the completion of the Works and the means of access to the Site as well as the accommodation he may require; and in general shall himself obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect his Tender.

All costs associated with such inspection shall be for the tenderer's account.

### 3.12 SUFFICIENCY OF TENDER

The Tenderer shall be deemed to have satisfied himself before tendering as to the correctness and sufficiency of his Tender for the Works and of the rates and prices he has stated in the Schedules which rates and prices shall cover all his obligations under the Contract and all matters and things necessary for the proper completion of the Works.

### 3.13 RATES / PRICES

The rates and prices inserted in the Contract Documentation shall be deemed to include, but shall not be limited to the following:

- materials, workmanship and utilization of plant and equipment,
- transport, unloading, storing and hoisting to all levels of all materials,
- temporary works,
- cutting and waste,
- overhead charges and profit,

- stoppage for inspection purposes by the Principal Agent or Engineer,
- overtime working necessary to complete the Works within the time for completion.

Value Added Tax shall not be included with the rates and prices, but shall be shown separately on the Form of Tender.

### 3.14 OCCUPATIONAL HEALTH AND SAFETY ACT

Tenderers must note, and make provision for, the fact that the successful tenderer will be required to execute the contract works in strict compliance with the relevant clauses of the *Occupational Health and Safety Act*.

# PART FOUR

## TENDER PRICING SCHEDULE (FIXED PRICE)

### 4.1 GENERAL NOTES

This Tender Price Schedule contains pages numbered consecutively in each section as indicated in the Master Index. Before the Tenderer submits his tender he should check the number of pages, and if any are found missing or duplicated, or the figures or writing indistinct, or the Tender Price Schedule contains any obvious errors, he should apply to the Engineer immediately and have same rectified, as no liability whatsoever will be admitted by the Engineer in respect of errors in tender due to the foregoing.

The Tender Price Schedule forms part of, and must be read in conjunction with the Specification, which document contains a full description of the work to be done and material and equipment to be used. Unless otherwise described in the Tender Price Schedule, reference should be made to the Specification for the full meaning and description of work to be done, and materials and equipment to be used in this service. The tender prices shall be based on the equipment as specified in Part 7 of this specification and on the drawings. Prices for alternative makes of equipment shall be provided separately.

The total of the Tender Price Schedule constitutes the basis of evaluation and comparison of tenders.

Tenderers are advised to check their total additions, as no claim for arithmetical errors will be considered.

No alteration, erasure nor addition is to be made in the text of the Tender Price Schedule. Should any alteration, erasure or addition be made, it will not be recognised, but the original wording of the Tender Price Schedule will be adhered to.

The priced Tender Price Schedule for the successful tender will be checked and the Engineer reserves the right to call for adjustments to any individual price to rectify any discrepancies whilst the total tender prices, as submitted, remains unaltered.

The tenderer is relieved of responsibility of measuring quantities at the tender stage, and the tender sum submitted shall be in respect of the quantities set out in the Parts 6 and 7 of the specification and as indicated on the drawings, although he/she will be required to make his/her assessment of items such as brackets, fixings, etc., from details stated in the specification and on the drawings and shall include in the prices for such small installation materials as are required for the complete installation in accordance with the Specification.

Variations in the scope and extent of the work included in the Tender Price Schedule shall be allowed to meet the Employer's requirements and shall be measured and costed at rates entered in the Tender Price Schedule and in Part 9, where appropriate, and shall form an addition to or deduction from the total of the Tender Price. Any items or variation for which prices have not been included in the Tender Price Schedule shall be agreed and priced as non-scheduled items in accordance with the provisions of the contract.

Variations to the planning before the work has been executed shall be priced as above. Alterations to work already executed cannot necessarily be priced as above and must be reviewed on its merits.

All contingency and/or Provisional Sums (if applicable) shall be expended as directed by the Engineer and any balance remaining shall be deducted from the amount of the contract sum.

No work for which "provisional" items are provided shall be commenced without written instructions from the Engineer.

The prices and rates quoted under this section shall be deemed to include all the Equipment, Materials and Labour required to carry out works specified and to comply with Site Requirements and Conditions and Local Regulations and Legislation.

