TENDER NUMBER: GEP001-SUPERBLOCK/18

ISSUED BY:
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NAME OF THE TENDERER: : .....

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PART C – MECHANICAL INSTALLATIONS

TENDER FOR THE APPOINTMENT OF A CONTRACTOR FOR CONSTRUCTION OF JEWELLERY MANUFACTURING PRECINCT (JMP) SUPERBLOCK BUILDING :(BUILDING 4)

FEBRUARY 2018

PART C – MECHANICAL INSTALLATIONS

PART C-1: HVAC & FIRE

Specifications & BOQ

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TECHNICAL SPECIFICATION

1 GENERAL AND REQUIREMENTS

1.1 SCOPE

This specification covers the supply, delivery, erection, wiring, installation, testing, commissioning and handing over in complete working order, ready for immediate use and the subsequent monthly maintenance and guarantee for a period of twelve months of all plant and equipment necessary for the complete Air-conditioning and Ventilation System at **838 JMP**. All the work shall be carried out to the complete satisfaction of the Client and Consulting Engineer

1.2 REFERENCE SPECIFICATIONS AND STANDARDS

The latest revision of any specification, code of practice or standard referred to in this specification shall apply.

Equipment, materials and operational methods shall in order of preference, comply with the relevant SANS, NS, ISO, BSS, DIN or equivalent American Standard whether prescribed or not.

1.3 STATUTORY REQUIREMENTS AND OTHER STANDARDS

The equipment shall be manufactured, erected, built, constructed, commissioned and tested in compliance with the following regulations and standards where applicable:

- Code of practice for wiring or premises – SANS-10142-1.
- Occupational Health and Safety Act, Act 85 of 1993.
- Mines and Work Regulations Government Notice R1609 of 28 September 1962, as amended.
- National Building regulations. SANS Code 10400.
- Local municipal bylaws and regulations as well as regulations of the local electrical supply authority. The bylaws and regulations applicable to be those of the Ekurhuleni Municipality or those applicable in that geographical area.
- Local fire regulations.
- All applicable SANS specifications or BS specifications where no SANS specification exists.

All losses, costs or expenditures which may arise as a result of failure to comply with any regulation applicable to this service as specified above shall be for the account of the contractor.

Should any requirement, bylaw or regulation which applied at the time of tender or which becomes applicable during the supply of the installation, contradicts any requirement of this or the standard specifications, such requirement, bylaw or regulation shall over-rule this or the standard specifications and the Contractor shall inform the Engineer immediately of such a contradiction.

The Engineer shall also inform the Contractor of any contradiction of which he is made aware of during the supply of the installation.

1.4 MANUFACTURER'S RATINGS

All equipment specified shall operate well within the manufacturer's ratings. Any tender offering equipment for use beyond these limits will not be considered.

Tenderers shall submit manufacturer's ratings and all technical information of all equipment offered for the full range of capacities, requirements, pressure & temperature ranges, sizes, etc.

1.5 POWER AND DRAIN CONNECTIONS

All plumbing between equipment, water and drain points shall form part of this contract and the Contractor shall supply and deliver the equipment required.

The power supply from the distribution boards up to a main isolator including the final connections from the isolator to the equipment shall form part of this contract. The Contractor shall therefore supply all electrical and control equipment required for the final connections.

1.6 SPACE FOR EQUIPMENT AND ACCESS

Tenderers shall satisfy themselves that the equipment offered by them can be accommodated in the available space as shown in the drawings. Should it be found at a later date that the equipment offered does not fit, all costs arising from the rectification of this problem shall be for the Contractors account.

Tenderers shall satisfy themselves that the equipment as offered by them will pass through available building openings. Large equipment shall be made up in sections and each section shall be small enough for access through doors and other building openings. All additional costs involved for the modification of equipment or to change the make of equipment in order to allow access shall be for the account of the Contractor and shall form part of this tender.

1.7 INSURANCE AND SURETY

The Mechanical Contractor shall carry Insurance and surety in accordance with the contract requirements.

1.8 INSPECTION, TESTING AND COMMISSIONING

The Client reserves the right to arrange for the inspection of all goods forming the specification at any stage before final acceptance and by any means it may think fit, and when such inspection is to be carried out, the relevant contracts, orders or sub-orders shall, be endorsed accordingly.

The Contractor shall supply, without charge to the Client, all tools, gauges, templates and other equipment which may be required for checking the accuracy of the work; shall provide the labour necessary for inspecting the work or order and shall render all reasonable assistance in carrying out this checking and inspection.

1.9 OPERATION AND MAINTENANCE MANUALS

The Contractor shall prepare and supply manuals for the successful installation, operation and maintenance of the equipment. A draft of the manual shall be submitted after pre-testing for approval. The draft shall then be corrected, if required, and two sets of the manual shall be submitted before delivery and hand-over of the equipment will be taken.

The manual shall contain the following information:

a) **Equipment data (mechanical / electrical and controls):**

- Description of all equipment (make, model, ratings, etc.)
- Manufacturer, brochures and numbers.
- Design capacities, selection parameters, size and rating.
- Pressures and temperature limitations (if applicable).

b) **Operating procedures / instructions :**

- Starting and stopping procedures.
- Abnormal and emergency operating procedures.
- Safety devices and settings.
- Manual operation.
- Operator's duties.
- Temperature, pressure, etc. settings for controllers, etc .

c) **Testing data**

The results of all checks and measurements as recorded during the testing and commissioning period shall be included and shall be compiled in such a manner that every check and measurement is clearly defined.

d) **Maintenance instruction:**

- Routine maintenance calendar.
- All maintenance procedures.
- Trouble shooting guide.
- Maintenance schedules for all equipment.
- Maintenance data and record books.

e) **Spares:**

- List of all spares and model numbers.
- Addresses and contact numbers of suppliers.

f) **Drawings**

Refer to “Drawings”, paragraph 1.10.

The operating maintenance instructions specified above shall preferably be obtained from the equipment manufacturer and where no such manuals exists, they shall be compiled by the Contractor to the best of his ability and approved by the Engineer.

The contract will be considered incomplete until all test and commissioning results and certificates have been conducted to the satisfaction of the client’s representative and all drawings and manuals have been handed over to the Engineer / Client.

1.10 DRAWINGS

The contractor is to supply all drawings required for manufacture and installation and drawings shall be in accordance with SABS 0111, Code of Practice for Engineering Drawings. Refer to clause 1.4 of the SPAC and 3.10 of the SPEI.

Engineers’ drawings issued for the service are not manufacturing drawings and the dimensions given are sufficient for tendering purposes only or to enable the contractor to complete his working drawings.

Three copies of the following drawings shall be submitted by the Contractor to the Engineer/Client for approval before the supply/delivery of the equipment.

a) Contractor’s working drawings

These are structural or other drawings on which all building requirements as indicated on the engineer’s drawings are verified. Contractor’s working drawings shall also include positions, sizes and masses of major pieces of equipment, positions, sizes and masses of bases for the equipment, all piping connections, as well as all other building requirements necessary for the successful installation and operation of the plants.

b) Mechanical drawings

These are all workshop and equipment layout drawings required for the erection of the installation.

The Contractor shall check in detail the Engineers and Architect drawings issued and take measurements on site before workshop drawings are issued for construction or equipment is manufactured, to ensure that the equipment will fit into the space available. Positions and sizes of openings through walls, floors, etc., as indicated on the Engineering/Architect drawings shall be adhered to.

All piping routes and piping accessories shall be shown in detail on the mechanical drawings.

Drawings, except Contractor's drawings, shall be submitted for approval but shall in any event not be submitted later than six weeks after the date of acceptance of the tender. The Contractor shall base his drawings on the Architects, Structural and Engineer's drawings issued to him by the Client.

The Contractor is advised to submit three copies of the mechanical workshop drawings for comments by the representative after which his original drawings shall be updated and submitted for signature to ensure that all drawings issued for construction are certified as approved by the Engineer.

The following information shall be supplied with workshop drawings:

Certified dimension drawings, indicating pipe sizes, location of equipment, component parts and installation details.

Manufacturer's specifications, including materials, type and capacity ratings.

A list of all deviations from the plans and specifications and reasons for the deviation.

Electrical control panel wiring diagrams and panel layout drawings.

Pipe support and bracket construction detail drawings.

Any work carried out by the Contractor without approved drawing shall be at the Contractor's own risk and any changes required to conform to the contract Documents or to co-ordinate his work with other trades shall be for the account of the Contractor.

Approval of drawings by the Engineer shall not relieve the Contractor of his responsibilities to carry out the work in terms of the contract documents.

The mechanical drawings shall be updated (if applicable) during the contract period and shall be included in the O and M manual as required.

1.11 TESTING AND ACCEPTANCE

The Contractor shall test all equipment to be supplied in accordance to any recognized testing procedure or code approved by the Engineer/Client. The contractor shall submit, at least two weeks prior to the commencement of the testing, a testing program and check lists to the Engineer/Client and at the same time notify the Engineer/Client of the code or procedure to which all equipment to be supplied will be tested. The results of all checks and measurements shall be recorded in writing during the testing period and the Engineer/Client representative must witness these tests. Certified testing records shall be handed to the Engineer/Client. The following equipment shall be tested.

