SANBI
Biodiversity for Life
South African National Biodiversity Institute

PROJECT NAME	**APPOINTMENT OF A SERVICE PROVIDER FOR THE COMPLETION OF THE DRY ROOM AND MINOR REPAIR WORK TO THE SEEDBANK FACILITY AT THE KIRSTENBOSCH NATIONAL BOTANICAL GARDEN, CAPE TOWN**
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	COMPILED	**REVIEWED**	**SIGNED**	**APPROVED**
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SCOPE OF WORK AND TECHNICAL SPECIFICAITIONS FOR MECHANICAL INSTALLATIONS

PART 2

SCOPE OF WORK AND TECHNICAL SPECIFICATIONS FOR MECHANICAL INSTALLATIONS

PART 2

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1. SCOPE OF WORK

1.1 The works comprise the complete supply, installation, testing, commissioning and handover of a refrigeration-based HVAC system for the Dry Room in Seedbank at the Kirstenbosch, including all labour, materials, equipment, tools, transport, supervision and specialist services required for a fully functional installation.

1.2 The Contractor shall supply and install a commercial refrigeration condensing unit, matched to a double-skin DX Air Handling Unit complete with cooling coil, electric heater bank, plug fan, filters, HEPA filtration, heat recovery section, monitoring sensors, Carel controller, terminal boxes, drip tray and all required supports.

1.3 The works include insulated ductwork tie-ins to the existing ducting network, including flanges, gaskets, supports, suspension systems and testing, in accordance with approved drawings and specifications.

1.4 Refrigeration works shall include copper pipework, insulation, pipe trays, refrigerant charge, driers, valves, refnets, sight glass, solenoid valves, oil traps and all accessories required for a complete, leak-free and serviceable system.

1.5 Electrical works shall include power cabling, isolators, circuit breakers, control panel DB, over-/under-voltage protection, control wiring, interlocks and all wiring required for safe automatic operation.

1.6 The Contractor shall allow for craneage, hoisting, rigging, positioning and installation of all new equipment, including safe removal and disposal of existing AHU, condenser and dehumidifier units.

1.7 Testing, commissioning, as-built drawings, manuals, end-user training and electrical and refrigeration Certificates of Compliance shall form part of the handover.

1.8 Additional works include VRV and freezer room repairs, door repairs, plumbing installations, hydroboil replacement, monitoring system installation and making good building works.

1.9 System Description

The system provides controlled low-temperature air to the Dry Laboratory to maintain environmental conditions suitable for long-term seed storage and handling. Key equipment includes:

- One LREQ20BY1 inverter-driven low-temperature condensing unit
- One factory-assembled double-skin DX AHU (Model MAH C)
- Full refrigeration interconnection piping (liquid and suction lines)
- Electric heater bank
- Plug fan assembly
- Multi-stage air filtration including primary, secondary, and HEPA filters
- Environmental monitoring instrumentation
- Electrical control panel and power distribution
- Safety, interlock, and communication wiring

All components must be new, unused, compliant with relevant SANS, ASME, EN, and ISO standards, and installed in accordance with accepted engineering practice.

1.10 Contractor Responsibilities

The Contractor shall:

- Supply all materials, labour, tools, equipment, consumables, and transport
- Implement the installation according to the drawings, specification, and manufacturer model data
- Ensure compliance with SANS 10147, SANS 10142-1, and all applicable regulations
- Protect, store, and handle equipment to prevent damage
- Provide all testing, commissioning, calibration, training, and documentation
- Restore all affected building surfaces to original condition

2. APPLICABLE CODES AND STANDARDS

2.1 Refrigeration Standards

- SANS 10147 – Refrigeration and Air-Conditioning Installations
- EN 378 – Safety Requirements for Refrigerating Systems
- ISO 5149 – Refrigeration Safety Standard

2.2 Electrical Standards

- SANS 10142-1 – Wiring of Premises
- IEC 60364 – Low Voltage Installations

2.3 Mechanical Standards

- ASME B31.5 – Refrigeration Piping & Heat Transfer Components
- ISO 559 – Copper & Copper Alloy Tubes
- SMACNA Ductwork Standards

2.4 Quality & Compliance

- ISO 9001 – Quality Management
- ISO 14001 – Environmental Management
- OHS Act & Construction Regulations

3. SYSTEM DESIGN REQUIREMENTS

3.1 Environmental Performance Targets

The HVAC-refrigeration system shall achieve the following:

Parameter	**Requirement**
AHU Airflow	303 L/s
Cooling Duty (DX Coil)	≥20.89 kW
Off-coil Temperature	–10.4°C
Refrigerant Type	R410A
Total Refrigerant Charge	~18.5 kg (as per model calculation)
Evaporating Temperature	–27°C
Ambient Design Condition	32°C

3.2 Operating Conditions

The system must maintain stable cooling performance under variable load with inverter regulation, ensuring:

- Continuous operation from –45°C to +10°C evaporating temperature
- High subcool degrees as per model tables
- Safe oil return under all running conditions
- Proper superheat and subcooling tuning during commissioning