Prices and Rates shall include:

- (a) Nett cost of materials and equipment necessary for each item and system and delivered on site (excluding 15% VAT).
- (b) Nett cost of labour as necessary for each item.
- (c) All temporary works, stocking, scaffolding, tooling, hoisting and rigging, transport on site, handling, waste, travelling time etc., not included in the preliminary and general provisions for the Subcontract.
- (d) Profit and Overhead.
- (e) Drafting, Engineering & Contract Management.
- (f) All costs to comply with the rules and regulations of the Occupational Health and Safety Act.

All the costs associated with the following must be listed as separate costs in the Tender Price Schedule:

- (a) Preliminary & General Costs
- (b) Hoisting, Rigging and Cranage
- (c) Value Added Tax (at 15%)



**4.2 ADMIN 2<sup>ND</sup> FLOOR LEVEL:**

	<u>Description</u>	<u>Labour</u>	<u>Materials</u>	<u>Total</u>
4.2.1	Supply and installation of the main HVAC system to the 2 <sup>ND</sup> FLOOR LEVEL	R.....	R.....	R.....
4.2.2	Supply and installation of the electrical and controls installation applicable. Roeland level 1	R.....	R.....	<u>R.....</u>
4.2.3	<b>Sub Total</b>			R.....
4.2.4	Supply only one set of spare filter panels and one set of filters panels for testing and commissioning			R.....
4.2.5	Testing, balancing and commissioning of all the AC & ventilation systems			R.....
4.2.6	O&M Manuals (complete with "As-built" drawings & diagrams)			R.....
4.2.7	12 Months free maintenance and guarantee			R.....
4.2.8	Preliminary & General Items			R.....
4.2.9	Hoisting, Rigging & Cranage			<u>R.....</u>

**TOTAL TENDER AMOUNT FOR ADMIN SECOND FLOOR LEVEL 1 (FIXED PRICE)**

**R.....**  
(Carried forward to Price Summary)

**4.3 ADMIN 3<sup>RD</sup> AND 4<sup>TH</sup> FLOOR LEVEL LIBRARY:**

	<u>Description</u>	<u>Labour</u>	<u>Materials</u>	<u>Total</u>
4.3.1	Supply and installation (MODIFICATION) HVAC system to the ADMIN 3 <sup>RD</sup> AND 4 <sup>TH</sup> LEVEL	R.....	R.....	R.....
4.3.2	Supply and installation of the electrical and BMS controls installation applicable. 3 <sup>RD</sup> AND 4 <sup>TH</sup> LEVEL	R.....	R.....	<u>R.....</u>
4.3.3	<b>Sub Total</b>			R.....
4.3.4	Supply only one set of spare filter panels and one set of filters panels for testing and commissioning			R.....
4.3.5	Testing, balancing and commissioning of all the AC & ventilation systems			R.....
4.3.6	O&M Manuals (complete with "As-built" drawings & diagrams)			R.....
4.3.7	12 Months free maintenance and guarantee			R.....
4.3.8	Preliminary & General Items			R.....
4.3.9	Hoisting, Rigging & Cranage			<u>R.....</u>

**TOTAL TENDER AMOUNT FOR ADMIN THIRD AND FOURTH FLOOR LEVEL 1 (FIXED PRICE)**

**R.....**  
(Carried forward to Price Summary)

**4.4            PRICE SUMMARY:**

4.4.1	ADMIN SECOND FLOOR LEVEL	R.....
4.4.1	ADMIN 3 <sup>RD</sup> AND 4TH LEVEL	R.....
	Sub Total	R.....
	Add 10% Contingency Sum	<u>R.....</u>
	Sub Total	R.....
	Add VAT @ 15%	<u>R.....</u>
	<b>TOTAL TENDER AMOUNT – INCL. VAT (FIXED PRICE)</b>	<b><u>R.....</u></b>

(Carried forward to JBCC 2000 “FORM OF TENDER”)

Name of Firm: .....

Name of Tenderer: .....

Signature of Tenderer: .....

Telephone No.: .....

Fax No.: .....

Date: .....