- VRV Air Conditioning Systems
- Rooftop Packaged Unit
- Fresh air systems

- Extraction air systems

The equipment shall be tested in accordance with the following codes, standards or any other recognized commissioning procedure or code approved by the Engineer/Client before testing commences:

a) Control systems - CIBS: Commissioning Code: Series C: Automatic Controls.

b) Air distribution systems may as an alternative be commissioned in accordance with CIBS: Commissioning Code: Series A: Air Distribution.

Air quantities as specified in the specification and drawings are quantities required when filters are approximately 75% dirty (75% between initial clean filter resistance and recommended final resistance not to be exceeded in accordance with the. Fan speeds and blade settings shall be selected at a static pressure loss of 180 Pa through each stage of filtration (360 Pa for primary and secondary filters). Clean filters shall be partially blanked off until the above pressures are reached before fans are adjusted. The pressure must be maintained at the initially set value, as indicated, throughout the complete process of adjustment.

Testing, balancing and commissioning shall consist of the following:

1. Checking of all safeties by means of simulated overload conditions.

2. Checking and setting of protection devices to stop the operation of equipment at overload or abnormal conditions.

3. Balancing of water systems including all existing secondary and tertiary systems connected to the new system.

4. Checking the performance criteria by plotting it on the original selection curve of all fans and pumps.

5. Marking operating values (temperatures, pressures, amps, etc.) on gauges and thermometers as appropriate.

6. Compile a field test report of the above tests for inclusion in the operating and maintenance manual.

The testing, balancing and commissioning report shall be submitted to the Engineer for approval prior to application for final hand-over.

NOTE:

All testing operations shall be witnessed and approved by the Engineer.

1.12 GUARANTEE

The Contractor shall guarantee that the equipment offered will give satisfactory and efficient service, for a period of one year from the date of practical completion, and to replace or repair, with a minimum of delay and free of charge, any components which may fail other than by fair wear and tear during this period.

1.13 PAINTING

Iron and steel surfaces must be properly cleaned by removing all dirt, oil, scale and rust by brushing and sanding until a clean shiny surface is obtained. Hereafter a metal primer must be applied.

Galvanized surfaces must be cleaned with a galvanizing cleaning agent and then washed with clean water to remove the factory-applied protection against white rust. Hereafter a calcium plumbate primer must be applied, followed by an undercoat between 24 and 72 hours after application of the primer.

Other surfaces must be cleaned by removing all dirt and a primer as specified by the paint suppliers for the particular surface must be applied.

Metal surfaces shall be painted as follows:

Surfaces shall be thoroughly cleaned in accordance with SNBS 064. A zinc chromate primer complying with SANS 679 type 1 shall then be applied. Finally two coats of paint complying with Grade 1 of SANS 630 shall be applied.

The primer coat must be followed by a matt undercoat and a final top coat of high gloss enamel of a colour approved by the Engineer.

Each layer of paint must be clearly distinguishable from each other by means of different colours and each layer must be properly sanded before the following coat is applied.

All paint must be at least SANS quality for industrial use and must be approved by the Engineer, both regarding quality and colour. Colour coding shall be according to SANS 10140 Part IV

The following SANS codes shall apply:

SANS 10064	PREPARATION OF STEEL SURFACES FOR PAINTING
SANS 10140	IDENTIFICATION COLOUR CODING (ALL PARTS)
SANS 630	HIGH GLOSS ENAMEL ART PAINT
SANS 678	BASE PAINT FOR WOOD (INTERIOR AND EXTERIOR)
SANS 679	SINC-CHROMATE BASED BASE PAINT FOR STEEL
SANS 681	UNDERCOATS FOR PAINTWORK
SANS 682	ALUMINIUM BODY COLOUR PAINT
SANS 723	ETCHING PAINT
SANS 912	CALCIUM PLUMBATE BASE PAINT

SANS 1091	NATIONAL COLOUR STANDARD FOR PAINT
SANS 1186	SAFETY SYMBOL SIGNS

1.12 WELDING

All welding, during the manufacturing or pre-assembling of the equipment, shall be performed according to the latest technology using the latest developed and approved welding equipment by a qualified welder, and where exposed it shall be smoothly finished off.

1.13 SOUND AND VIBRATION CONTROL

The Contractor shall be responsible for the detail design and/or selection of all sound and vibration control equipment. Sound and vibration control shall be designed to give the resultant sound pressure levels specified, when based on the sound characteristics of the rooms given. The vibration isolation system shall be designed and selected and adjusted for a maximum total transmissibility of not more than 2,5%.All rotating equipment shall be balanced, both statically and dynamically and shall not have any critical speeds within 30% of the operating speed. In addition all rotating equipment and associated pipe work and ductwork shall be provided with vibration isolation mounts.

Isolators shall give both horizontal and vertical deflection and the amplitude shall not exceed 3 mm.

All pipe and duct connections to vibrating equipment shall be flexible to allow freedom of the equipment to move.All vibration isolation equipment shall be designed and selected after selection of the relevant equipment and shall be approved by the engineer before ordering of the equipment.

Each spring mounting shall be provided with 7 mm thick neoprene acoustical pads.

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
1.	Offices	25-30
	Boardrooms	25-30
	Executive Offices	30-35
	Secretaries and General Offices	35-40
2.	Meeting Rooms	25-30
3.	Restaurants/Cafeteria	35-40
4.	Kitchens	45-50
5.	Toilets	40-45
6.	Basement Parking Area	50-55
7.	Stairwells	
	to service areas	40-45
	to function areas	35-40

8.	Plant rooms	
	Air Handling Units	70-75
	Main Chiller	75-80
9.	Site Boundary	40-45

1.14 TRAINING OF CLIENT REPRESENTATIVES

The Contractor shall be responsible for the training of the Client's staff during the commissioning period and after the installation and maintenance manuals have been completed. The staff must receive enough instructions to ensure that they are fully conversant with the equipment concerned. Site staff shall be instructed on:

a) The full installation, commissioning, testing and operating methods of the equipment.

b) All instructions and problem solving of equipment.

c) Stopping the equipment in emergency and warning against restarting after an emergency.

d) Positions and settings of all control equipment.

e) Operating temperatures, pressures, etc.

f) All safety measures including electrical.

g) Name, address and telephone number of the equipment suppliers and contractor that can be contacted during installation and maintenance of the equipment.

The operating and maintenance manual must be available during the training of the staff. Staff must also be made conversant with the contents of the manuals.
All instruments such as thermometers, pressure gauges, indicators, etc. shall be marked at the operating point under normal conditions. Such markings shall be neatly done on the scale itself and not on the protecting glass cover.

1.15 OMISSIONS AND VARIATIONS DURING TENDER

When the Tenderer desires to make omissions or variations from the specification, he shall record these below and in the major equipment schedule together with references to the relevant sections of the specification.

2 LIST OF PROPOSED DEVIATIONS FROM THE SPECIFICATIONS

The Tenderer shall list any proposed deviations from the specification with the reasons and descriptions. If there are no deviations, write NIL. Only those deviations listed here will be considered.

ITEM	DESCRIPTION	ADD	OMIT
	TOTAL DIFFERENCE		

Tenderer's signature _____ Date_____

Witnesses: 1._____ 2. _____

3 DESIGN CONDITIONS

- Project Location : Kempton Park

- Indoor temperature : 22°C ± 2 °C dry bulb

- Outdoor temperature : Summer : 30 °C Db
  Winter : 0 °C Db

- Altitude : 1667 m

- Electrical power : 3 Phase + Neutral, 400V, 50Hz

4 DESCRIPTION OF SYSTEM AND SCOPE

The scope of work shall include for the following mechanical and electrical work as listed hereinafter, namely:

- VRV heat recovery air conditioning system serving the ground floor, first and second floor, complete with condensing unit, cassette indoor units, in-ceiling hide-away ducted indoor units, wall mounted controls, insulated refrigeration piping, control wiring, PCV condensate piping, externally insulated ducting for ducted units, ceiling diffusers.

- Packaged unit to be installed complete with supply air and return air sound attenuators, externally insulated ducting, circular diffusers, fresh air intake louvre with filter, wall mounted thermostat, control wiring, temperature sensor.

- Fresh air systems each complete with, axial supply air fan with sound attenuators, speed controller, duct mounted filter with side access, un-insulated galvanised sheet metal ducting, balancing dampers.

- Toilet extraction systems each complete with, in-line tube fans c/w sound attenuators, speed controller, un-insulated galvanised sheet metal ducting, extract disc air valves and door louvres.

- Kitchen and store room ceiling mounted fans

- Miscellaneous other items herein specified and indicated on the drawings, which are required to facilitate this installation as a whole.

4.1 GENERAL REQUIREMENTS

- By virtue of submitting a tender it will be deemed that the Tenderers have satisfied themselves with all aspects of the project and in particular with the Contractual Conditions pertaining to the Principal Contract and that due allowances have been included in the tender price.

- Under no circumstances will claims for additional costs, in respect of the foregoing, be entertained after submission of tenders.

- It is a requirement that the entire installation shall function, prior to the beneficial use stage having been reached, in order to facilitate the commissioning of the entire plant prior to that stage.

