

NHLS BLOCK 14

DETAILED SPECIFICATION

**THE REFURSBISHMENT, UPGRADING AND
COMMISSIONING OF BLOCK 14 HVAC**

Potent Engineering Projects

[March 2025]

DETAILED SPECIFICATION

THE UPGRADING, REFURSBISHMENT AND COMMISSIONING OF NHLS Block 14 HVAC

<u>CLAUSE</u>	<u>TITLE</u>	<u>PAGE NUMBERS</u>
5.1	SCOPE OF WORKS	2
5.2	PROGRAMME	6
5.3	DRAWINGS AND DOCUMENTATION	7
5.4	DESCRIPTION OF WORKS	13
5.5	Work sequencing	15
5.6	General Requirements	19
5.7	DESIGN CONDITIONS	20
6.0	EQUIPMENT SPECIFICATIONS	22
7.0	EXISTING SYSTEMS	40
8.0	BMS SYSTEM	43
9.0	ELECTRICAL WORKS	43
10	OTHERS	46
11	VALIDATION AND CERTIFICATION OF SYSTEMS	49
12	BUILDERS WORK	49

5.1 SCOPE OF WORK

This detailed specification has been prepared to enable interested parties to prepare tender submissions for the Heating Ventilation and Air conditioning works at the NHLS Block 14 building that is located at 1 **Modderfontein Road, Sandringham Johannesburg.**

The Contract, as detailed in these specification documents and the accompanying drawings, comprises of the following: Manufacture, supply, transport and delivery to site, offloading, hoisting, installation, testing, setting into operation, leaving in complete working order, guarantee and the maintenance of the entire air conditioning units. The provision of all labour, materials, Contractor's equipment and everything, whether of a temporary or permanent nature required in and for such manufacture. Supply, transport and delivery to site, offloading, hoisting, installation, testing, setting into operation, leaving in complete working order, guarantee and maintenance, so far as the necessity for providing the same is specified in or reasonably to be inferred from the contract including linking of new system to existing fire system.

Making good building work and all such work, shall be included in the Contract for the upgrading and refurbishment of NHLS Block 14 HVAC.

5.1.1 Building Description

The intention of this Project is to replace the exist water cooled chillers units with new designed chiller system. NHLS Block 14 is a two-storey four section building.

The footprint of the building measures approximately 5356 m².

This project thus entails decommissioning of existing HVAC system.

The works under this contract includes the preparation of the site and the enabling works and also the installation of the new HVAC system and it's testing and commissioning.

5.1.2 Description of existing system

The existing HVAC installation in the building consists of the following;

- 2XWater cooled chillers
- 2XCooling towers
- 4XChilled water and condenser water pumps

- Hot water calorifiers
- Chilled water piping and valves
- Steam piping and valves
- 14X Air Handling units
- 71 Ducted units Fan coil units
- Fresh air fans
- Extraction fans
- Ducting and air grilles
- Hepa filters
- Plant rooms

The above HVAC system will all need to be decommissioned: The decommissioning and upgrade will be done in phases as the facility must remain operational during the upgrade thus minimal disruptions will be expected to the operations.

5.1.3 Description of the proposed works

The scope of work entails decommissioning of existing mechanical systems which are housed in the existing building plant rooms on the roof of the building.

All the HVAC systems in the existing buildings are going to be decommissioned and all major equipment is going to be stored at a place to be directed by the client which is within a 30km radius from the site.

Most of the major equipment is located in the roof plant room on the 3rd floor of the building. Contractors must ensure they adequately provide for the cost of rigging which will be required for the installation in their preliminaries and generals.

The works will be carried out in three main phases as follows:

1. Phase 01: Chiller plant and associated equipment replacement
2. Phase 02: Air Handling units and fan coils upgrade.
3. Phase 03: 5-year maintenance of the installation

Contractors must ensure they adequately price for this type of project implementation especially on the Crain hire and scaffolding hire for both decommissioning (taking out existing equipment) and rigging in of new equipment which will take place on many occasions.

The new works consists of the following:

HVAC

A central water-cooled chiller system will provide cooling to the entire block 14 complete with associated indoor units which are hide away ducted fan coil units for individual office spaces and Air handling Units for open plan office spaces, large lab spaces and production facilities.

The chiller system is designed to run on ozone friendly refrigerant.

The system, will be central with air distribution in the buildings being done through Air handling units and fan coils dedicated for each wing.

The chillers will provide chilled water to variable volume hide away fan coil units in the ceiling space of the areas being served and Air handling units in the various roof level plant rooms from which air is ducted to the various air diffusers and return air grills in the rooms being served. These in turn will condition the building in proportion to the cooling requirements of each respective space. These hide away fan coil units and Air handling units are going to be area specific.

Fresh air to the space is through various Ducted fresh air fans with air filtration capabilities located in the roof level plant rooms.

Heating of the space is achieved by means of either steam supplied from the existing steam boiler on site to the various Air handling units and hot water from steam heated hot water calorifiers in the various plant rooms to the fan coil units.

5.1.4 General System Components

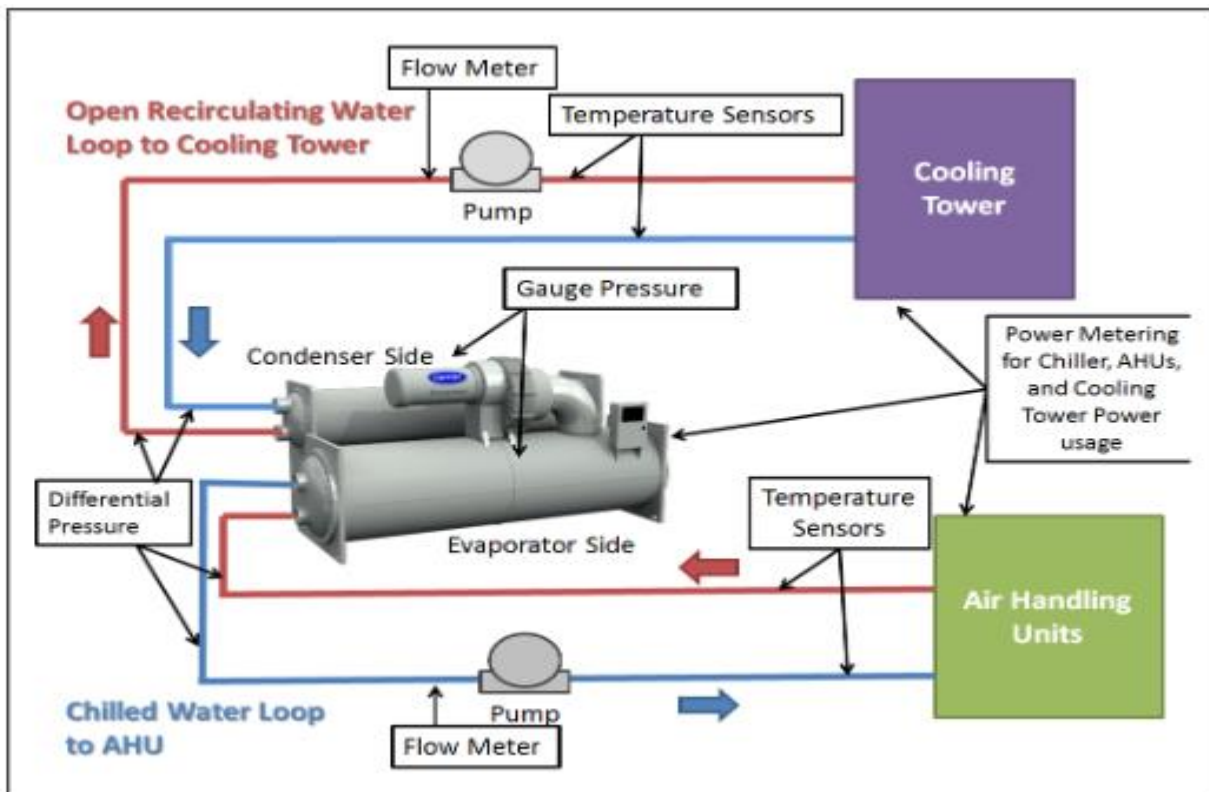


Fig 01 block 14 HVAC system general system components

Each of the above system components will be replaced with new in line with the system design.

Following Existing system components will be reutilised with the new system.

- Duct system
- Chilled water piping
- Extraction fans
- Fresh air fans
- Chilled water pumps
- Condensing water pumps

The above will be overhauled and reutilised with sections that are beyond repair being replaced with new.

All the above works are described in detail within the later sections of this specification along

with the Mechanical and Electrical tender drawings.

The new system will be linked to the existing fire detection system for compliance.

5.2 PROGRAMME

The programme for the works shall be in accordance with master program as agreed with the Engineer and the client. The Contractor shall ensure that all works in the Contract comply with that programme.

The entire installation is to be completely commissioned, tested and taken over by the Engineers before the completion date.

The Contractor shall be required, within One week 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 and the associated method statement for the works. The Contractor shall also provide method statements relating to the delivery of each major plant of equipment, including proposed access, storage and positioning.

The method statement shall be submitted to the Client's representative and shall be subject to Approval by the Project team.