Company Stamp:

# PART FIVE

## SCHEDULE OF RATES

(APPLICABLE TO TENDER PRICES AND FOR UNSCHEDULED WORK)

### 5.1 GENERAL

#### 5.1.1 Unit price schedule, to be filled in by tenderers

Including:

Supply	Delivery
Installation	Profit
Wastage	Administration
Office Expenses	Drawing office expenses

Excluding : Value Added Tax

### 5.2 SHEET METAL, INSULATION & PAINTING

#### 5.2.1 Sheet metal - including supports, hangers, joints, price based on rate of sheet metal installed:

0,6 mm thick	R...../per m <sup>2</sup>
0,8 mm thick	R...../per m <sup>2</sup>
1,0 mm thick	R...../per m <sup>2</sup>
1,2 mm thick	R...../per m <sup>2</sup>

5.2.2 Cost to be added to above for external 25 mm thick foil faced fibre glass (FRK) insulation. R...../m<sup>2</sup>

5.2.3 Cost to be added to above for internal 25 mm thick Sonic Liner insulation R...../m<sup>2</sup>

5.2.4 Cost to be added to above for external 30 mm thick high density polystyrene boards covered and coated with fibreglass mat and coloured resin coat R...../m<sup>2</sup>

5.2.4 Cost to be added to above for painting of sheet metal & spiral ducting (including cleaning, preparation, primer coat, under coat and two final coats) R...../m<sup>2</sup>

### 5.3 SPIRAL DUCTING

Including supports, hangers, joints, price based on the lengths installed.

1250 dia.	R...../m
1120 dia.	R...../m
1000 dia.	R...../m
900 dia.	R...../m
800 dia.	R...../m
710 dia.	R...../m
630 dia.	R...../m
560 dia.	R...../m
500 dia.	R...../m
450 dia.	R...../m
400 dia.	R...../m
355 dia.	R...../m
315 dia.	R...../m
250 dia.	R...../m
200 dia.	R...../m
160 dia.	R...../m
100 dia.	R...../m

### 5.4 PIPING (Drain & Refrigerant)

#### 5.4.1 Soft drawn copper – Refrigeration & Drain Piping - (insulated)

	Per m Straight Length	Per Elbow	Per Equal Tee	Per Reducer
10 dia.	R	R	R	R
13 dia.	R	R	R	R
16 dia.	R	R	R	R
19 dia.	R	R	R	R
22 dia.	R	R	R	R
28 dia.	R	R	R	R
35 dia.	R	R	R	R

#### 5.4.2 Galvanised Drain Piping – (insulated)

22 mm dia.	R...../m length
32 mm dia.	R...../m length
40 mm dia.	R...../m length

#### 5.4.3 PVC Drain Piping – (insulated)

12 mm dia. R...../m length  
 22 mm dia. R...../m length  
 32mm dia. R...../m length

5.5 PRICE FOR LABOUR

Including bonus, profit, compulsory contributions, overhead, supervision, administration and drawing office time:

TYPE	PER HOUR (R)
Erector (Artisan & 2 Labourers)	R
Fitter (Pipe fitter & 1 Labourer)	R
Electrician	R
Other (specify)	R

5.6 TRAVELLING

Distance from office/ workshop to site .....km  
 Travelling charges ..... R/km

5.7 PRICE FOR MATERIALS

SCHEDULED:

Including overheads and profit:

Capital Items: Cost plus .....%  
 Regular Materials: Cost plus .....%  
 Subcontractors, crantage, etc. Cost plus .....%

UNSCHEDULED:

Including overheads and profit:

Capital Items: Cost plus .....%  
 Regular Materials: Cost plus .....%  
 Subcontractors, crantage, etc. Cost plus .....%

5.8 DECLARATION

I hereby certify that the above information is true and correct.

Signature of Tenderer \_\_\_\_\_

Name \_\_\_\_\_

Firms name \_\_\_\_\_

Address \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Telephone No. \_\_\_\_\_

Dated this \_\_\_\_\_ day of \_\_\_\_\_ 2019

Witnesses 1. \_\_\_\_\_

2. \_\_\_\_\_

Company Stamp