- Beneficial use of the installation shall be deemed to have commenced when all installations have been fully commissioned and all the requirements of this specification and drawings complied with, for the installation as a whole.

- Tenderers shall make due allowances for the proper maintenance and guarantee, in terms of this specification, of the entire installation from the time of the first operation of individual components up to the beneficial use stage.

- Thereafter, a full 12 months free monthly maintenance and guarantee period shall commence from the date of approval by the Engineer of beneficial use of the entire installation.

- No combustible materials will be permitted in the ceiling and/or floor void or any other air plenums.

- Although certain items are required to be effected by others, i.e. marked thus (*) on the drawings, it shall still be the responsibility of the Subcontractor to co-ordinate and ensure that this work is carried out by the other trades.

- Where difficulty may be experienced in sealing gaps (openings) between underside of slabs and the top of ducts etc. where they go through walls and structure, the Subcontractor shall install Compri-band, Sondor, or an equally approved product, before the duct etc. is placed in position.

- Where switched socket outlets are provided in the ceiling void for either 220 Volt or 24 Volt connections to HVAC equipment, the cable connection between the local isolator and the equipment served may be exposed PVC insulated cable not greater than 2 000 mm in length.

- Tenderers shall include for the specified supplier/manufacturer of equipment as detailed hereinafter and stated in the schedules of equipment. Failure to include the specified

supplier/manufacturer in the main tender price shall render the tender invalid. Alternative offers may be submitted in the "Schedule of Alternative Prices" in this Specification.

- Provide all detailed information as required in the "Bills of Quantities". Should alternative equipment be offered, these schedules shall also be completed for all alternative equipment offered after tender / appointment.

- It is hereby pertinently brought to the Tenderers notice that once this contract has been awarded, should it in the opinion of the Consulting Engineer, be found at any stage during the course of the project that the Engineer's involvement in the project is in excess of what is considered to be reasonable in terms of his conditions of Employment, due to the non-performance of the Mechanical Subcontractor (or his Subcontractors), then the Mechanical Subcontractor shall be accordingly advised and be liable for such additional costs as identified and incurred by the Engineer.

- The tender period is fixed and no extension shall be entertained.
- Making off of the main incoming power cables reticulated by the Site Electrician, shall be the responsibility of the appointed AC Contractor.

- All equipment base formers, brackets and accessories to complete the installation as required.

- As-built drawings – hard copy and magnetic DXF/DWG format of all drawings.

- Operating and Maintenance Manuals – 3 sets.

- Spares and tools as specified and where applicable, as provided with the equipment.

- The Subcontractor shall allow for two days training of the Client's Maintenance and Technical Staff in the use and operation of all systems/ equipment.

- Painting of all equipment and ducting in accordance with the Specification. All exposed piping, ducting and equipment shall be painted i.e. Roof Plant / Piping and in Plant Rooms, including the ducting exposed in the Roof plant rooms. All bare steel surfaces shall be painted with primer and where exposed, with 2 coats of enamel.

4.2 EXCLUSIONS

The following work is excluded from this subcontract and will be carried out by others:

- All builder's work including forming of holes in the structure, walls and floors and making good thereafter.
- Casting of all concrete bases and plinths as/where indicated on the drawings. However, base formers shall be provided for by the Mechanical Subcontractor.
- Building in of fire damper sleeves in walls and fire baffles, however, detailed instruction to the Builder and supervision thereof shall be the responsibility of the Mechanical Subcontractor.
- Supply and installation of cat ladders, steel platforms, mentis grating and handrails.
- Concealing of ducting and piping, unless otherwise indicated.
- Supply and fitting of timber frames where necessary.
- Access panels in ceilings.
- Raised floors where indicated on the drawings.
- Cutting of ceiling tiles for diffusers and grilles.
- Cutting openings in doors and installing door louvres supplied by the Subcontractor. It is however the Subcontractors responsibility to ensure that all such door louvres are satisfactorily installed by the Principal Contractor.
- Building in of Access Doors.
- Main water supply where indicated on the drawings.
- Floor drains where indicated on the drawings.
- Waterproofing of all openings exposed to outside.
- Electrical wiring from the fire detection system interfacing with the respective HVAC equipment hereinafter identified. However, it shall be the responsibility of the A/C Subcontractor to fully liaise with the Fire Detection Subcontractor to ensure total co-ordination and integration where required between these two services.

- Supply of electricity for installation and testing purposes. During the installation period electricity will be available at the Principal Contractor's switchboard.

- All hole openings and waterproof flashing thereafter, through roof structures. Hole openings shall however be detailed by the Mechanical Subcontractor.

4.3 PROGRAMME

The A/C Subcontractor will be required to meet with the Principal Contractor and agree their Construction Programme. On appointment of the A/C Subcontractor, he shall be required to immediately commence with Builders Work drawings.

4.4 PROJECT DRAWINGS

It is hereby brought to the Tenderers notice that once the Contract is awarded, it shall be the sole responsibility of the HVAC Contractor to generate 1:50 Scale **As Fitted Layout** drawings during the construction period. All drawings thus generated shall be CAD drawings. The HVAC Contractor shall be issued tender drawings on disc at the outset of the project to facilitate this process forwards. The Consulting Engineer will forthwith only issue hand sketched drawings of any changes and/or variations in the future i.e. no further CAD drawings will be issued by the Consulting Engineer. The Tenderer shall make due allowance for this when pricing his tender.

4.5 SELECTION & ORDERING OF MATERIALS AND EQUIPMENT

The Contractor shall note the following:

- Within 45 days after acceptance of contract, submit to the Engineer for approval a complete list in quadruplicate, of materials and equipment that the Subcontractor proposes to furnish, including manufacturer's catalogue information as to construction, capacity, materials, etc. Detailed pressure drop calculations shall be submitted with all pump and fan selections where applicable.

- Within 30 days after approval of the above list, arrange for purchase and delivery of materials and equipment required, in ample quantities and at proper time. The Employer reserves the right to purchase required materials and equipment and deduct the cost thereof from the contract sum, if the items are not on the job in time to expedite completion.

- Materials of similar class or service shall be of one manufacture.

- Capacities, sizes and dimensions given are minimum unless otherwise indicated.

- Deliver and store manufactured materials in original containers, which shall indicate clearly the manufacturer's name, brand and identifying number. Clearly mark or stamp with manufacturer's name and rating.

- Specified equipment shall be as hereinafter specified.

- It is the Subcontractor's responsibility to ensure that all materials and equipment provided are entirely suitable for the application. Materials and equipment which are not suitable for the application, or are not to the satisfaction of the Engineer, shall be replaced by materials and equipment which are suitable and which are to the satisfaction of the Engineer. All such replacement costs shall be for the account of the Subcontractor.

- It shall remain the responsibility of the A/C Contractor that all equipment requiring a lead time with respect to delivery shall be timeously submitted in keeping with the programme, so as to ensure timeous delivery and installation.

4.6 DETAILED DESCRIPTION

Refer to Equipment Schedules on the drawings and hereinafter which contain certain detailed information pertaining to plant and equipment operation.

The installation as a whole consists of the following:

4.6.1 Ventilation Systems

Public Toilets

Air extraction per each toilet comprises of extraction disc valves, flexible duct connections, un-insulated galvanised sheet metal ducting, in-line extract fan with attenuators and discharges air via a wall mounted weather louvre. – Power supply by Site Electrician terminating in local isolator.

Fresh Air

There are a total of seven ventilation systems. Each fresh air system comprises of wall mounted weather louvre, duct mounted filter with access, axial supply air fan with sound attenuators, un-insulated galvanised sheet metal ducting, flexible duct connections and balancing dampers. – Power supply by Site Electrician terminating in local isolator.

Kitchen Stores

Each store room shall be ventilated by ceiling mounted extraction fan, to be switched with lights in that room.

4.6.2 Air Conditioning Systems

4.6.3 Variable Refrigerant Volume Air Conditioning Systems

The VRV system shall serve the ground, the first and the second floor.

The condensing unit shall be located in the plant on the roof as indicated on the drawings. The system comprises of condenser units in the plant room, cassettes & ducted hide-away indoor units, interconnecting externally insulated refrigerant copper piping, heat recovery boxes, refnet joints, interconnecting control wiring, wall mounted controls and central controller.

The successful contractor will be required to supply, deliver, install, commission, test and hand over a variable refrigerant volume (VRV) split air conditioning plants. The plants shall be of the heat recovery type.

VRV Compressor Condensing Units

General

The compressor condensing units shall be of the heat recovery type. Each unit shall be able to service as the lead unit, but normally the largest unit shall be set as the primary lead unit. Each unit shall contain variable compressor drive, normal compressors and condenser sections.

The unit shall be a factory assembled unit housed in a sturdy weatherproof casing constructed from rust-proofed mild steel panels coated with a baked enamel finish.

The compressor shall be equipped with inverter controller capable of changing the rotating speed to follow variations in cooling and heating load.

The noise level of the outdoor unit shall not be more than 58 dB(A) at normal operation measured horizontally 1m away and 1.5m above ground.

The units shall be modular in design.