Such programme shall show the times for the preparation of drawings, ordering and delivery times promised by the suppliers for each major item of plant, manufactured items, installation times and the programmed dates for testing and commissioning the plant

NB: It must be noted that the project will be implemented in two Phases as below:

1. Phase 01: chiller plant and associated equipment replacement
2. Phase 02: Air Handling units and fan coils upgrade.
3. Phase 03: 5-year maintenance of the installation to commence at the end of the 12 month warrant period.

The project program will have to be prepared to cater for the three phases

5.3 DRAWINGS

5.3.1 Tender Drawings

The drawings accompanying this specification, shall be deemed to indicate the general layout and requirements only and are not shop drawings.

The Engineer shall provide the Contractor, free of charge, with one set of specification documents, to include all tender drawings.

5.3.2 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 drawings from the Client.

5.3.3 Builder's Work Drawings

All Builders' work shall be carried out in accordance to specification. The Contractor shall provide builder's work or alter drawings as may be necessary to suit the plant offered by him, and accepted by the Engineer, and shall submit to the Engineer in duplicate any revisions, which shall be made to such drawings.

Such builder's work drawings shall indicate the location and extent of all foundations, bases, openings, timber frames and all other builder's work. 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 Contractor to execute the work without any misunderstanding.

Within a reasonable period (10 working days) after receiving such drawings, the Engineer shall signify his approval, or otherwise, and one signed copy of each approved drawing shall be returned to the Contractor.

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

Client:	1 Paper Print
Consulting Engineer:	1 Paper Prints + Electronic format (dwg)
Contractor:	3 Paper Prints

The drawings relating to the Contract provided by the Client's representative shall be read in conjunction with each other and all relevant Specifications in the preparation of the Tender by the Contractor. No claim will be considered on the grounds of want of knowledge in this respect

5.3.4 Documentation Prior to Tendering

Any questions in respect of the requirements for testing and commissioning shall be raised, in writing, with the Consulting Engineer during the tender period.

No claims for extra will be considered if the Contractor neglects to examine the full requirements.

The Contractor shall be responsible for familiarising themselves with the site and any relevant documentation within the tender or otherwise which provides details relating to the programme, phasing of works, working hours, dates and time periods for executing such works.

All works shall be carried out and executed in accordance with the main programme. The Contractor shall ensure the Client's representative is fully aware of the requirements for testing, commissioning and verification of the installation.

The time allocated for the above sequence of works shall not under any circumstances be reduced or compromised to allow other activities to be carried out. The criterion for system verification is paramount.

5.3.5 Inspection of the Site

The Contractor shall be deemed to have visited the site to establish the details, site conditions and existing services before submitting his tender bid.

No claim for extra costs will be considered in respect of any items the existence of which could have been established by inspection of the site.

The Contractor must make all arrangements to visit the site during the tender period with the named Clients representative.

5.3.6 Inspections and Approvals

The Contractor shall be responsible, and shall make due allowance in the Tender, for giving all notices to and attendance for inspection by the local Authority required for the execution of the Contract Works, obtaining all necessary licenses, approvals etc. and paying all fees, charges, rates and taxes legally demandable.

The Contractor shall install the Contract Works in accordance with the Bye-Laws, Building Regulations and Regulations of all interested parties as previously noted and utilising best practises throughout.

Prior to commencement of the works a joint inspection of all areas where work is to be carried shall be undertaken and a detailed photographic record taken of all areas and existing services to form the basis of an agreed record of the areas to be handed to the Contractor.

5.3.7 Shop Drawings

The Contractor shall submit to the Engineer, for approval, 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 plant rooms shall be drawn to a scale of not smaller than one in fifty and all drawings of work within plant rooms shall be drawn to a scale of not smaller than one in twenty-five. 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. Should the drawings not be approved, these shall be corrected and resubmitted until they are completely approved. Any delays in the resubmission and approval process shall be the Contractors responsibility.

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 Contractor, at his cost, if it is considered by the Engineer to deviate from the Specification.

The Contractor shall also supply additional copies of all approved drawings in accordance with the requirements of the standard technical specification. (Operating and Maintenance Instructions) of the Specifications.

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.

5.3.8 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 Contractor.

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 be not due to inaccurate information or particulars furnished in writing to the Contractor by the Engineer or Architect. The Employer shall be responsible for drawings and information supplied in writing by the Engineer or Architect and for the details of special work by either of them.

5.3.9 Schedule of Drawings

As per tender document

5.3.10 Working Area & Contractor Facilities

Contractor Facilities and the Contractor's Site Boundary will be advised. The Contractor is to agree with the Client's representative on the location of the welfare facilities.

For the works in restricted areas to be identified on site handover, the Contractor is obliged to obtain a Site Working permit from the Clients representative each time he needs to access and work within these areas.

5.3.11 Out of hours working

Because of the existing function of the building and the retaining of the existing system during the replacement works the Contractor shall include for all necessary out of hours working.

Where this work will entail any major drain down of systems or work which prevents the use of the large sections of the building, this work shall be carried out over a weekend.

5.3.12 On Site Manager

The Contractor shall allow for a full-time on-site Manager dedicated to this project alone, not a working foreman, to ensure that all operations are carried out in accordance with the Client's requirements and to attend the site meetings with Client's representatives.

This Manager shall also be responsible for the liaison between the users on site, Client's representative and Consulting Engineers to ensure that when existing services are shut-off, modified cut back etc. that all parties are aware and in agreement with the proposed works, well in advance of their implementation.

5.3.13 Origin of Equipment

Wherever practicable, equipment installed shall have been manufactured in South Africa. The equipment shall carry A SABS marking for proof of construction to International Standards.

Any equipment not meeting this criterion may be rejected and any costs associated with this rejection will be borne by the Contractor.

5.3.14 Standard of Manufacture

Where equipment is identified either by manufacturer and/or model number, it shall be taken that this is the standard of quality expected. However, this does not preclude the offer of alternative equipment provided it is of equal standard and quality to the named manufacturer.

5.3.15 Equipment

Equipment shall be installed and connected to the manufacturer's recommendations unless detailed otherwise in the Specification or agreed in writing with the Engineer.

5.4 Description of Work

The extent of this contract's works shall be as follows:

5.4.1 Description of existing system

NHLS Block 14 Building is an existing Building which is located in Modderfontein Johannesburg.

The existing HVAC will be decommissioned and replaced with a new designed system. Usable existing equipment which must be identified prior to commencement of any replacement work will be utilised in the project.

All the existing HVAC systems are going to be inspected and a report produced for the Engineer's approval prior to commencement of work.

The work will be phased to ensure minimum disturbance of the user client's operations.

5.4.2 Description of the proposed works

During the start of any section of the project, the existing equipment in that section are to be decommissioned and replaced with a new design as per tender drawings.

It must be noted that the work will be carried out in a live office environment and thus coordination with the user client is of paramount importance to ensure very minimal disturbance to client operations.

Drawings for existing HVAC system layouts are not available only the new system as per tender drawings. It is incumbent on the tenderers to check these drawings to familiarised themselves with the full scope of the work.

Tenderers attention is drawn to the requirement that before submitting the tender, tenderers should ensure that their offered price is for equipment that meets specification as no compensation will be provided should the price of the units be based on equipment which the engineer will not approve or which is not equal to that specified.

It is noted that after sales service and response to system failures is an important consideration when approving suppliers and full details of this as well as the equipment, must be submitted with any application for approval.

5.4.3 Contractor's responsibilities

The Contractor shall be responsible for the supply, delivery, installation, testing and commissioning of all of the mechanical and electrical installation works as shown on the tender drawings and described in this specification. The contractor must provide the client's representative with As-built drawings/ inventory of the installation on completion. Where brackets are required especially on the fans, appropriate anti-vibration mountings must be installed and the units must be placed at an easily accessible area for service and maintenance.

5.5 Work sequencing

The scope of works shall be as follows:

5.5.1 Site preparation and strip out of Existing Services

NB: It must be noted that work will take place in an occupied building as such work will be planned and implemented in sections with the contractor being responsible for the necessary coordination for minimal disruption to tenant operations.

The first phase of the equipment replacement work would involve site preparation that would enable the actual equipment replacement. The works under this part involve, but are not limited to the following: -

- Site preparation
- Condenser water drain out and replacement of the existing isolating valves
- Chiller water drain out and replacement of the existing isolating valves
- stripping out and removal from site of the existing mechanical and electrical system.
- Rigging into position, installation, testing and commissioning of new HVAC system.
- Wiring of the electrical installation to the distribution box, to suit the new units to be installed

The Contractor shall allow for the stripping out and removal from site of the existing mechanical and electrical equipment, chilled water pipework and all redundant materials associated with the Mechanical services installation.

This shall include, but not be limited to the following:

- The decommissioning and Removal of the existing 14 Air Handling units and associated duct work.
 - The decommissioning and removal of two the existing water-cooled chillers, including the existing R22 refrigerant disposal.
 - The decommissioning and removal of two existing open circuit cooling tower
 - The decommissioning and removal of existing primary and secondary pumps
 - The decommissioning and removal of existing Motor control centre
 - The decommissioning and removal of existing chilled water and condenser water piping
-
- The decommissioning and Removal of the Chiller units, refrigerant piping, existing fans.
 - Making good the walls to close all holes left by the decommissioned console units

NB: The above work entails use of Cranage and road closures which needs to be authorised with relevant authorities as the plant room is in the 2nd floor approximately +/- 15m in height. The contractor is to allow for the cost of such authorisation and cranage

5.5.2 Modification

- Pipe fittings to suit the new chillers, cooling towers and water pumps
- New equipment plinths to suit the new equipment foot print
- Replacement of the existing chilled water run and standby pumps located at the 2nd floor plant room.
- All existing connections to the existing chillers in the 2nd floor plant room
- All existing connections to the existing pumps in the 2nd floor plant room
- All existing valves that are to be replaced on the chilled and condenser water system.
- Ducting according to new design

5.5.3 Replacement of Equipment

The whole scope of replacement works of the existing units must be communicated with the end user client to suit their time.