4. MECHANICAL EQUIPMENT SPECIFICATION

4.1 Condensing Unit – Model LREQ20BY1

A low-temperature condensing unit incorporating:

- Scroll compressors (hermetically sealed)
- Variable-speed inverter capacity control
- R410A refrigerant
- Sound pressure approx. 63 dBA
- Operating range: –45°C to +10°C evaporating temperature
- Ambient operating range per model table
- High subcooling characteristics (as per technical table)

Mechanical Construction Requirements:

- Weather-resistant coated steel casing
- Cross-fin coil heat exchanger
- Propeller fans with direct drive motors
- Integrated electronic control module
- Refrigerant receiver where required
- Anti-vibration mounts

Performance Requirements:

- Refrigeration capacity approx. 22.15 kW at –27°C Te, 32°C ambient

- Subcool degrees per published matrix
- COP values in accordance with model performance tables

4.2 DX Air Handling Unit – Model MAH C

Factory-built double-skin AHU including:

- Double-skin 50 mm insulated panels
- Supply airflow: 303 L/s
- DX cooling coil (8 rows/8 fins)
- Electric heater bank: 9 kW
- Plug fan: 1 x K3G310P
- Primary, secondary, and HEPA filters
- Drain pan and drainage connections
- Access doors, lighting, manometers, and inspection panels

Materials:

- Stainless steel frame 304 for coil housing
- Copper tubes with aluminium fins
- Condensate tray in stainless steel
- Powder-coated external surfaces

4.3 Cooling Coil Specification

- Type: DX
- Cooling duty: 20.89 kW
- Face velocity: 2.16 m/s
- Air-in: 25.5°C DB / 18°C WB
- Air-out: approx. –10.4°C DB
- Coil configuration: 8 rows × 8 fins
- Tube diameter: 9.53 mm
- Fin spacing: 14 FPI
- Refrigerant velocities: ~13.40 m/s gas / 0.13 m/s liquid

4.4 Electric Heater Bank

- Duty: 9 kW
- Stainless steel sheathed elements
- Over-temperature cut-out
- Stage or proportional control capability

4.5 Filtration Section

- **Primary filter:** EU4, 50 mm
- **Secondary filter:** included
- **HEPA filter:** included
- **Pressure drop:** 25 Pa (clean), 150 Pa (dirty)
- **Manometer and gauge assembly included**

4.6 Fan Section

- Plug fan, electronically commutated
- Airflow: 303 L/s
- External static pressure: 250 Pa
- Smooth performance curve with low vibration

4.7 Drainage

- Sloped stainless steel drain tray
- 25 mm drain connection
- Trap included

5. REFRIGERATION SYSTEM SPECIFICATION

5.1 Piping Requirements

Copper pipework per ASME B31.5:

- Liquid line: hard-drawn copper, matching sizes from design
- Suction line: hard-drawn copper, matching the design
- All bends to be long-radius
- Refnet installation:
    - Liquid lines: horizontal
    - Suction lines: 45° downward to evaporator branch
- Refrigerant piping must respect maximum equivalent lengths

5.2 Insulation

- Suction: min. 3/4" (≈32 mm) wall
- Liquid: min. 3/8" wall
- Closed-cell elastomeric insulation
- UV-resistant covering for outdoor sections

5.3 Refrigeration Accessories

Mandatory components:

- Liquid line drier (molecular sieve type)
- Suction line drier with replaceable core
- Sight glass
- Liquid line solenoid before expansion device
- Electronic expansion valve or TX valve per design
- Oil traps at 5 m vertical intervals
- Isolation valves at each evaporator

5.4 Leak Testing

- Nitrogen pressure test to manufacturer design pressure
- Bubble test on all joints
- Test duration: min. 24 hours

5.5 Vacuum Requirements

As per advanced commissioning guidelines:

- Vacuum target: **≤500 microns**
- Decay test: vacuum must not rise more than **100 microns in 60 minutes**
- Vacuum measured at liquid service valve
- Evacuation via suction line

5.6 Refrigerant Charging

Per model calculation:

- Total additional charge: 6.4 kg
- Base charge: 11.5 kg
- Total system charge: ~18.5 kg
- Refrigerant type: R410A
- GWP: 2087.5

6. ELECTRICAL INSTALLATION SPECIFICATION

6.1 Power Supply

- 380–415 V, 3-phase, 50 Hz
- Dedicated circuit breakers
- Separate isolators per major component
- Voltage monitoring required

6.2 Control Panel

A fully populated and factory-wired panel including:

- Main isolator

- Control transformers if required
- Protection relays
- Contactor logic
- Phase-failure and undervoltage protection
- Terminals for:
    - Sensors
    - Solenoid valves
    - P1/P2 communication
    - E-stop circuit

6.3 Control Wiring

Includes:

- P1/P2 communication pair
- Sensor wiring (temperature, humidity, CO_2)
- Safety cut-out wiring
- Relay interlock between condensing unit and solenoid valves

6.4 Earthing

- SANS 10142-1 compliant earth bonding
- Earth continuity testing

7. CONTROLS AND INSTRUMENTATION

7.1 Sensors

- Temperature sensors at AHU coil inlet/outlet
- Hygrometer for relative humidity
- CO_2 sensor for air quality
- Differential pressure sensors for filters