The contractor shall further install a 20 x 15 mm industrial wire mesh screen over the condenser coils to protect the coils from hail damage.

Compressors

Compressors shall be of the hermetic scroll type equipped with inverter control capable of changing the speed in accordance to the cooling or heating load requirements.

- Gate Bipoler Transistor) type.
- The outdoor units shall have at least 20 steps of capacity control to meet load fluctuation and ensure individual control for the indoor units.
- The compressors shall be equipped with crankcase heaters.
- Should the unit be equipped with more than one compressor then only one of the compressors shall be fitted with an inverter motor.

Heat Exchanger

The heat exchanger shall be constructed with copper tubes mechanically bonded to aluminium fins to form a cross fin coil.

The aluminium fins shall be covered by anti-corrosion acrylic resin film.

Refrigerant Circuit

The refrigerant circuit shall include an accumulator, E-bridge heat exchanger to control the liquid level in the receiver, liquid and gas shut-off valves, solenoid valves, filter drier and oil separator. The refrigerant shall be R410a.

All necessary safety devices shall be provided to ensure the safety operation of the system.

Safety Devices

The following safety devices shall be part of the outdoor unit:

High pressure switch, fuse, crankcase heater, fusible plug, over current protection for the inverter, thermal overload protection on the compressors and condensing fans, a timer to prevent short-circuiting of the compressor and anti-freeze-up protection.

Oil Recovery System

The unit shall be equipped with an oil recovery system to ensure stable operation and maximum oil separation.

Oil equalizing piping shall be installed between the condensing units to equalize oil levels every six (6) minutes and so ensure equal refrigerant distribution.

Installation

The condensing units are to be installed on concrete plinths in the positions shown on the drawings. The size and location of the plinth to be confirmed with the structural engineer and supplied by the building contractor. If the moving parts of the unit are free of vibration, the units may be placed directly onto the concrete plinths on “Teco” rubber pads. If however, vibration is transmitted, the units will have to be installed on anti-vibration mountings.

Capacity

The cooling capacity of each outdoor unit shall meet the sum of the total cooling capacities of the indoor units of a single zone or the nominal capacity stipulated below, whichever is the highest. The outdoor units shall be selected at an utilization level of not more than 100%.

Indoor Units - Mid-Walls, Cassettes and Ducted Hide-aways:

Indoor units shall either be cassette type, mid wall or ducted hideaway type installed in the positions shown on the drawings.

Each unit shall have an electronic expansion device, which controls refrigerant flow rate in response to load variations of the room.

The address of the indoor unit shall be set automatically in case of individual and group control.

The mid-wall units shall consist of an evaporator coil, mildew-proof polystyrene condensate drip compartments, supply air fan, fan scroll, fan motor, controls, condensate pump and efficient filter all mounted in an attractive compact casing.

The cassette unit shall consist of an evaporator coil, mildew-proof polystyrene condensate drip compartments, supply air fan, fan scroll, fan motor, controls and efficient filter all mounted in an attractive compact casing with a hinged decorative bottom panel.

The unit shall be suspended through an opening in the ceiling from and including four (4) correctly sized hanger rods securely bolted to the unit's hanger brackets. Where specified, the unit shall be fitted with a condensate drain pump capable of raising the condensate 550mm above the level of the drain connection.

The unit shall be fitted with a single, silent running, diffuser type turbo fan. The fan blades shall be of dynamically balanced aluminium or other non-ferrous metal manufacture, mounted on a central shaft and driven by a continuously rated two-speed electric motor, resiliently mounted on a suitable cradle. The fan motor is to be fitted with self-aligning sealed bearings.

The fan motor shall be of the single phase, permanent split capacitor type with built-in re-settable overload protection. The motor shall have multi speed windings and shall be factory connected to a terminal box. All wiring is to be marked to correspond with labelled terminals matching the motor wiring diagram.

The supply air louvres shall be of the auto-swing type with remote pre-set and automated vertical airflow direction control.

Air shall be supplied from the bottom of the unit and returned through a bottom mounted hinged grille. The unit shall be adjustable for four-way, three-way and two-way air discharge. Provision shall be made for one or two branch ducts to be connected to the unit as standard accessories. Provision shall also be made for a fresh air duct to be connected to the unit as a standard accessory.

The evaporator coil shall consist of a multi-pass coil of heavy gauge, solid drawn copper tubing mechanically expanded into aluminium cooling fins. The coil shall be provided with an automatic defrost thermostat to prevent excessive frosting.

The evaporator coil shall be completely sealed off to ensure that maximum supply air flows over the coil.

The air filter shall be of the easily accessible and removable mould resistant resin net type, washable with mild detergent. The filter media shall be arranged so that no air bypasses the filter at the edges.

The unit shall be efficient and extremely quiet in operation and the noise level shall not exceed 33 dB's on the "A" scale at a distance of three meters from the unit.

The units shall be self contained and set to deliver air that is filtered and cooled, or filtered and heated as may be required. The units shall be suitable for a single phase, 220V, 50 Hz, AC power supply.

Heating shall be by reverse (heat recovery/pump) cycle only.

Piping Installation

The pipe routes shown on the drawings are generally diagrammatic. The runs and arrangements of piping shall be as indicated, subject to modifications as required to suit conditions at the building, to avoid interference with work of other services and for proper convenient and accessible location of all parts of the piping system. All required offsets, fittings, valves, traps, drains, etc. may not be indicated but allowance must be made in tenders for all such necessary items to be furnished.

Piping shall be installed as straight and direct as possible, neatly spaced and in general forming right angles with, or parallel to walls or other piping.

The pipe sizes shall be installed by the contractor for the sizes of units offered in accordance with the manufacturer’s specifications and the schematic pipe layout indicated on the drawing. The pipe sizing must be verified by the manufacturer. Any discrepancy between this specification and the manufacturer’s specification is to be brought under the attention of the Engineer.

The piping network shall be connected using refrigerant branch joints, complete with the necessary reducers with the matching insulation as supplied by the system manufacturer.

Heat recovery shall be achieved by heat recovery units, complete with the necessary reducers with the matching insulation as specified and supplied by the system manufacturer.

Suction, discharge and liquid pipes are to be insulated separately and not grouped together as for a single line. Approved pipe insulation shall be used.

All piping shall be run so to avoid passing through ductwork, recessed light fixtures or interference with electric light outlets.

Where piping protrudes through building structures, pipe sleeves are to be installed, as part of the contract, to ensure easy removal thereof. No pipes may be built or plastered directly into the structure.

The contractor shall be responsible for the drilling of the holes and making good on the outside of the building to the plaster and paint.

Pipe sleeves must be of similar material as the pipe and must be large enough to allow enough free space for movement.

Where specified and where the opening between the sleeve and pipe is large and unsightly, blank cover plates must be installed.

Sleeves through outside walls, slabs and piping through roofs and windows must be sealed off watertight.

All sleeves must be installed neatly and made watertight. The opening between the pipe and sleeve must be sealed off by means of silicon rubber or any other approved product.

Provision shall be made for the drainage of condensate to the outside or to dedicated drain points by means of PVC piping of the sizes as indicated on the drawing.

Piping shall run above ceilings and vertical down in the positions indicated on the drawings. All piping shall terminate at ground level where it shall be routed to the nearest drain point.

Drain piping shall be installed without any loops in the piping where condensate can accumulate. The pipes shall have a uniform slope of 1 in a 100 from the unit to the outside and shall be tested in the presence of the Engineer.

Refrigerant Piping

All piping and fittings shall be of the best quality seamless, dehydrated, de-oxidised refrigeration class copper tubing, suitably sized for the unit installed and in accordance with SANS 460 as amended.

All refrigerant piping shall be hard drawn refrigeration copper tubing in accordance with ASTM B280-88.

Only jointing by means of capillary fittings will be allowed except in cases where equipment needs to be removed from the piping system for regular maintenance or replacement. In such cases joints between the equipment and piping shall be with DZR brass compression fittings.

Capillary type fittings shall comply with SANS 1067 - Part 2 or any of the related ISO 2016, DIN 2856 and BSS 864 - Part 2 specifications.

Soldering flux shall be used to remove residual traces of oxides, to promote wetting and to protect the surface to be soldered from oxidation during heating.

The flux shall be applied to clean surfaces and only enough should be used to lightly coat the areas to be joined and should be applied as soon as possible after cleaning.

Only the following solders shall be allowed to be used on capillary joints:

Composition	Specification
97/3 (97% tin and 3% copper)	SANS 24 – DIN 1707
96/4 (96% tin and 4% silver)	SANS 24 – DIN 1707
75/25 (75% tin and 25% zinc)	

Resin core and acid core solder shall not be used at all.
No welding of refrigeration systems will be allowed unless the pipe system is continuously filled and under pressure using nitrous gas.

All soldered joints, on factory supplied equipment, shall be carefully checked before commissioning and remade if found damaged in transit.

Refrigerant piping shall be arranged so that normal inspection and servicing of the compressor and other equipment is not hindered. Locations where copper tubing will be exposed to mechanical damage shall be avoided.

A refrigerant charging connection shall be provided in the liquid line. Before charging the system with refrigerant the circuit shall be leak tested and dehydrated.