The contractor is to be responsible for the delivery, positioning and commissioning of the New system.

After the replacement of the units and all associated equipment the Contractor is to allow for the re-commissioning of the whole installation under the instructions of the new schedules. The testing and commissioning procedure is described in detail in a separate section of this specification.

5.5.4 Making Good Defects

The Contractor will be provided by the Client's representative, upon Practical Completion, a list of incomplete and unacceptable works. The Contractor will immediately be provided with written notice by the Client's representative to remedy the incomplete or unacceptable works within one month.

The Contractor is to produce a written schedule of those items on the Client representative's list of incomplete and unacceptable works, that he is unable to remedy within the period of notice, together with a fully detailed programme of when such works can be completed.

The incomplete and unacceptable works will be valued by the Client's representatives.

The Client's representatives will recommend to the Client that this sum will be a minimum to be withheld from the Contractor's Final Account pending remedy of the incomplete and unacceptable works.

Should the Contractor fail to remedy the defects within the specified time period issued under written notice, the Client's representative shall instruct the works to be executed by other competent bodies and the costs of this instruction will be deducted from or added to the retained sum.

In the event the Contractor calls the Client's representative for re-inspection of the works and

the works are deemed unacceptable and not remedied, the cost of the Client's representatives abortive visit will be charged against the retained sum.

All lists of incomplete and unacceptable work prepared by the Client's representatives will be carried out at the discretion of the Client's representatives.

The Contractor shall carry out his own detailed inspection of the works prior to notifying the Client's representatives that the works are fully complete and ready for inspection.

All services prior to being covered up shall be offered for inspection with a minimum 5 days' notice being provided.

In the event that the inspection carried out by the Client's representatives produces an excessive list of items that are incomplete or needing corrective action, then the Client's representative reserves the right to contra charge the Contractor the cost of carrying out the inspection

5.5.5 Maintenance During Defects Liability Period

The Contractor shall include for the full planned preventative maintenance of all installed plant and ancillaries during the 12 months Defects liability Period (including the extended warranty period).

The maintenance shall allow for attendance by the relevant manufacturers of specialist equipment which shall include controls, Water Cooled Chiller units etc.

The Contractor shall include in the Tender for all necessary tools, equipment and materials to properly effect the maintenance of the installation to the satisfaction of the Client and Client's representatives.

The Contractor shall provide at the commencement of the Defects Liability Period, a maintenance programme for approval by the Client's representative. Further, the Contractor shall provide following each service visit during the Defects Liability Period and consequent thereto, a report on plant and services which shall include;

- .01 Details of works undertaken.

- .02 Plant Condition report.
- .03 Repair recommendations.

This report shall be forwarded to the Client's representative within 5 working days of the visit
The maintenance shall be as per **additional specification SA GENERAL MAINTENANCE**

5.6 General Requirements

The equipment offered must be configured to fit in the existing spaces and ceiling voids.

A phase failure and voltage relay shall be incorporated into the controls to shut down the units should the voltage vary by more than 15% of the normal supply voltage. The relay shall reinstate the units operation automatically after 5 minutes. A phase reversal relay shall also be incorporated to shut down the units in this eventuality.

5.6.1 General and Standard Requirements

a) General Requirements

The automatic controls for all refurbished and new mechanical services are to be supplied, installed, commissioned and demonstrated under this contract. The control systems are to be generally electronic/ electric.

All control valves, actuators, linkages, sensors, controllers, relays, etc., necessary for fully operational systems are to be provided under the Contract, unless specifically otherwise stated.

All controls are to be selected by the Contractor's Controls specialist to ensure stable and accurate operation.

The Contractor is to arrange for the Controls specialist's schematic and wiring drawings to be forwarded in duplicate to the Consulting Engineers for comment in reasonable time before manufacture or installation proceeds. Irrespective of any comments, it is the responsibility of the Contractor to ensure that the finished installation performs as specified in this Section.

The new control panels are to be supplied and installed under this contract. Wiring of equipment, sensors, etc., from the outgoing terminals of the control panel is to be carried out

by the Contractor. The Contractor is to ensure that the outgoing terminals are sized to suit the cables concerned.

The Contractor is to check with the manufacturers of all mechanical equipment that the equipment sizes stated in this Specification are correct, and is to inform the Consulting Engineers in the event of an alteration.

The Contractor is responsible for ensuring that his control systems are fully compatible with the requirements of all equipment.

The Contractor is to prepare drawings confirming the exact locations of all items to be wired, before electrical installation work is started.

5.7 Design Conditions

5.7.1 Site Conditions

Outside Temperature (air conditioning):

Location	Johannesburg
Altitude	1753 above sea level
Summer:	32°C db 21°C wb
Winter:	-1 °C db saturated
Electricity Supply:	380-volt, 3 Ph, 50 Hz, 4 wire
Lightning Conditions:	Severe

5.7.2 Internal Conditions

The building is designed for normal office occupation and Laboratory production.

Summer maximum operative temperature	23°C db
Summer indoor relative humidity range	50%
Winter minimum operative temperature	21°C
Winter minimum indoor relative humidity	30%

20% Fresh air shall be introduced into the spaces.

NOISE LEVELS

Offices:

General: NC38

Private: NC35

Meeting Rooms NC30

Toilets stores and Public Areas: NC40

The ventilation of the toilets and bathrooms shall be of a negative pressure type with minimum 10 (ten) air changes per hour. The toilets shall be provided with motorized exhaust dampers with local control.

6.0 EQUIPMENT SPECIFICATION

6.1 WATER COOLED CHILLER

2x York or equally approved Model Factory assembled and tested, water cooled screw chillers.

EQUIPMENT TYPE: Water-cooled Screw Chiller

Required quantity: 2

Cooling Capacity: 1650kW

Chilled water entering: 12°C

Chilled water leaving: 7°C

Condenser water entering: 26°C

Condenser Water Leaving: 31°C

Number of capacity control steps: 6

COP: 6 or better

twin-screw, semi-hermetic compressor

Refrigerants: Environmentally friendly refrigerant with no Ozone Depletion Potential (ODP) and no phase out date per the Montreal Protocol.

CAPACITY CONTROL: Unit must have *slide valve in the compressor to modulate unit capacity from 100% to 12.5% of design for normal air conditioning applications.*

The unit must be equipped with Refrigerant Isolation Valve to enable the condenser shell is to store the entire system refrigerant charge during servicing.

Capacity control

Operating Characteristics: 1. Chiller is installed in an indoor location and must be capable of operating in room temperatures between 40°F and 110°F (4.4°C and 43.3°C). 2. Provide capacity control system capable of reducing unit capacity to 12.5% of full load. Compressor must start in unloaded condition. Application of factory installed hot gas bypass must be acceptable as required to meet specified minimum load. Chiller must be completely factory-packaged including evaporator, condenser, compressor, motor, control centre and all interconnecting unit piping and wiring. The complete chiller assembly must be painted to meet 500-hour salt spray test in accordance with the ASTM B117 standard. D.

Factory Run Test: Chiller must be pressure-tested, evacuated and fully charged with refrigerant and oil, and must be factory operational run tested with water flowing through the vessel.

Chiller manufacturer must have a factory trained and supported service organization.

Warranty: Manufacturer must warrant all equipment and material of its manufacture against defects in workmanship and material. The warranty is for a period of 12 months from date of start-up, whichever occurs first.

DELIVERY AND HANDLING.

Unit must be delivered to job site fully assembled with all interconnecting refrigerant piping and internal wiring ready for field installation. Unit must be charged with refrigerant and oil by the manufacturer.

Provide protective covering over vulnerable components for unit protection during shipment. Fit nozzles and open ends with cloth enclosures.

Unit must be stored and handled per manufacturer's instructions.

Shipping: Unit must ship in one piece and requires the installer to provide the evaporator and condenser inlet and outlet pipe connections. If providing chiller model that ships in multiple pieces, bid must include all the material and field labor costs for factory authorized personnel to connect the pieces, all interconnecting piping, and wiring.

QUALITY ASSURANCE

Products must be designed, tested, rated and certified in accordance with, and installed in compliance with applicable sections of the following standards and codes:

1. AHRI 550/590 – Water Chilling Packages Using the Vapor Compression Cycle
2. GB/T 18430.1 – water chilling (heat pump) packages using the vapor compression cycle - Part 1: Water chilling (heat pump) packages for industrial, commercial and similar application
3. AHRI 575 – Method of Measuring Machinery Sound Within an Equipment Space
4. ANSI/ASHRAE 15 – Safety Code for Mechanical Refrigeration
5. ANSI/ASHRAE 34 – Number Designation and Safety Classification of Refrigerants
6. ASHRAE 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings
7. ANSI/NFPA 70 – National Electrical Code (NEC)
8. GB150/151 – Steel Pressure Vessels/Tubular Heat Exchangers
9. Conform to Intertek Testing Services for construction of chillers and provide ETL/ cETL Listed Mark

10. The equipment manufacturer must be fully certified and registered to comply in the areas of CE, Eurovent, ISO9001 and ISO14001. The equipment manufacturer shall be responsible for the

Testing and certification.