7.2 Safety Controls

- High/low pressure safety switches

- Heater over-temperature protection
- Fan motor overload protection
- Emergency stop

7.3 Environmental Controls

The system shall automatically regulate:

- Cooling capacity
- Heater capacity
- Fan speed
- Airflow monitoring
- Refrigerant flow via EEV/TXV

8. INSTALLATION REQUIREMENTS

8.1 Mechanical Installation

- AHU installed level with proper access
- Condensing unit on vibration-isolated plinth
- Pipe supports per manufacturer spacing
- No crushing or deformation of copper tubes
- Brazing with nitrogen purge mandatory

8.2 Electrical Installation

- Cable trays and conduits neatly routed
- All terminations ferruled and labelled
- Isolators installed within 1.5 m of equipment

8.3 Workmanship

All workmanship must be:

- Neat, aligned, and free of defects
- In accordance with SANS standards
- Subject to inspection at each stage

9. TESTING AND COMMISSIONING

9.1 Mechanical Testing

- Pressure testing
- Leak testing
- Vacuum testing
- Refrigerant charging
- Oil return verification

9.2 Airflow Testing

- Fan speed verification
- Air balancing to 303 L/s
- Filter pressure drop measurement

9.3 Electrical Testing

- Insulation resistance
- Earth continuity
- Phase rotation
- Control logic verification

9.4 Functional Testing

- Cooling performance tests
- Heater tests
- Defrost cycle (if applicable)
- Sensor calibration
- Alarm testing

9.5 Performance Validation

The system must demonstrate:

- Cooling duty ≥20.89 kW
- Stable off-coil temperature –10.4°C

- Continuous operation within defined limits

9.6 Handover

Deliver:

- Commissioning report
- Refrigerant log sheet
- COC (Electrical)
- COC (Refrigeration)
- O&M manuals
- As-built drawings
- Training certificate

10. PERSONNEL COMPETENCY REQUIREMENTS

A minimum of one **Category B Refrigeration Mechanic** shall serve as Site Foreman and must:

- Be registered with SAQCC Gas (SARACCA)
- Be authorised for Refrigerant Groups A1 and A3
- Hold a Trade Test qualification
- Be verifiable on the SAQCC Gas registry
- Be authorised to issue electronic COCs as per the requirements in the letter 24 February 2023

South African Qualification & Certification Committee
Block G Hurlingham Office Park
Woodlands manor
2196

Tel: 011 285 0038
Fax: 086 550 8444
Email: info@saqccgas.co.za

RE: End of the Road for Paper CoC's Announced 24/02/2023

As of the 1st of April 2023, any Certificate of Conformity (CoC) issued by paper will not be considered valid.

Dear Stakeholder,

SAQCC Gas is proud to announce the complete digital shift to the issuing of certification by gas practitioners in South Africa. The move comes in the wake of an increase in certification-related incidents of fraud. This is a proactive initiative put in place by the SAQCC Gas, to ensure accountability and safety within the gas industry, only a registered gas practitioner can issue a CoC.

The digital CoC was launched in 2021 and is in line with South African standards, ensuring the gas industry remains one of the safest in the world.

SAQCC Gas would like to encourage the end-user to not accept paper CoCs after the 1st of April 2023 and confirm the validity of a gas practitioner's registration by visiting www.saqccgas.co.za.

Practitioner's registration cards can also be viewed onsite via the SAQCC Gas App.

We call on the gas industry and consumers to report any illegal installations by emailing info@saqccgas.co.za.

At SAQCC Gas we encourage all gas practitioners to download the SAQCC Gas App and register. The process of issuing a digital CoC is quick, simple, and convenient whether you are on or offline. The application has specifically been designed to suit the requirements of our industry and technical support is on hand to assist with any enquiries.

We would like to thank the gas practitioners who have made the transition to issuing digital CoCs effortlessly and look forward to assisting others to do the same.

Yours in Safety,

E Cooke



SAQCC Gas
Communication Manager

Registration No.:. 2008/027203/08.
Directors: J Parry (Chairman), HR Lubbe, W J Winterton; BM Richardson, N Brijlal, B J Little, E Cooke, G Dihlabi

11. QUALITY CONTROL

The Contractor shall implement:

- Inspection Test Plans (ITPs)
- Material approvals
- Method statements
- Risk assessments
- Site checklists
- Final QA dossier

12. BUILDING WORKS (MAKING GOOD)

The Contractor shall restore all affected building surfaces, including:

- Minor brickwork
- Wall chases or penetrations
- Crack repairs
- Painting
- Door adjustments
- Sealing of openings

All finishes must match existing surfaces.

13. HEALTH, SAFETY & ENVIRONMENTAL COMPLIANCE

Comply with:

- OHS Act
- Construction Regulations
- Refrigerant handling regulations
- Environmental protection measures

Provide:

- Safe work procedures

- PPE
- MSDS for chemicals
- Emergency response plan

14. WARRANTY REQUIREMENTS

- 12-month workmanship warranty
- 24-month equipment warranty (model-based)
- Defect resolution within specified timeframes