All pipes, vessels, etc. operating below ambient dew point shall be insulated and a vapour barrier provided.

An isolating valve shall be installed in both the liquid and gas lines where connected to the evaporator unit. Valves shall be of the bronze body, ball type.

When completed, the installation shall maintain a complete vapour barrier and any signs of sweating or dripping shall cause the installation to be rejected.

All piping shall be rigidly supported, both vertically and horizontally.

Inside the building piping shall be installed on approved medium-duty galvanised cable tray wide enough to accommodate both refrigerant pipes and the drain piping.

Outside the building piping shall be installed on approved medium-duty galvanised cable tray wide enough to accommodate both refrigerant pipes and the drain piping, including galvanised sheet metal covers painted to colour match the walls. Rung spacing shall be at 300mm intervals.

All cable trays shall be supported on approved 41x41x1.5mm galvanised channels including

galvanised hold down saddles, bolts, nuts, washers and screws. The channel shall be supported from 8mm diameter hanger rods including washers and nuts. Channels to be spaced at intervals not exceeding 1500mm. Cable trays are to be installed to a fall of 1 in 100.

All cable ladders shall be supported on approved 41x41x2.5mm galvanised channels including galvanised hold down cup, bolts, nuts, washers and screws. The channel shall be rawl bolted directly to external walls or slabs. Channels to be spaced at intervals not exceeding 1500mm. Cable ladders to be installed to a fall of 1 in 100.

All piping shall be secured to cable trays and ladders with approved adjustable type galvanised cross rung clamps only. Care shall be taken not to pinch, compress or damage the pipe insulation when securing piping to cable trays and ladders. Any damaged insulation shall be completely removed and replaced to the satisfaction of the Engineer.

Strappings and cable ties will not be permitted. Hangers and supports where piping penetrates through walls shall be designed to prevent transmission of vibration to the building. Supports must be installed near to joints and fittings. Pipe clamps shall be installed at the following centre to centre distances.

Nominal Pipe Size	**Centre to Centre Spacing**	
Copper	**Horizontal Pipe**	**Vertical Pipe**
12 mm	1.0 m	1.2 m
15 mm	1.2 m	1.5 m
22 mm	1.5 m	1.8 m
28 mm	1.9 m	2.1 m
35 mm	2.1 m	2.4 m
42 mm	2.4 m	2.7 m
54 mm	2.4 m	3.0 m
66 mm	2.4 m	3.0 m
76 mm	2.5 m	3.0 m

Extra support must be supplied at T-offs, valves and other heavy fittings.

Pipe Insulation (Sans 1445 & Sans 1508 As Applicable)

The copper piping installed inside the building shall all be insulated with approved insulation. Vapour barrier integrity will be critical to prevent dripping. No zip type insulation will be allowed. Liquid and gas lines shall be insulated separately.
The insulation material shall meet the following minimum requirements:

Temperature range	:	-80°C + 120°C
Thermal conductivity	:	0,038 W/m K at 0°C
Thickness	:	15 mm
Density	:	35kg/m3
Odour Properties	:	Neutral
Cellular Structure	:	Totally closed
Fire Properties	:	Self-extinguishing

The insulation shall be applied to form a continuous and homogenous vapour barrier over bends, supports, etc. All joints and seams shall be glued. Non-drip tape shall not be used for assembling seams and joints.

All fittings and valves shall be wrapped with black non-drip tape.

When completed, the installation shall ensure a complete vapour barrier and any signs of sweating or dripping shall cause the installation to be rejected.

Pressure Testing On Piping

All new copper refrigerant piping shall be hydraulically pressure tested to 1,5 times the working pressure or 1000 kPa, whichever is the largest. The test shall be carried out in the presence of the Engineer.

All piping shall be subjected to the test pressure for a period of one (1) hour during which time the system shall retain the pressure with no leaks or losses.

Controls Individual control unit

The contractor shall supply and install approved hard- wired remote controllers in the positions indicated on the drawings.

The controller shall perform the following functions:

(a) Start/Stop.

(b) Temperature setting.

(c) Airflow setting.

4.6.4 Packaged Air Conditioning Units – Air Cooled

The packaged air conditioning units shall be suitable in all respects for outdoor location and shall be equal to Dunham-Bush Roof Mounted Packaged Air Conditioners.

Units shall comprise of the following components all housed within or forming part of, their cabinet:

- Refrigeration Compressors
- Air Cooled Condensing Coils
- Condenser Fans and Motors
- Refrigeration pipe work and controls
- Refrigerant gas charge
- Direct Expansion Cooling coils
- Centrifugal Supply Air Fans with Motor and Belt Drive
- Cleanable air filters
- Mixing plenum with Economy Cycle Dampers
- Electric Switch panel
- Internal electrical wiring.

Unit casings shall be constructed of not less than 1,2mm thick steel panels suitably braced and framed so as to prevent drumming whilst at the same time being arranged in easily removable panels to facilitate access to any portion of the internal components. Casing panels shall be attached to a sub-frame of welded mild steel sections, which framework shall also hold all internal equipment in position. The casing panels shall be internally lined with "sonic liner" or equivalent non-combustible material, such insulation being adequately secured to the internal surfaces with non-combustible adhesive and mechanical fasteners. All mild steel casing panels and framework shall be thoroughly degreased and then painted with a suitable rust proofing primer prior to the application of two finishing coats of good quality enamel or lacquer in the standard colour of the manufacturer.

Tenderers are to note that the unit casing specification above is the minimum required and that preference will be given to units having double skin panel construction. Further, preference will be given to units having an outer skin of anodised aluminium or be of a fibreglass construction.

Units shall contain a minimum of two refrigeration compressors. These shall be of the hermetic or the accessible hermetic type direct driven by integral suction gas cooled squirrel cage motors at a rotational speed not exceeding 1500 r.p.m. The compressor shall be complete with positive displacement reversible force-feed lubrication systems, have low oil pressure protection and contain crankcase oil heaters to ensure boil-off of dissolved refrigerant from lubricating oil when the compressors are stationary.

Each compressor shall have at least one stage of capacity modulation other than full load and shall be arranged to start unloaded.

Condenser coils shall consist of copper tubes with mechanically bonded aluminium plate fins, all housed in a robust galvanised steel frame and protected with a suitable galvanised wire mesh screen. Suitable space shall be provided at the coil ends in order that tube bends is easily accessible in the event of possible refrigerant leaks.

Condenser fans shall be of the slow-running propeller type direct driven by squirrel cage electric motors. The units shall be provided with a minimum of two propeller fans, which shall be arranged for preferable vertical discharge through suitable weatherproofed

protective wire guards. The fan and motor shall be resiliently mounted so as not to transmit vibrations to the unit casing.

Condenser air intake and discharge arrangements shall be such that no short-circuited discharge air can be drawn back into air intake.

Refrigerant pipe work shall be carried out in seamless refrigerant quality copper tubing, suitable provision being made that the piping is not subjected to any stresses by vibration from the compressors. The refrigerant system shall be split into at least two stages on the liquid side for adequate capacity control. Refrigerant circuit shall incorporate replaceable type filter-dryers, sight glasses, thermostatic expansion valves and vapour proof insulation on the suction lines. The systems shall be factory charged with Refrigerant R407C.

Automatic safety controls within the unit shall include a dual pressure switch with manual reset on the high-pressure side and an oil pressure switch manual reset. Provision shall be made for pressure relief of the high side refrigerant piping in accordance with government regulations. Provision shall also be made for cycling the condenser fans so those units may be capable of operating down to an ambient temperature of 10°C db.

Direct expansion cooling coils shall consist of at least two separate refrigerant circuits and shall comprise of copper tubes with mechanically bonded aluminium fins. The coils shall be encased in a heavy gauge galvanized steel casing and fitted with a 1,2 mm thick stainless steel condensate pan so sizes and located to prevent entrapment of moisture into the air stream, whilst also ensuring positive drainage of condensate.

Supply air fans shall be of double inlet forward curved centrifugal type with impellers running in sealed, permanently lubricated ball-bearing plumber blocks located in the suction eye on each side of each fan. Fan impellers shall be statically and dynamically balanced and run well below critical speed. Fan assemblies shall be so mounted within the packaged air conditioning unit that they do not transmit any vibration. Where units having more than one fan are offered, these shall all be driven by a common motor.

Tenderers are to note that the supply air fan specification above is the minimum required and that preference will be given to units having a single backward curved centrifugal fan mounted on anti-vibration mounts and complete with a ventilated removable guard on the V belt drive.

Supply air fan motors shall be three phase squirrel cage type rated not less than 25% above the power input absorbed by the fans and run at a rotational speed not exceeding 1500 r.p.m. The motor shall drive the fans by means of a V belt drive having not less than two V belts.

Air filters shall be equal to FIBATRON WP77 minimum 50mm thick high performance washable pleated panel type housed in adequate holding frames and fitted with gaskets to ensure a positive airtight seal around them.

The return air and fresh air mixing plenum shall be factory installed and shall be of similar construction to the rest of the cabinet. The mixing plenum shall be complete with return air and maximum fresh air volume control dampers equal to those specified later herein.