All equipment shall be run tested in accordance with the following procedures prior to leaving place of manufacture:

- 1) A choke test carried out on the refrigerant piping to detect obstacles.
- 2) The pipework shall be tested to 38bar.
- 3) Electronic leak testing shall be carried out to ensure maximum system refrigerant containment.
- 4) System vacuum test to 2 Torr
- 5) Refrigerant test to within 0.3%
- 6) Electrical tests shall include flash testing at 1440V AC to ensure that current leaks above 5mA are detected, megger test at 500V DC to ensure resistance levels are above 10 mega Ohm and earth continuity tests.

COMPRESSORS

twin-screw, semi-hermetic compressor shall be provided, operating in series and using a common refrigerant circuit on the unit. The rotor assembly shall consist of a heat-treated alloy steel drive shaft and impeller shaft with a cast aluminium, fully shrouded impeller. The impeller shall be designed for balanced thrust, dynamically balanced and over-speed tested for smooth, vibration-free operation. Insert-type journal and thrust bearings shall be fabricated of aluminium alloy, precision bored and axially grooved.

Capacity control shall be achieved by use of pre-rotation vanes to provide fully modulating control from full load to minimum load. Control shall automatically compensate for adverse operating conditions, such as fouled tubes, and adjust to prior operation after correction of these conditions. The unit shall be capable of continuous, reliable operation with low ECWT at all load conditions as outlined on the equipment schedule.

LUBRICATION SYSTEM

EVAPORATOR

Evaporator shall be of the shell-and-tube, flooded type designed for a minimum of 180 psi g (12.4 bar g) working pressure on the refrigerant side. Shell shall be fabricated from rolled carbon steel plate s with fusion welded seams, carbon steel tube sheets, drilled and reamed to accommodate the tubes, and intermediate tube supports spaced no more than four feet apart. The refrigerant side of each shell is designed, tested and stamped in accordance with ASME Boiler and Pressure Vessel Code, Section VIII – Division I. Heat exchanger tubes shall be high-efficiency, externally and internally enhanced type. Tubes shall utilize the “skipfin” design, providing a smooth internal and external surface at each intermediate tube support.

If skip-fin tubes are not used, minimum tube wall thickness shall be 0.035" (0.889 mm). Each tube shall be roller expanded into the tube sheets providing a leak-proof seal, and be individually replaceable. Water velocity through the tubes shall not exceed 3.65 m/sec. A liquid level sight glass shall be provided on the side of the shell to aid in determining proper refrigerant charge and to check condition of the refrigerant charge. Aluminium mesh eliminators or baffles shall be located above the tube bundle to prevent liquid refrigerant carryover to the compressor. The evaporator shall have a refrigerant relief device sized to meet the requirements of the ASHRAE 15 Safety Code for Mechanical Refrigeration. Water boxes shall be removable to permit tube cleaning and replacement. Stub-out water connections having ANSI/AWWA C-606 grooves shall be provided. Water boxes shall be designed for 150 psi g (10.3 bar g) design working pressure and be tested at 225 psi g (15.5 bar g). Vent and drain connections with plugs shall be provided on each water box. Low flow protection shall be provided by a thermal-type flow sensor, factory mounted in the water nozzle connection and wired to the unit pane.

CONDENSER

The refrigerant circuit water cooled condenser

is a cleanable shell and tube heat exchanger with seamless external finned copper tubes rolled into tube plates.

Condenser shall be of the shell-and-tube type, designed for a minimum of 235 psi g (16.2 bar g) working pressure on the refrigerant side. Shell shall be fabricated from rolled

carbon steel plates with fusion welded seams. Carbon steel tube sheets, drilled and reamed to accommodate the tubes, are welded to the end of each shell. Intermediate tube supports are drilled and reamed to eliminate sharp edges, fabricated from carbon steel plates. The refrigerant side of each shell is designed, tested and stamped in accordance with ASME Boiler and Pressure Vessel Code, Section VIII – Division I. Heat exchanger tubes shall be high efficiency, externally and internally enhanced type. Tubes shall utilize the “skip-fin” design, providing a smooth internal and external surface at each intermediate tube support. This provides extra wall thickness and non-work hardened copper at the support location, extending the life of the heat exchangers. If skip-fin tubes are not used, minimum tube wall thickness shall be 0.035" (0.889 mm). Each tube shall be roller expanded into the tube sheets providing a leak-proof seal, and be individually replaceable. Water velocity through the tubes shall not exceed 12 ft./sec. (3.65 m/sec.). A liquid level sight glass shall be provided on the side of the shell to aid in determining proper refrigerant charge and to check condition of the refrigerant charge. The condenser shall have dual refrigerant relief devices; each sized to meet the requirements of the ASHRAE 15 Safety Code for Mechanical Refrigeration. Arrangement shall allow either valve to be isolated and replaced without removing the unit refrigerant charge. Water boxes shall be removable to permit tube cleaning and replacement. Stub-out water connections having ANSI/AWWA C-606 grooves shall be provided. Water boxes shall be designed for 150 psi g (1034 bar g) design working pressure and be tested at 225 psi g (1551 bar g). Vent and drain connections with plugs shall be provided on each water box. A thermal-type water flow sensor shall provide low flow protection, factory mounted in the water nozzle connection and wired to the unit control panel.

CHILLER INSULATION

The unit must come factory fitted with a 19mm thick flexible closed-cell plastic anti-sweat insulation attached to the evaporator shell, tube sheets, suction connection, and (if necessary) to the auxiliary tubing. The 19mm thick insulation must prevent sweating in environments with relative humidity up to 75% and dry bulb temperatures ranging from 10 to 32°C.

FLASH ECONOMIZER (INTERCOOLER)

A single stage flash economizer (intercooler) shall be provided with internally mounted mesh eliminators, liquid spray pipe, an externally mounted (field installed) level transmitter

and an external control valve. Economizer shall include eight sight glasses, two above and two below the mesh eliminators, two at the liquid spray pipe and two in liquid line leaving the economizer. A thermometer well shall be furnished for checking liquid temperature. Connections and field installed pressure transmitter and relief valve assemblies shall be provided for field installation.

Support legs of structural steel tubing shall be provided with mounting brackets for optional spring type isolators.

CONTROL CENTER General –

The Unit must come complete with a stand-alone microprocessor-based control centre with linux operating. The unit control panel shall provide control of unit operation and monitoring of unit sensors, actuators, relays and switches. The unit panel shall provide capacity control operation of the compressor in response to low entering condenser water and start-up requirements. The panel shall also allow the unit to operate down to 0% evaporator load.

Control Panel – The control panel shall include a 10.4" colour active-matrix display with integral keypad and touchscreen for operator interface. The control panel shall be factory wired, unit mounted, Nema 12, gasketed enclosure. The panel shall be fabricated of 10-gauge steel and include full height front access door. The panel enclosure shall be painted to match the unit colour. All controls are arranged for easy access and internally wired to clearly marked terminal strips wiring connections. Wiring shall be color-coded black (power), red (control), light-blue and green (ground), with each wire numerically identified at both ends with wire markers. Wiring enclosed in shielded cables and pre-wired cables shall be colour coded per the wiring diagram. The screen shall detail all operations and parameters, using a graphical representation of the unit and its components. Graphic screens shall provide for:

- a. Unit Overview
- b. Evaporator
- c. Condenser
- d. Low stage compressor
- e. High stage compressor
- f. Motors g. Capacity control diagram
- h. Manual/Auto stations for all control outputs

The operator interface shall be programmed to provide display of all major operating parameters in both graphical and list type screen displays. PID control loop set points, and Manual/Auto functions shall be accomplished by the operator interface. Alarm indicators on the graphic display screen shall provide annunciation, and an alarm history screen to which show the most recent alarms, with the time and date of occurrence. Trip status screens shall be provided which show the values of all analogue inputs at the time of the last 128-unit safety shutdowns. The time and date of the shutdown should also be shown. Function Keys shall be provided on the control panel for Unit Start, Stop, Reset and Emergency Stop. The Quantum LX control system can be accessed remotely by any internet browser, when it is incorporated into an ethernet network. This virtual operator interface allows quick access to the units for full remote management without having to create a separate SCADA or supervisory control.

CAPACITY CONTROLS SYSTEM

The Capacity Control philosophy of the unit control system shall allow efficient fully automated control, without need for operator intervention. This control system shall monitor and display all safety aspects of the unit and provide alarms and a shutdown if safety limits are exceeded. If operator intervention is required, manual controls shall be provided on the electronic operator interface, for all electric actuators. The capacity controls algorithm shall automatically seek out the most efficient operation of the unit. The pre-rotation vanes are automated to obey the temperature controller to maintain chilled water production. In cases of low load, the pre-rotation vanes shall automatically throttle and be limited to a minimum anti-surge position. To provide light duty operation, the hot gas recycle valve shall be seamlessly throttled open according to temperature demands. This keeps the centrifugal compressor out of surge and maintains chilled water production. In cases of high load, which exceeds the motor kilowatt (or current) usage, the capacity controls algorithm shall automatically unload the system to maintain a restriction on power consumption. In the same way, conditions of high discharge pressure or low suction pressure shall override the production of chilled water in the interests of keeping the unit system online. In cases of light load and a low head, the high stage compressor shall be dropped offline, the flash economizer bypassed, and the unit will be run with the low stage compressor like a normal single-compressor unit.

6.2 COOLING TOWER

2x Evapco or equally approved Model Factory assembled and tested, induced draft belt driven fan Open Circuit counter flow cooling tower complete with fan, fill, louvers, accessories and rigging supports.

The units must be supplied in standard ZAM" mill galvanized Zinc-Aluminium-Magnesium alloy coated steel construction. The units will have 1 x 18.5 Kw motors suitable for 380/50/3 electrical supply.

THERMAL PERFORMANCE

A. Each unit shall be capable to cool 86.6 LPS of water entering at 31.0°C leaving at 26.0°C at a design wet bulb of 20.0°C.

Required Capacity: 1,810 kW

Air Flow: at least **31 m³/s**

Materials of Construction

1. All cold-water basin components including vertical supports, air inlet louver frames and panels up to rigging seam shall be constructed of heavy gauge mill hot-dip galvanized steel.
2. Upper Casing, channels and angle supports shall be constructed of heavy gauge mill hot-dip galvanized steel.
3. Fan cowl and guard shall be constructed of galvanized steel.

All galvanized steel shall be coated with a minimum of 2.35 ounces of zinc per square foot of area (G-235 Hot-Dip Galvanized Steel designation). During fabrication, all galvanized steel panel edges shall be coated with a 95% pure zinc-rich compound.

Fan(s):

Fan(s) shall be high efficiency axial propeller type with aluminium wide chord blade construction. Each fan shall be dynamically balanced and installed in a closely fitted cowl with venturi air inlet for maximum fan efficiency.

Drift Eliminators

Drift eliminators shall be constructed entirely of Polyvinyl Chloride (PVC) in easily handled sections. Design shall incorporate three changes in air direction and limit the water carryover to a maximum of 0.001% of the recirculating water rate.

Water Distribution System

Spray nozzles shall be precision moulded ABS, large orifice nozzles utilizing fluidic technology for superior water distribution over the fill media. Nozzles shall be designed to minimize water distribution system maintenance. Spray header and branches shall be Schedule 40 Polyvinyl Chloride (PVC) for corrosion resistance with a steel connection to attach external piping.

Heat Transfer Media

Fill media shall be constructed of Polyvinyl Chloride (PVC) of cross-fluted design and suitable for inlet water temperatures up to 130° F. The bonded block fill shall be bottom supported and suitable as an internal working platform. Fill shall be self-extinguishing, have a flame spread of 5 under A.S.T.M. designation E-84-81a, and shall be resistant to rot, decay, and biological attack.

Air Inlet Louvers

The air inlet louver screens shall be constructed from UV inhibited polyvinyl chloride (PVC) and incorporate a framed interlocking design that allows for easy removal of louver screens for access to the entire basin area for maintenance. The louver screens shall have a minimum of two changes in air direction and shall be of a non-planar design to prevent splash-out and block direct sunlight and debris from entering the basin.

Makeup Float Valve Assembly

Makeup float assembly shall be a mechanical brass valve with an adjustable plastic float. 1. Pan Strainer 1. Pan Strainer(s) shall be all Type 304 Stainless Steel construction with large area removable perforated screens.

Fan Motor

Fan motor(s) shall be totally enclosed, ball bearing type electric motor(s) suitable for moist air service. Motor(s) are Premium Efficient, Class F insulated, 1.15 service factor design. Inverter rated per NEMA MG1 Part 31.4.4.2 and suitable for variable torque applications and constant torque speed range with properly sized and adjusted variable frequency drives.

Fan motor(s) shall include strip-type space heaters with separate leads brought to the motor conduit box.

Fan Drive

The fan drive shall be multi-groove, solid back V-belt type with QD tapered bushings designed for 150% of the motor nameplate power. The belt material shall be neoprene reinforced with polyester cord and specifically designed for evaporative equipment service. Fan sheave shall be aluminium alloy construction. Belt adjustment shall be accomplished from the exterior of the unit.

Fan Shaft

Fan shaft shall be solid, ground and polished steel. Exposed surface shall be coated with rust preventative.

Fan Shaft Bearings

Fan Shaft Bearings shall be heavy-duty, self-aligning ball type bearings with extended lubrication lines to grease fittings located on access door frame. Bearings shall be designed for a minimum L10 life of 100,000 hours.

MAINTENANCE ACCESS**Fan Section**

Access door shall be hinged and located in the fan section for fan drive and water distribution system access.

Basin Section

Framed removable louver panels shall be on all four (4) sides of the unit for pan and sump access.

Internal Working Platform

Internal working platform shall provide easy access to the fans, belts, motors, sheaves, bearings, all mechanical equipment and complete water distribution system. The fill shall be an acceptable means of accessing these components.

Louver Access Door

Hinged access door in louver shall be provided.

6.3 CONDENSER WATER PUMP

Inverter-Driven **Centrifugal Pump**

Required maximum flow: 86.6 l/s

Head: 62 m,

Operating temperature range of -10°C to +40°C

Materials of Construction: Casing cast iron, shaft: stainless steel, impeller bronze, seal mechanical seal with ceramic seat.

6.4 CHILLED WATER PUMP

Inverter-Driven **Centrifugal Pump**

Required maximum flow: 95l/s

Head: 75 m,

Operating temperature range of -10°C to +40°C

Materials of Construction: Casing cast iron, shaft: stainless steel, impeller bronze, seal mechanical seal with ceramic seat.

6.5 AIR HANDLING UNITS

Existing air handling units will be decommissioned and replaced with new of same capacity as follows:

INSIDE AN AIR HANDLING UNIT

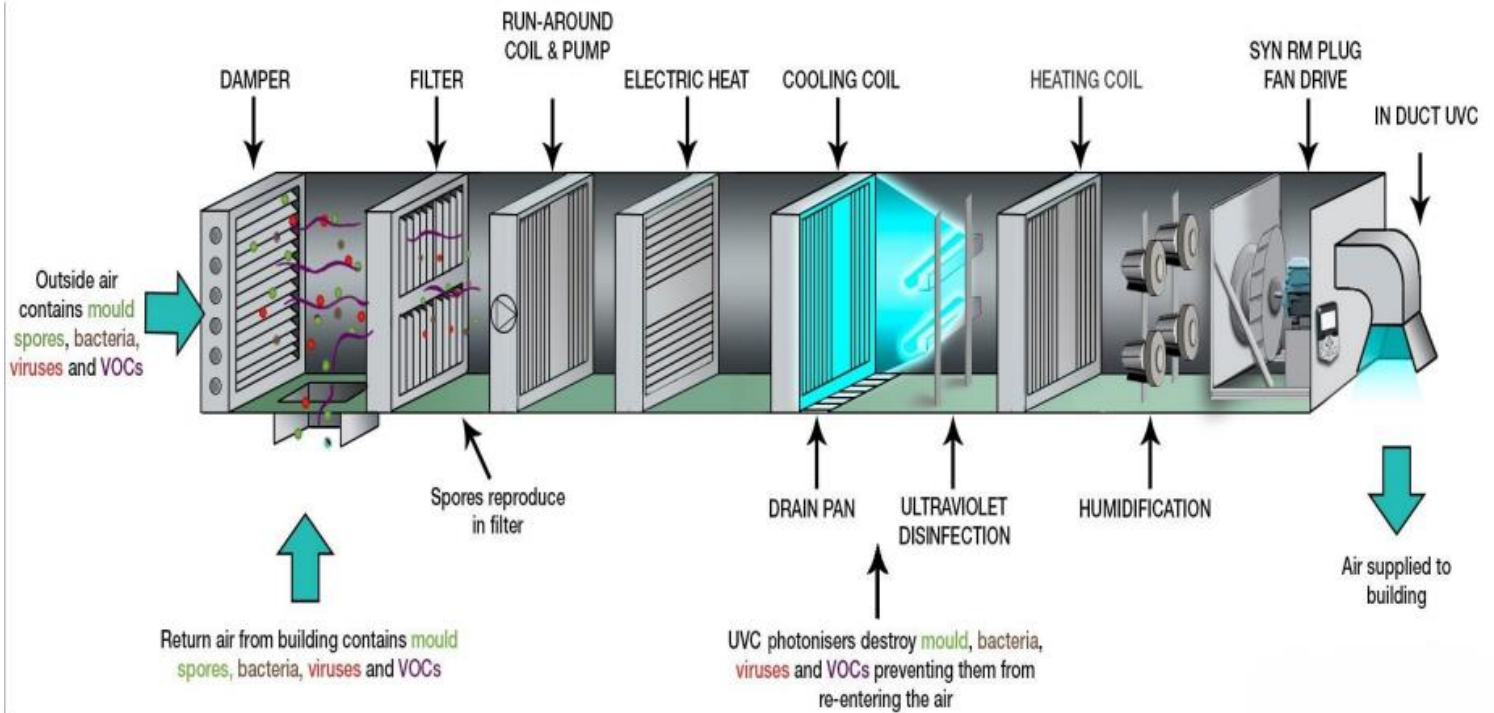


Fig 02 illustrative AHU components

AHU GENERAL SPECIFICATION

Coils:

Cooling coils- CU/Al/ SS

Steam Heating coils: CU/Al/ SS

Static Pressure: 650Pa

Fan Type EC type centrifugal fan with built in VSD

Application: Indoor

Assembly: Site Assembly

Filtration: 3 stage (Primary Secondary and downstream H13 Hepa filter)

Automation and control

The air handling units must come with the following automation and controls:

- Pressure Switch to give a signal when the set pressure drop value is exceeded, i.e. it informs about the clogged air filters or incorrect fan operation.
- The humidifier control functions
- Three-way valve with a servo controls agent flow through water exchanger (heater or cooler)
- Damper actuator to control closing and opening of multi-leaf dampers

- Limit switch To disconnect the fan's power supply when the inspection doors a
- Frequency Inverter to control power supply to the fan motors, thus regulating the AHU supply air rate. Duct Temperature Sensor is used to measure the temperature of the air supplied to or exhausted from a room.
- Room Temperature Sensor to measure the room air temperature
- CO detector for continuous control of carbon monoxide levels in rooms.