Because of the use of an economy cycle and the resultant possible low on coil dry bulb temperature in the intermediate season the compressors shall be protected by low limit thermostats positioned in the mixing plenum and set to prevent the compressors from operating at a mixed temperature below 18°C.

A weatherproof electrical switch panel shall be incorporated to from part of the unit and shall house all the necessary switchgear and controls required to operate the various components within the units. The switch panel shall comply with best modern practice and incorporate all necessary protection against overload or short-circuit. The switch panel shall be fitted with a suitably sized main isolator backed up by High Rupturing Capacity fuses with a minimum capacity to suite the system fault level. In addition phase failure relays shall be incorporated to protect against low voltage or phase failure. The switchgear shall be fully interlocked so that cooling and heating cannot operate simultaneously and so that the compressors cannot operate unless the condenser fans and supply air fans are operational. A run down timer shall be incorporated so that the supply air fans shall continue to run for three minutes after the unit is switched off. The switch panels shall be fully labelled with engraved black ivorine labels having 6mm high white lettering. The labels shall be riveted chassis plates to identify all switch-gear, relays, instruments and controls inside the switch panel.

Wiring within the switch panel and the unit shall comply with wiring regulations as relevant and shall be colour-coded in the colours red, yellow and blue for the relevant phases and black for neutral, the bus bars being similarly marked. Bus bars shall be copper of adequate cross sectional area, suitably spaced and mounted on stand off type porcelain in insulators. All exposed current carrying parts must be fully insulated in P.V.C. tape of the colours mentioned above. Every wire inside and outside the switch panel shall be fitted with ferrules and labelled with identical numbers at both ends. All outgoing leads shall be connected to a clearly marked terminal strip.

DUCTWORK

Ductwork shall be carried out in accordance with the details shown on the Drawings and shall be fabricated from prime quality galvanised sheet steel. All duct sizes indicated on the drawings are metal sizes and include the necessary allowances for any internal insulation, which may be specified.

Ductwork shall be fabricated and installed in accordance with the following specification, which shall be read in conjunction with the standards set by the Sheet Metal and Air Conditioning Contractors National Association of America (SMACNA), which shall be adhered to in detail except only as hereinafter specified.

Rectangular ductwork sheet thickness and cross breaking shall be as follows: -

Duct Size Long side mm	**Duct Joint**	**Sheet Steel thickness mm**	**Sheet Steel gauge**	**Cross Breaking Length mm**	**Type of Intermediate Stiffener**
Up to 750	Slip & Drive	0,6	24	2400	None
Up to 760	Mez	0,6	24	2400	None

751 to 1250	Mez	0,8	22	2400	None
1250 to 2400	Mez	1,0	20	1200	Tie-Rods
Above 2400	Mez	1,2	18	1200	Tie-Rods & Flat V Top hat

Longitudinal seams shall be Pittsburgh lock on all duct sizes. Cross joints on concealed ductwork having a semi-perimeter not exceeding 1150mm shall be as follows: -

Duct Size **long side mm**	Long Side	Short Side
Up to 450	'S' slip	Drive Slip
460 to 750	25 mm Bar Slip	Drive Slip

Cross joints on concealed ductwork having a semi perimeter in excess of 1150mm shall be of Mez or equal flange type, installed in accordance with the manufacturer's recommendations. As an alternative to the Mez or equal flange joints, 40mm x 3mm angle flange joints may be used.

Cross-joints on all exposed ductwork shall be of Mez or equal flange type.

Panel stiffening shall either be cross breaking, beading or pleating of longest side of all ducting.

Ductwork supports shall be of rod and angle type, sheet metal straps not being permitted. The size and spacing of these supports shall be as follows: -

Duct Size long side mm	Angles mm	Rods dia mm	Spacing max - mm
Up to 750	40 x 3	6	3000
751 to 1250	40 x 3	8	3000
1251 to 2400	40 x 6	10	2400
Above 2400	50 x 6	12	2400

Rectangular ductwork shall be regarded as low velocity low-pressure ductwork suitable for pressures up to 500 Pa and velocities up to 10 m/s. It shall accordingly be fabricated and installed to comply with the above requirements and the "Low Velocity Duct Construction Standards" manual published by SMACNA.

All cross-joints in ductwork shall be sealed with a liberal coating of 3M or equal Duct Sealer. Longitudinal joints/seams exposed to weather shall be made waterproof.

All duct connections to vibrating equipment shall consist of a flanged joint, followed by a flexible connector consisting of a neoprene covered fibreglass cloth fixed on either side of the joint in a double lock seam to form an airtight flexible joint with a minimum of 50mm separation between metal edges. Ducting at flexible joints shall be so supported that the

ductwork is held square with the adjoining duct and no stress is imposed upon the flexible joint. Copper earthing straps shall be fitted over all flexible duct connections and be carried out in accordance with the standard wiring regulations.

Flexible ducts shall be equal to INSULATED EUROFLEX, comprising glass fibre fabric. P.V.C. coated with spirally wound metal inserts. Where flexible ducts connect to normal sheet metal ductwork or other equipment, a liberal coating of 3M or equal Duct Sealer shall be used, the joint then sealed with DURO - DYNE or equal 75 mm wide duct tape and finished with an approved clamp or metal strap to ensure an airtight joint.

Circular flexible ducting connected to supply air diffusers shall not exceed 1,5m in length.

All supply air ducting shall be pressure tested with a maximum permissible leakage of 5% at a test pressure of twice the working pressure.

The maximum permissible leakage rate for return and ventilation air systems shall not exceed 5%.

Kitchen canopy and fume extract air ducting systems shall be made 100% airtight.

All insulated ducting in storage or in position shall be adequately protected at all times

All ducting joints exposed to weather shall be waterproof and corrosion free.

DUCTWORK INSULATION

Ductwork shall be insulated according to the requirements noted on the Drawings and in accordance with the following specifications.

Where noted on the Drawings, the supply air ducting shall be internally insulated with 25 mm thick "sonic liner" or equal, glued to the inside surface of the ducting with a fire retardant adhesive. In addition the insulation shall be further mechanically secured with Grip Nails or "Spotter Pins" at 450mm centres and not more than 75 mm from the edges of each panel. The insulation ends shall be covered with 0,8mm thick galvanised metal strips rivetted to the duct panels to prevent erosion of particles of the insulation into the air stream.

External supply and return air ducting shall be internally insulated with 50 mm thick "sonic liner" or equal, glued to the inside surface of the ducting and mechanically secured.

Ducting installed in open roof spaces above insulated ceilings shall, in addition to being insulated internally with 25mm thick "sonic liner" or equal in accordance with clause 16.2, be wrapped externally with 50mm thick "foil faced" or equal fibreglass insulation, unless otherwise noted on the Drawings. This external insulation shall be strapped around the ducting with strapping bands fixed at 1200 mm centres, and joints sealed with foil duct tape.

Ventilation ducting only installed above ceilings and below concrete slabs shall be un-insulated unless otherwise noted on the Drawings.

DIFFUSER, GRILLES AND LOUVRES

Air distribution shall be effected by means of ceiling diffusers or grilles of the sizes, types and having the discharge patterns as indicated on the Drawings.

Ceiling Diffusers and grilles shall be fixed to spigots extending not less than 100 mm from the ducting, unless otherwise indicated on the Drawings, and shall be securely fixed so that no screws or other fixing devices are visible.

Supply air diffusers shall be of steel construction and shall consist of an inner core which shall be easily removable from the outer section to facilitate access to the volume control damper located behind the diffuser. The inner core shall consist of concentric rectangular collars and the outer section shall consist of a single rectangular or bevel collar provided with a concealed spigot for attaching the diffuser to the supply ductwork.

The rear backing including the disc of all supply air diffusers for coastal projects, shall be lagged with minimum 3mm thick life care – fire and heat resistant foam.

Supply air diffusers shall be equal to RICKARD model CCD and CRD complete with dampers, and shall be finished in an epoxy powder coating in a colour to suit Architects requirements. Alternatively fibreglass or aluminium diffuser casings will be acceptable.

Supply air grilles shall be of the double deflection type consisting of two rows of individually adjustable aerofoil section vanes, the front vanes being horizontal and the rear vanes vertical. The vanes shall be housed in a surrounding fixing flange with neat mitred joints at the corners. The entire grille assembly shall be of extruded aluminium unless otherwise noted on the Drawings.

Supply air grilles shall be equal to Europair type DD complete with factory fitted opposed blade dampers.

The multivane opposed blade dampers provided with supply air diffusers and grilles shall be finished in matt black lacquer. The dampers shall be attached to the rear of the grilles and fitted into the spigot connections or the diffusers and shall be adjustable, by means of a key or a lever, from the front of the installed diffusers and grilles.

Return air grilles shall consist of aluminium grid core housed in an extruded aluminium-fixing flange with neat mitred corners and finished in plain anodised aluminium unless otherwise noted on the Drawings.

Return air Grilles shall be equal to Europair type RA.

Door grilles shall be extruded aluminium construction equal to Europair type DG suitable for fitting into doors of varying thickness and shall be finished in a colour to suit Architects requirements. Door grilles shall be fixed to doors by means of countersunk screws with a colour to match the door grille.