The Units must also be able to monitor and show the following: The AHU operation status (i.e. clogged filter, activation of protections) are signalled by lamps to aid the service personnel to diagnose any problems.

CONSTRUCTION

Base Frame

All units shall be provided with Galvanized steel/100 base frame of Minimum height 100 mm. Base Frame should be C Channel Type with a minimum thickness of 2.8 mm.

Profile

- a) AHU Profile shall be made of extruded aluminium alloy. Substitutions including galvanized steel painted profile or Frameless design will not be permitted.
- b) The profile construction (62 x 62 mm) shall be with thermal break layer (35 mm polyamide in 62 mm profile).
- c) Gaskets or insulation on the profile does not guarantee a true metal to metal thermal break and will not be accepted.
- d) Profiles shall be internally rounded (10 mm) ensuring that frame is flush with the internal housing surfaces and completely smooth to avoid dirt accumulation and guarantee excellent cleanability. Profile shall be externally rounded (10 mm), for safety reasons
- e) All profiles shall be "double chambered" so that the fastening screws on the closure panels remain enclosed inside the profiles

CASING

- a) The unit casings shall be double skin with 62 mm thick PIR insulation (Polyisocyanurate insulation) CFC free sandwiched between 0.7 mm thick Precoated Steel outer skin and 0.5 mm thick Stainless steel inner skin. Precoated external skin shall meet 1000 hrs salt spray tested in accordance with ASTM B-117.
- b) Panel Insulation thickness less than 62mm will not be permitted.

c) The polyurethane foam insulation shall have an overall density of 40-42 kg/m³ and thermal conductivity of 0.02 W/m °K.

d) The Panels to be held to the Frame by self-drilling / self-tapping screws. The Screws shall remain inside the profile and shall be installed from outside of the unit only. Screws shall not be exposed to both inside and outside air. Stainless steel screws shall be used.

e) The sound absorption through the panel shall be according to Eurovent. The sound reduction through the panel shall conform to the below values:

f) AHU Casing when exposed to 2500 Pa Positive and Negative pressure shall not cause any permanent deflection.

g) Inside the unit there shall be no grooves or gaps, where dirt can accumulate. Silicone shall be applied between frame and panels inside the unit. Silicone shall have certificate/test report showing proof of microbiological inertness according to ISO 846 Method A and C.

h) Mixing Box Segment

Outdoor Air ratio: 30%

Inlet Type: Aluminium electronic actuated damper

Filter Segment

Primary Filters: Class G4 /

Type: Panel pleat/ washable

Standard: [European EN 779 standard](#)/ ISO Coarse 60%-90% category, that captures airborne particles larger than 10 microns, such as dust and pollen, with an average efficiency of 90%.

Material specification: synthetic, non-woven fiber filter medium with metal frame, a high moisture and temperature resistance, and a low initial pressure resistance for maintaining good airflow in HVAC systems.

Secondary Filters: F8 class

Standard: [EN 779 standard](#),

Medium efficiency air filter designed for high-demand environments like laboratories, pharmacies, and operating rooms.

Dust spot efficiency: 90-95% for particles, effectively removing fine dust, soot, and mist.

Type: Bag type

The filter media is usually a synthetic micro-fiber that provides an electrostatically charged surface to capture particles, resulting in better filtration and longer lifespan than lower-grade

6.5.1 Central Wing

Type: Horizontal Chilled water & steam Air Handling units installed complete with, 3 level filtration system (Primary, Secondary and Hepa), Magnehelic gauges across filter bank, 1.5D Eurolon infill, return air fans, vibration isolation, supports, variable speed drive, Plenum lights in each chamber with light switch per light, Damper motors on mixing box dampers and bypass dampers, Intake Weather louvres on plenum boxes or fresh air units and all appurtenances related. Unit must have built in condensate drainage pumping system, Enthalpy control Dampers to enable free cooling with variable speed drive control

PRODUCTION

Air quantity: 5000L/s @ 650 Pa

Coil Face velocity: 2.5m/s

Cooling duty: 150kW

Steam Heating coil: 70 Kw

Quantity: 1

Offices

Air quantity: 900l/s

Coil Face velocity: 2.5m/s

Cooling duty: 40kW

Water Heating coil: 32 Kw

6.5.2 East Wing

Type: Horizontal Chilled water & steam Air Handling units installed complete with, 3 level filtration system (Primary Secondary and Hepa), Magnehelic gauges across filter bank, 1.5D Eurolon infill, return air fans, vibration isolation, supports, variable speed drive, Plenum lights in each chamber with light switch per light, Damper motors on mixing box dampers and bypass dampers, Intake Weather louvres on plenum boxes or fresh air units and all appurtenances related. Unit must have built in condensate drainage pumping system, Enthalpy control Dampers to enable free cooling with variable speed drive control

Air quantity: 2500L/s

Coil Face velocity: 2.5m/s

Cooling duty: 60kW

Steam Heating coil: 35 Kw

Quantity: 10

AHU 9 EAST QC Roof

Air quantity: 950L/s

Coil Face velocity: 2.5m/s

Cooling duty: 25kW

Steam Heating coil: 15 Kw

Quantity: 1

6.5.3 North Wing

Type: Horizontal Chilled water & steam Air Handling units installed complete with, 3 level filtration system (Primary, Secondary and Hepa), Magnehelic gauges across filter bank, 1.5D Eurolon infill, return air fans, vibration isolation, supports, variable speed drive, Plenum lights in each chamber with light switch per light, Damper motors on mixing box dampers and bypass dampers, Intake Weather louvres on plenum boxes or fresh air units and all appurtenances related. Unit must have built in condensate drainage pumping system, Enthalpy control Dampers to enable free cooling with variable speed drive control

Air quantity: 5000L/s

Coil Face velocity: 2.5m/s

Cooling duty: 125kW

Steam Heating coil: 70 Kw

Quantity: 1

Air quantity: 2500L/s

Coil Face velocity: 2.5m/s

Cooling duty: 125kW

Steam Heating coil: 70 Kw

Quantity: 2

6.5.4 South Wing Parasitology

Type: Horizontal Chilled water & steam Air Handling units installed complete with, 3 level filtration system (Primary, Secondary and Hepa), Magnehelic gauges across filter bank, 1.5D Eurolon infill, return air fans, vibration isolation, supports, variable speed drive, Plenum lights in each chamber with light switch per light, Damper motors on mixing box dampers and bypass dampers, Intake Weather louvres on plenum boxes or fresh air units and all appurtenances

related. Unit must have built in condensate drainage pumping system, Enthalpy control Dampers to enable free cooling with variable speed drive control

Air quantity: 5000L/s

Coil Face velocity: 2.5m/s

Cooling duty: 125kW

Steam Heating coil: 70 Kw

Quantity: 2

6.6 FAN COIL UNITS

The indoor units shall be concealed ceiling ducted type, to be installed hidden into ceiling space. They must have sufficient ESP to overcome the resistance of ducts and return and discharge grilles according to the project design.

DESCRIPTION AND MECHANICAL FEATURES

The unit casing shall be manufactured from galvanised steel plate and shall be fully insulated. The use of a polystyrene only construction for the outer casing will not be acceptable. Facility shall be provided for duct connection for introduction of fresh air to the unit and branch ductwork from the unit. The return air to the unit shall be through the back of the unit as standard. A facility shall be provided for alternative return air position through the underside of the unit. The heat exchanger coils will be manufactured from copper tubes and aluminium fins. It shall have electronic expansion valve to control refrigerant flow rate in response to the load variation in the conditioned space. The expansion valve shall be controlled by an integral computerised PID control system to maintain correct room temperature. The fan shall be of the dual suction multi blade type, statically and dynamically balanced to ensure low noise and vibration free operation. The fan motor must be brushless DC inverter type to provide energy efficient operation. The condensate shall be drained from the unit using suitable tube and run directly to a main drainage point. A condensate lift pump shall be provided within the unit and shall be capable of discharging 625 mm above the bottom plate of the unit. The air filter must be included with the units and must be removable and washable and have a mould proof coating.

KEY CHARACTERISTICS

The units shall be no more than 300 mm in height. The units must have ESP at least 200 Pa (5-12,5 kW units) for the whole line-up to enable operation with sufficiently long ducts. The units must have sound pressure level of no more than 40 dBA (low fan speed) for biggest models.

FUNCTIONS

The units must be able to be operated by wired or wireless remote controllers (by designer choice), available wired controllers must be available in 2 types at least (simplified and fully functional) to allow the design flexibility. The units must have the automatic restart function and multi-tenant ability.

The units must have the ability to alter the External Static Pressure (ESP) from the controller during commissioning; the steps to select ESP must be no less than 13. This is required to avoid the insufficient air flow if the real installed ducting differs from the designed one.

ADDITIONALS

Adapters for remote control and monitoring must be available to allow integration with other types on engineering equipment. Remote temperature sensor must be also available as an option to allow the correct temperature control if installation situation does not allow using the built-in sensor or remote controller sensor.

Capacities of the units are as per project drawings and detailed below

6.6.1 Central Wing

Item No	Cooling Capacity Kw	Heating Capacity Kw	Water flow L/s	Air Volume L/s	Qty
01	2.8Kw	7.4	0.15	315	2
02	3.6Kw	11	0.22	345	3
03	4.9kw	12.5	0.28	385	3
04	5.8Kw	14.8	0.32	425	1
05	6.5Kw	17.7	0.41	490	1
06	11.2Kw	32	0.78	945	3

Noise Level: **55**

Drain Pain: Stainless steel, SUS430

Maximum operating Pressure: 1700Kpa

Drain Pain: Stainless steel, SUS430

6.6.2 East Wing

Item No	Cooling Capacity Kw	Heating Capacity Kw	Water flow L/s	Air Volume L/s	Qty
01	1.8Kw	5.4	0.105	215	5
02	2.8Kw	7.4	0.15	315	12
03	3Kw	7.9	0.18	325	4
04	4Kw	11.45	0.25	355	3
05	5kw	12.65	0.305	405	2
06	6.5Kw	17.7	0.41	490	1
07	7.6Kw	19.8	0.52	575	1
08	11.2Kw	32	0.78	945	2

Noise Level: **55**

Drain Pain: Stainless steel, SUS430

Maximum operating Pressure: 1700Kpa

6.6.3 North Wing

Item No	Cooling Capacity Kw	Heating Capacity Kw	Water flow L/s	Air Volume L/s	Qty
01	2.8Kw	7.4	0.15	315	10
02	3.6Kw	11	0.22	345	5
03	4.9kw	12.5	0.28	385	1
04	5.8Kw	14.8	0.32	425	10
05	6.5Kw	17.7	0.41	490	1
06	11.2Kw	32	0.78	945	3

Noise Level: **55**

Drain Pain: Stainless steel, SUS430

Maximum operating Pressure: 1700Kpa

6.6.4 South Wing

Item No	Cooling Capacity Kw	Heating Capacity Kw	Water flow L/s	Air Volume L/s	Qty
01	2.8Kw	7.4	0.15	315	7
02	3.6Kw	11	0.22	345	2
03	4.9kw	12.5	0.28	385	2
04	5.8Kw	14.8	0.32	425	2
05	9Kw	25.9	0.59	770	4
06	13.5Kw	32	0.78	945	1

Noise Level: **55**

Drain Pain: Stainless steel, SUS430

Maximum operating Pressure: 1700Kpa

7.0 EXISTING SYSTEMS

Existing systems that are in maintainable condition will be repaired and overhauled as detailed below.

7.1 Ducting

All ducts are going to be cleaned, deodorised and sanitised using OXINE sanitizer.

All leaks on the ducts are going to be repaired and properly sealed. Duct sections which are beyond repair are going to be replaced with new.

All duct external insulation is going to be replaced with new as specified in the general HVAC specification on ducting. Below are details of the repairs to be carried out

- (a) Inspect and clean all ductwork
- (b) De-rust, neutralize and touch up paint work of ductwork
- (c) Check tightening of all securing bolts
- (d) Check duct work for leaks and repair defects
- (e) Replace all duct insulation
- (f) Check vapor barrier for defects and repair as required
- (g) Replace all joint seal and gaskets with new
- (h) Check for operation and reset all fire dampers
- (i) Replace all diffusers and return air grilles

7.2 chilled water pipping

All Existing chilled water and condenser water pipes that are in maintainable condition will be repaired and overhauled as detailed below.

- Repair all leaks
- Internal tubing to de-rust and unclogging piping internals
- Internal Chemical cleaning of the piping
- Replace all sections that are beyond repair.
- Replace sections of piping insulation that is beyond repair.

7.3 condenser water piping

All Existing condenser water pipes that are in maintainable condition will be repaired and overhauled as detailed below.

- Repair all leaks
- Internal tubing to de-rust and unclogging piping internals

- Internal Chemical cleaning of the piping
- Replace all sections that are beyond repair.
- Replace sections of piping insulation that is beyond repair.

The Cleaning Process

1. Preparation:

The system is surveyed for any potential issues and strainers are installed to protect equipment from large debris.

2. Pre-Flush:

Water flush to remove loose debris.

3. Chemical Cleaning:

- The system is filled with water and a specialist cleaning chemical clean guard 70F02 at 0.5-1kg per m³ of system volume is added.
- The mixture is circulated using the system's pumps for 48 hours or more.
- Samples are taken to monitor the cleaning progress and ensure the chemical reaches all parts of the system.
- Dynamic flushing to be continued and then it is passivated with clean guard 70F03 @ 1kg/m³ which should be circulated for 24hrs
- System should be flushed until running clear, colourless and odourless water and the iron level is less than 2pp

4. Testing and Verification:

Samples are tested by a third party to confirm that the water is clear, odourless, and meets the contract specifications.

5. Draining and Flushing:

The chemical solution is drained and the system is flushed with clean water until it is free of contaminants.

6. Inhibitor Dosing:

Once the system is clean, corrosion and biological inhibitors are added to protect it from future issues. Once cleaning operation is complete with water in the system, the same should be treated with corrosion and scale inhibiting treatment to prevent any future problems
Use Corro Guard 33L01 at 2.5kg/m³ of the system volume and circulate for 24hrs

7.4 Water pumps

All Existing water pumps that are in maintainable condition will be repaired and overhauled as detailed below

7.4.1 Chilled water pumps

Repair all leaks,

Pump & Motor Alignment: Ensure proper alignment of the pump and motor coupling.

Electrical Connections: Check for loose or damaged connections, including earth wiring

Replacement of Bearings

Controls: Ensure all controls are functioning correctly and that valves are operating smoothly.

Replace all Mechanical Seals

Overhauling of Motor: Inspect the motor for proper operation, lubrication, and signs of wear.

Electrical System: Inspect the electrical system for proper operation, including connections, controls, and safety devices.

Checking for unusual noises or vibrations.

7.4.2 Condenser water pumps

Repair all leaks,

Pump & Motor Alignment: Ensure proper alignment of the pump and motor coupling.

Electrical Connections: Check for loose or damaged connections, including earth wiring

Replacement of Bearings

Controls: Ensure all controls are functioning correctly and that valves are operating smoothly.

Replace all Mechanical Seals

Overhauling of Motor: Inspect the motor for proper operation, lubrication, and signs of wear.

Electrical System: Inspect the electrical system for proper operation, including connections, controls, and safety devices.

Checking for unusual noises or vibrations.

7.5 VENTILLATION FANS

7.5.1 Extractions Fans and Fresh Air Fans

- (a) Inspect and report on the condition of the unit for any defects.
- (b) Replace Xpelair unit
- (c) Check and replace bearings of fan motors and lubricate.
- (d) Replace fan.
- (e) Replace solenoid switch.
- (f) Replace speed controls.
- (g) Inspect and clean housing.
- (h) Check tightness of all electrical cables.
- (i) Clean fan blades and check for unbalance.
- (j) Check running amps of fan.
- (k) Check, clean and replace back draught shutters and the solenoid switch.
- (l) Reseal penetrations through the window and wall.

7.6 VALVES AND ACCESSORIES

All existing valves will be replaced with new similar as per specification

7.7 PLANT ROOMS

Existing plant rooms are going to be cleaned and sanitised. Each of the plant rooms is going to be bird proofed to ensure pigeons do not nest in the plantrooms. Secure Door from unauthorised access.

Ensure Plant room lighting adequate

8.0 BMS SYSTEM

A new BMS system will be designed and installed as specified in the BMS specification.

9.0 ELECTRICAL WORKS

9.1 GENERAL REQUIREMENTS

The power and automatic controls for all mechanical services are to be supplied, installed, commissioned and demonstrated under this contract.

The Contractor is responsible for ensuring that his control systems are fully compatible with the requirements of all plant and equipment.

All electrical work on the program will be as per the electrical drawings which forms part of this contract.

The control panels must be delivered to site to suit the Contract programme. Panel design and wiring diagrams must proceed in sufficient time to allow any comments necessary to be made and incorporated prior to manufacture of the panel.

All control panels to be of sheet steel, painted with primer, undercoat, and topcoat of oil-based paint to an approved colour. They are to have front access hinged doors for maintenance. All lamps, gauges, manual controls, etc., are to be arranged in a logical array on the front face of the panels, at a convenient height, with 'Traffolyte' labels to indicate their function. To be arranged for top entry of all cables unless otherwise stated. Externally-mounted control panels must be weatherproof and constructed from GRP.