Outside air intake weather louvres shall be of the extruded aluminium fixed vane type fitted with a vermin proof screen on the rear side as well as an opposed blade damper.

Dampers shall be provided with a locking device so that once has been set for the correct airflow they can be permanently locked in position. Louvres shall be finished in plain anodised aluminium.

Where indicated on the Drawings the outside air intake louvres assembly shall be fitted with firmly fixed foam rubber gaskets and spring clips for the attachment of the fresh air filters, as later specified herein. The frames shall be fixed to the weather louvres so as to prevent any air by-passing the filters.

Rubber gaskets shall be glued to the rear of the fixing flanges of all diffusers, grilles and louvres to ensure airtight seals and prevent smudging.

DAMPERS

Dampers shall be provided where shown on the Drawings for shut-off, bypass or volume control purposes or where required to comply with local fire codes.

Volume control dampers shall consist of multiple blades acting in opposed blade manner, the blades being robustly linked together to operate in complete unison. Individual blades shall be hooked-edge construction, so bent for rigidity. The blades shall have steel trunnions mounted in bronze sleeve bearings or ball bearings. Permanently set dampers shall be provided with suitable devices to facilitate locking them in position with "Open" and "Shut" position indication.

Motorised dampers shall include suitable fastenings and supports for motor actuators.

Damper hardware shall be the product of an accredited manufacturer of such items, equal to DURO-DYNE. Dampers sections shall be housed in flanges steel metal casings of 1,6mm thick galvanised steel. Damper blades shall not exceed 200 mm in width and 1000 mm in length. Dampers over 1000 mm in length shall be sectionalised into separate cells each with its own shaft and bearings to ensure that the blade length of each section does not exceed 1000 mm.

Fire dampers shall be equal to BLENDAIR or TROX and manufactures to a recognised fire code with a two-hour fire rating. Damper casings shall have flanged ends and damper blades shall not exceed 300 mm in width. The fire dampers shall comply in all respects with the requirements of the local municipal fire authorities in the area where they are to be installed.

Damper blades shall be closed by the operation of approved fusible links located where they would be immediately affected by an abnormal rise in temperature of the air stream. When called for on the Drawings the blades shall also be actuated by solenoid operators, which shall be provided by the damper manufacturer. When closed in the blades shall be held by a catch arrangement so as to provide a positive seal against the air stream.

Duct mounted air volume control dampers and fire dampers installed in ducts shall be provided with a minimum 300 x 300mm inspection opening so that the dampers may be checked, maintained and reset when required. These inspection openings shall be covered with suitably sealed access panels.

SOUND ATTENUATORS

Sound attenuators shall be provided and installed in the positions indicated on the Drawings and shall be selected to provide the Noise Criteria levels specifies in Part 4 hereof. Sound attenuators shall be of factory fabricated type equal to those manufactured by SOUND ATTENUATORS LIMITED or DONKIN.

The sound absorbing lining material shall impart no odour to the air, shall not delaminated readily, shall have no loose material or any exposed surface that may be detached by the air stream either during installation or under regular operating conditions. The material shall also be non-combustible.

All lining material shall be in good condition at the time of final inspection. Material that has been damaged in shipment by rough handling vibration or exposure shall be rejected. Material that has been damaged prior to final inspection shall be replaced or coated to prevent detachment of loose material as directed by the Engineer.

Sound absorbing lining material generally shall have a density of not less than 16 kg per m3, a thickness of not less than 25mm and sound absorbing efficiency at each frequency of not less than the following: -

Frequency cycles per second	250	500	1000	2000
Percent absorption	45	65	70	80

The factory fabricated sound attenuators shall be complete units consisting of an outer casing, sound absorbing material and internal baffles and supports. Casings shall be made of zinc-coated steel, not lighter than that specified herein for ducts of the same outside dimensions.

AIR FILTERS

Air filters shall be installed before the coils in the packaged air conditioning units and the air- handling units and shall be equal to FIBATRON WP 77 minimum 50mm thick high performance washable pleated panel filters.

Long life air filters installed in independent air filter banks in Plant Rooms or before the coils in packaged air conditioning units and air handling units, where indicated on the Drawings, shall be equal to BRANDT EXPO 3000 extended surface air filters with VILEDON type PSB 290 filter media having an arrestance of 90% (ASHRAE). Each filter cell shall be suitable

for the manufacturer's recommended air flow of O, 833 m3/s at an initial resistance of 20 Pa. Manometers to be used in conjunction with these filters shall be set for a final resistance of 150 Pa.

Fresh air filters shall be of the same make, type and size as the return air filters fitted in the units and shall be fitted into the holding frames installed on the rear of the outside air intake weather louvre so as to be easily removable from inside the plant room area.

Air filters shall be fitted into holding frames, which shall be designed to allow negligible quantity of air to bypass the filters.

All filter banks shall be mounted in easily accessible positions and shall be reachable with a normal 1.8m long ladder.

4.7 BILLS OF QUANTITIES

Tenderers must tender on the equipment specified, however, alternative equipment similar to that specified, may be offered as an alternative cost to the main tender bid. Alternative equipment/Suppliers may be offered and identified in the covering letter to accompany the tender return. – See attached "Schedule of Alternative Price" schedule hereinafter.

The following Bills of Quantities are intended to describe the equipment in the tender and are **not** to be considered fully comprehensive. It shall remain the responsibility of the Tenderer to check the quantities of equipment in accordance with the drawings and **no** extras shall be entertained should it be found that the Equipment Schedules do not include or identify all the equipment required per the Scope of Work identified on the drawings and/or specifications.

4.8 LIST OF TENDER DRAWINGS

GROUND FLOOR - AIRCONDITIONING & VENTILATION
FIRST FLOOR – AIRCONDITIONING & VENTILATION
SECOND LEVEL – AIRCONDITIONG & VENTILATION

4.9 SCHEDULE OF ALTERNATIVE PRICES

Tenderers are hereby given the opportunity to offer alternative equipment which complies with the specification. Alternative offers shall include technical information as called for in the Schedule of Information.

In addition, if Alternative Equipment is identified in this schedule it shall be seen as part of this tender and the Tenderer shall be required to provide Alternative Prices for such item(s) of Equipment identified. It shall be a requirement of this tender that such Equipment identified is priced accordingly.

Prices inserted in the schedule below shall be **nett prices including VAT**, and shall be **ADDITIONS** or **REDUCTIONS** to the **NETT TENDER PRICE** submitted on the Form of Tender. Tenderers shall note that the alternative prices shall be identified on this schedule only and that the **TOTAL TENDER SUM** as identified in the **FORM OF TENDER**, shall only include for those items of equipment as detailed and/or specified. Alternative offers submitted after the closing date of tender will not be considered.

EQUIPMENT	COMPANY / MAKE	ALTERNATIVE PRICES		REMARKS
		Nett Extra	Nett Reduction	

TENDERER'S SIGNATURE: _____ DATE: _____

4.10 EQUIPMENT AND CAPACITIES REQUIRED

4.10.1 VRV HEAT RECOVERY SYSTEMS

OUTDOOR CONDENSERS

CU-1

Type	VRV Recovery Condenser Unit
No. Off	1
Total Cooling Capacity	**130** kW
Total Heating Capacity	**130** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

INDOOR UNITS GROUND FLOOR

AC-1

Type	VRV Ducted indoor hide away unit.
No. Off	3
Total Cooling Capacity	**14** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

AC-2

Type	VRV Ducted indoor hide away unit
No. Off	1
Total Cooling Capacity	**22.4** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

AC-3

Type	VRV 4 Ducted indoor hide away unit
No. Off	3
Total Cooling Capacity	**28** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

AC - 4

Type	VRV In-ceiling ducted unit
No. Off	3
Total Cooling Capacity	**7.1** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

CU-1

Type	VRV 4 Way blow cassette unit

No. Off	7
Total Cooling Capacity	**7.1** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

CU-2

Type	VRV 4 Way blow cassette unit
No. Off	6
Total Cooling Capacity	**3.6** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

CU-3

Type	VRV 4 Way blow cassette unit
No. Off	10
Total Cooling Capacity	**2.2** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

4.10.2 VRV HEAT RECOVERY SYSTEMS

OUTDOOR CONDENSERS

CU-1

Type	VRV Recovery Condenser Unit
No. Off	2
Total Cooling Capacity	**135** kW
Total Heating Capacity	**135** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

INDOOR UNITS FIRST FLOOR

AC-1

Type	VRV Ducted indoor hide away unit.
No. Off	1
Total Cooling Capacity	**9** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

AC-2

Type	VRV Ducted indoor hide away unit
No. Off	2
Total Cooling Capacity	5.6 kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

AC-3

Type	VRV 4 Ducted indoor hide away unit
No. Off	1
Total Cooling Capacity	**11.2** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

AC - 4

Type	VRV In-ceiling ducted unit
No. Off	1
Total Cooling Capacity	**4.5** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

AC - 5

Type	VRV In-ceiling ducted unit
No. Off	1
Total Cooling Capacity	**11.2** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

AC - 6

Type	VRV In-ceiling ducted unit
No. Off	1
Total Cooling Capacity	**7.1** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

CU-1

Type	VRV 4 Way blow cassette unit
No. Off	63
Total Cooling Capacity	**2.2** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

CU-2

Type	VRV 4 Way blow cassette unit
No. Off	1
Total Cooling Capacity	**2.8** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

CU-3

Type	VRV 4 Way blow cassette unit
No. Off	5
Total Cooling Capacity	**3.6** kW
Model	Mitsubishi, Daikin or equal & approved

Refrigerant Type	R410A

CU- 4

Type	VRV 4 Way blow cassette unit
No. Off	3
Total Cooling Capacity	**4.5** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

CU- 4

Type	VRV 1 Way blow cassette unit
No. Off	25
Total Cooling Capacity	**2.2** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

4.10.3 FANS

EAF01

Type	Axial Fan 01
No. Off	6
Air Quantity	350 l/s
Static Pressure	300 Pa
Speed	2800rpm max
Size	Ø600 mm
Model	AMS, Donkin, Ziehl or equal

EAF02

Type	Axial Fan
No. Off	1
Air Quantity	950 l/s
Static Pressure	250 Pa
Speed	2800rpm max
Size	Ø500 mm
Model	AMS, Donkin, Ziehl or equal

EAF03

Type	Axial Fan
No. Off	1
Air Quantity	600 l/s
Static Pressure	200 Pa
Speed	2800rpm max
Size	Ø1,5
Model	AMS, Donkin, Ziehl or equal

FC-2

Type	Axial Fan
No. Off	2

Air Quantity	450 l/s
Static Pressure	200 Pa
Speed	2800rpm max
Size	Ø3150 mm
Model	AMS, Donkin, Ziehl or equal

4.10.4 VRV HEAT RECOVERY SYSTEMS

OUTDOOR CONDENSERS

CU-1

Type	VRV Recovery Condenser Unit
No. Off	1
Total Cooling Capacity	**135** kW
Total Heating Capacity	**135** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

INDOOR UNITS FIRST FLOOR

AC-1

Type	VRV Ducted indoor hide away unit.
No. Off	3
Total Cooling Capacity	**22.4** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

AC-2

Type	VRV Ducted indoor hide away unit
No. Off	2
Total Cooling Capacity	11.2 kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

AC-3

Type	VRV 4 Ducted indoor hide away unit
No. Off	1
Total Cooling Capacity	**11.2** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

AC - 4

Type	VRV In-ceiling ducted unit
No. Off	1
Total Cooling Capacity	**7.1** kW
Model	Mitsubishi, Daikin or equal & approved

Refrigerant Type	R410A

AC - 5

Type	VRV In-ceiling ducted unit
No. Off	1
Total Cooling Capacity	**9** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

AC - 6

Type	VRV In-ceiling ducted unit
No. Off	1
Total Cooling Capacity	**7.1** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

CU-1

Type	VRV 4 Way blow cassette unit
No. Off	26
Total Cooling Capacity	**2.2** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

CU-2

Type	VRV 4 Way blow cassette unit
No. Off	14
Total Cooling Capacity	**2.8** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

CU-3

Type	VRV 4 Way blow cassette unit
No. Off	2
Total Cooling Capacity	**3.6** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

CU- 4

Type	VRV 4 Way blow cassette unit
No. Off	8
Total Cooling Capacity	**5.6** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

CU- 5

Type	VRV 1 Way blow cassette unit
No. Off	5
Total Cooling Capacity	**2.2** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

3.11.6 FANS

EAF 01

Type	Axial Fan 01
No. Off	1
Air Quantity	600 l/s
Static Pressure	300 Pa
Speed	2800rpm max
Size	Ø400 mm
Model	AMS, Donkin, Ziehl or equal

EAF 02

Type	Axial Fan 02
No. Off	1
Air Quantity	450 l/s
Static Pressure	200 Pa
Speed	2800rpm max
Size	Ø315 mm
Model	AMS, Donkin, Ziehl or equal

EAF 03

Type	Axial Fan 01
No. Off	1
Air Quantity	700 l/s
Static Pressure	300 Pa
Speed	2800rpm max
Size	Ø500
Model	AMS, Donkin, Ziehl or equal

FAF 01

Type	Axial Fan 02
No. Off	1
Air Quantity	450 l/s
Static Pressure	250 Pa
Speed	2800rpm max
Size	Ø400 mm
Model	AMS, Donkin, Ziehl or equal

FAF 02

Type	Axial Fan 02
No. Off	1
Air Quantity	740 l/s

Static Pressure	300 Pa
Speed	2800rpm max
Size	Ø400 mm
Model	AMS, Donkin, Ziehl or equal

3.11.7 FANS

FT-1

Type	Axial fan
No. Off	1
Air Quantity	600 l/s
Static Pressure	200Pa
Speed	2800rpm max
Size	Ø400 mm
Model	AMS, Donkin, Ziehl or equal

FT-2

Type	Axial fan
No. Off	1
Air Quantity	900 l/s
Static Pressure	250Pa
Speed	2800rpm max
Size	Ø500 mm
Model	AMS, Donkin, Ziehl or equal

FT-3

Type	Axial fan
No. Off	1
Air Quantity	450 l/s
Static Pressure	200Pa
Speed	2800rpm max
Size	Ø500 mm
Model	AMS, Donkin, Ziehl or equal

FC-1

Type	Axial fan
No. Off	2
Air Quantity	665 l/s
Static Pressure	300Pa
Speed	2800rpm max
Size	Ø500 mm
Model	AMS, Donkin, Ziehl or equal

4.11 SCHEDULE OF INFORMATION

4.11.1 VRV HEAT RECOVERY SYSTEMS

OUTDOOR CONDENSERS

OUTDOOR CONDENSERS

CU-1

Type	VRV Recovery Condenser Unit
No. Off	2
Total Cooling Capacity	**130** kW
Total Heating Capacity	**130** kW
Model	Mitsubishi, Daikin or equal & approved
Refrigerant Type	R410A

FC-3

Type	Ceiling extract fan
No. Off	2
Air Quantity	100 l/s
Model	AMS, Donkin, Ziehl or equal

4.12 SCHEDULE OF INFORMATION

4.12.1 VRV HEAT RECOVERY SYSTEMS

OUTDOOR CONDENSERS

CU-1

Type	VRV Recovery Condenser Unit
No. Off	1
Total Cooling Capacity	……
Total Heating Capacity	……
Model	……
Refrigerant Type	……

INDOOR UNITS

AC-1

Type	VRV 4 Way blow cassette unit
No. Off	33
Total Cooling Capacity	……
Model	……
Refrigerant Type	……

AC-2

Type	VRV 4 Way blow cassette unit
No. Off	7
Total Cooling Capacity	……
Model	……
Refrigerant Type	……

AC-3

Type	VRV 4 Way blow cassette unit
No. Off	1
Total Cooling Capacity	……
Model	……
Refrigerant Type	……

DSU-1

Type	VRV In-ceiling ducted unit
No. Off	2
Total Cooling Capacity	……
Model	……
Refrigerant Type	……

DSU-2

Type	VRV In-ceiling ducted unit
No. Off	1
Total Cooling Capacity	……
Model	……
Refrigerant Type	……

4.12.2 ROOFTOP PACKAGE UNITS

RFT-01

Type	Rooftop Package unit (Heat Pump)
No. Off	1
Total Cooling Capacity	……
Total Heating Capacity	……
Air Quality	……

Make	……
Refrigerant Type	……

4.12.3 DX type mid-wall split Units

MW-01

Type	DX type Mid-wall Split unit
No. Off	1
Total Cooling Capacity	……
Make	……

4.12.4 FANS

FT-1

Type	Tube In-line fan
No. Off	6
Air Quantity	350 l/s
Static Pressure	……
Speed	……
Size	……
Model	……

FT-2

Type	Axial In-line fan
No. Off	4
Air Quantity	325 l/s
Static Pressure	180Pa
Speed	……
Size	……
Model	……

FC-1

Type	Ceiling extract fan
No. Off	5
Air Quantity	……
Model	……

FC-2

Type	Ceiling extract fan
No. Off	3
Air Quantity	……
Model	……

FC-3

Type	Ceiling extract fan
No. Off	2
Air Quantity	……
Model	……

5 SUB-CONTRACTORS PROPOSED BY TENDERER

The tenderer shall state in the schedule below the names of all sub-contractors he wishes to employ in the Works and shall specify their duties and outline their experience. No other sub-contractors shall be allowed without prior approval of the engineer.

NAME OF SUB-CONTRACTORS	PROPOSED DUTIES	EXPERIENCE

Note: Additional information shall be attached on the tender cover letter

NAME OF TENDERER .....

....

SIGNATURE OF TENDERER **DATE**

6 PREVIOUSLY COMPLETED CONTRACTS

The tenderer shall state in the schedule below, the names of all contracts of a similar / comparable nature, with which he has been involved, and the nature of his involvement, contract amounts and contact persons.

YEAR	CONTRACT	CONTRACT AMOUNT	NATURE OF INVOLVEMENT	CONTACT PERSON & TEL

NAME OF TENDERER.....

....

SIGNATURE OF TENDERER **DATE**

PART C-2 - BILL OF QUANTITIES SUMMARY