Shop drawings are to be produced for the engineer's approval before any manufacture of panels.

Every control panel is to have an isolator on each incoming feeder.

Relays, delay timers, H.R.C. control circuit fuses, etc., are to be provided to ensure fully functional systems.

All internal wiring is to be neatly loomed, with numbered ferrules at both ends of every wire, corresponding to the numbering on the Controls Sub-Contractor's wiring diagram.

All external connections are to be via numbered "Klippon" clamp type terminal blocks, or

equal.

Any wiring and equipment which could remain live when panel doors are open is to be shrouded and provided with warning labels. All internal starters, relays, timers, etc., are to be identified with "Traffolyte" labels. All work is to comply with the I.E.T. Regulations, 17th Edition.

Equipment and wiring within Control Panels is to be segregated into two categories:

1. Control circuits operating at voltages at which the I.E.T. Regulations permit bodily contact. Wherever possible, control equipment is to be in this category.
2. Control circuits necessarily operating at higher voltages. 400/230 Volt power distribution circuits. Starters and Contactors.

Category 1 is to be accessible without shutting down the Control Panel, and without risk of contact with equipment operating at high voltages.

Category 2 is to be protected by a door-interlocked isolator and/or is to have fully shrouded terminals, fuse holders, etc., so that there is no risk of electric shock by inadvertent contact for an electrician working within the control panel. Relays are to be of the plug-in replaceable type.

All Control Panels are to have control circuits operating at 24 Volt 60 Hz. Where this is not possible, then all control circuits greater than 50 Volts must be on the same phase, to prevent interconnections from giving rise to a presence of 420Volts at, say, a Fireman's Control Panel.

Control circuit transformers are to be manufactured to B.S.3535/EN 60742.

(e) Time Switches

Any time switches, unless otherwise specified, are to have a 7-day dial, sub-divided into hours, or the electronic equivalent. They are to have a 36-hour battery reserve which is self-recharging. To have two 'ON' and 'OFF' settings for each day.

(f) Emergency Stop Facilities

Each control panel is to be provided with an integral twist-to-reset Red emergency stop button, clearly identified. The button is to drop out a relay in the control panel, which is to stop all plant controlled from that control panel, and where the outgoing power supply is derived from the control panel to disconnect all supplies greater than 50 Volts. Attention is drawn to the requirements of the I.E.E. Regulations and the European Machines Directive in respect of wiring of emergency stop circuits.

Additional remote emergency stop button(s) are to be provided within any Plantroom adjacent to each entry and are to be wired to any control panels controlling equipment/plant in the relevant Plantroom, to provide the same functions as the stop button described above.

9.2 MOTOR CONTROL CENTRES

The contractor shall provide power supply of all the new HVAC systems from the Main DB to the isolator of each unit and from the isolator to the MCC of each system.

The contractor shall also provide field wiring to all indoor units as per system design and the installation must be as detailed in other sections of this specification.

The contractor shall Design, manufacture and install all required MCC panels for each of the new systems.

9.3 SMALL POWER INSTALLATION

The existing small power installation shall be modified where necessary.

The contractor shall also be responsible for the provision of LV power to each new outstation, which shall be located at the new equipment positions. The power supply shall consist of a unswitched fused connection unit wired in XLPE/SWA/LSF cable from the nearest distribution board with spare capacity available. The contractor shall ensure that the distribution board utilised shall be part of the essential services distribution system and is backed up by the

generator in the event of a power failure.

9.4 **Earthing System**

An earthing system shall be provided to conform with BS7671:2001, BS7430:1991 and local electricity supply authority guidelines:

The Equipotential bonding conductors shall include, but not be limited to:

- Drainage pipework Ventilation ducts
- Mechanical services pipework Mechanical Plant
- Domestic hot & cold-water pipe
- Cable ladders/trays/trunking/conduit
- All conductors shall be sized in accordance with BS7671:2001. Cable Trunking and Trays

The ends of protective conductors which are to be connected to the earth bar shall be terminated in a crimped cable socket and bolted separately to the earth bar using brass bolts, nuts and washers with locking arrangements.

Each connection to the earth bar shall have an engraved label fixed to the cable.

10 OTHERS

10.1 CONTAINMENT

The contractor shall allow for the installation of all containment required for the installation of all the system components

Tray and rack shall be Flanged or return flanged. Perforations shall be admiralty pattern for light or medium duty; GDCC pattern standard 23; or manufacturer's standard pattern.

The contractor shall use factory made fittings throughout of same material, type, pattern, finish and thickness as cable tray. Join lengths of tray and fittings using manufacturer's standard shouldered ends, fish plates, or couplers, with galvanized or zinc plated slotted domed head 'roofing' bolts, nuts, washers and shakeproof washers.

The Material shall be hot rolled steel galvanized after manufacture to BS EN 10327 or BS EN 10143.

Trays and rack are to be supported from building fabric with minimum clearance behind of 20mm. Install fixings at regular intervals to prevent visible sagging when loaded, with maximum spacing 1.2m and 230mm from fittings.

Keep cutting of cable tray to a minimum. Cut along a line of unperforated metal. Make good finish with zinc rich paint, primer and top coat, or two pack epoxy paste, as appropriate to tray material and finish.

Fit holes cut in tray for passage of cables with grommets, bushes or other lining.

Install all bolts, fixings and hangers with threaded portion away from cables. Cable routes to cross at right angles or spacing to BS EN 50374.

Cable cleats shall be one piece or single way pattern or claw pattern or two bolt pattern. Manufactured from Die cast aluminium alloy; moulded black polyethylene; or nylon.

10.2 FIRE DETECTION AND ALARM INSTALLATION

The contractor shall link the Air conditioning system to the existing fire alarm system for each level.

10.3 THERMAL INSULATION

The Contractor is to include the provision and fitting of thermal insulation of the type, grade and thickness all as specified to: -

- All refrigerant pipework.

Insulation is to be installed in a neat manner, and particular attention to neatness is required in the plantroom and other areas where it is exposed to view. The method of installation of each type of insulation is to be strictly in accordance with the manufacturer's recommendations. All insulation is to be in accordance with B.S.5422:2001 and the appropriate thickness tables.

All insulation shall be zero ODP and a maximum GWP of 5 such as phenolic foam installed fully in accordance with the supplier's requirements and recommendations.

10.4 IDENTIFICATION

All pipes and items of equipment, are to be identified in strict accordance with the established Colour Code or with B.S.1710 and are to be further marked for direction of flow. Such identification is to be applied at intervals not exceeding 16 metres, and more frequently as necessary for clarity where any confusion might otherwise exist, including plantrooms (where identification is to be applied to each straight length). All pipework that is trace heated is to be identified as such at a maximum of 3m centres.

10.5 FIRE STOPPINGS AND SLEEVES

In all cases where pipes of any service pass through walls, floors or ceilings, the pipes are to be enclosed by sleeves of similar metal to the pipe concerned, and such sleeves are to be of a size to permit free movement of the pipe and carefully cut to length. The Contractor is to acquaint himself with the nature of the wall finishes and is to co-ordinate his work. A neat finished appearance is required.

Where the wall is fire-resisting, oversize sleeves are to be used, and the annular gap is to be packed with suitable fire-resisting material and sealed with intumescent paste.

10.6 ANTI-VIBRATION PADS

Except where higher performance anti-vibration measures are specified, or are necessary to meet the noise limitations specified, the Contractor is to supply only a 25 mm thick 'Ticopad' or equal and approved anti-vibration pad for each outdoor condensers which he is supplying under this Contract and which is to be erected on a concrete base. The pads are to be incorporated onto the base by the Contractor.

Anti vibration system for the outdoor condensers is to be in accordance to the supplier's specification and must be supplied together with the outdoor condensers.

11 VALIDATION AND CERTIFICATION OF SYSTEMS

These will be inline with the standard operating procedures of the respective departments

12.0 BUILDERS WORK

Scope of Works

- Forming holes through walls to accommodate services.
- Making good existing holes made redundant by the removal of existing services.
- New plinths for equipment on the roof plant rooms.
- Provide paving slabs beneath pipework supports.
- Removal of all rubble and waste from site.
- Holes Through Structure
- Existing Holes to be made good
- Equipment Bases
- Provide temporary/permanent anti vibration pads beneath equipment
- Taking down ceilings to enable access to work
- Making good taken down ceilings
- Bird proofing of plant rooms

Holes through Structure

Holes through the structure shall be to suit the routes of services and equipment.

The Contractor shall allow for making good and any re-decorating required for making good around all new holes.

Equipment Bases

The Contractor shall allow for bases for the new water-cooled chillers, cooling towers, chilled water pumps and condensing water pumps. which shall be cast onto the existing structure. The sizes for the bases are to match the requirements of the new equipment.

The Contractor is to allow for tyco pad mats.

Bird proofing of plant rooms

The Contractor shall allow for bird proofing of all plant rooms to ensure pigeons do not find way into the plant rooms.

The plantrooms are as per project drawings

Ceilings

The Contractor shall allow for striping and provision of new ceilings in areas to be worked on.

Training

Training is to be provided on the system operation for user client, maintenance personnel and site engineers as per additional specification SD Training.