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TABLES

1. INTRODUCTION

This document specifies and describes the supplies, services and engineering, and construction *Works* that are to be provided and any other requirements and constraints relating to the manner in which the Eskom New Germany Ikhwezi Building Heating Ventilation and Air Conditioning (HVAC) System contract is to be performed.

The New Germany Ikhwezi Building is a double storey building which is constructed from face brick and plastered on the inside; and comprises of five levels as follows:

a) Lower basement parking
b) Upper basement parking and offices which comprise of four wings as follows:
    - A and D wing has parking, IT Rooms, and Ablution facilities.
    - B & C wing has offices.
c) Ground floor offices which comprise of four wings.
d) First floor offices which comprises of four wings.
e) Roof level which houses the HVAC plant rooms.

Due to the age of the building some of the building services are over their life span and need to be replaced, and others require major repairs and service.

2. SUPPORTING CLAUSES

2.1 SCOPE

The scope of this specification is limited to the replacement of Eskom New Germany Ikhwezi Building HVAC system.

a) Basement IT Room 1 and 2.
b) Basement Office Area.
c) Ground Floor Office Areas.
d) First Floor Office Areas.
e) First Floor Boardrooms.
f) First floor to basement floor atrium.

2.1.1 Purpose

The purpose of this document is to describe the minimum requirements for engineering, drawings, procurement, manufacture, quality control & assurance, supply, delivery, installation, commissioning, testing, training, and maintenance and handing over of HVAC *Works* replacement Eskom New Germany Ikhwezi Building.

2.1.2 Applicability

This document is applicable to Eskom Real Estate (ERE), at Eskom New Germany Ikhwezi Building.

2.2 NORMATIVE/INFORMATIVE REFERENCES

Parties using this document are to apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

[1] 240-102547991: General Technical Specification for HVAC Systems.

[1] 240-70164623: Eskom Heating Ventilation and Air Conditioning (HVAC) Design Guideline

[2] 240-143112846: Heating Ventilation and Air Conditioning System Design Work Instruction

2.2.2 Informative

[3] 240-53665024: Engineering Quality Manual

[4] 240-53114026: Project Engineering Change Management Procedure

[5] 240-53113685: Design Review Procedure

[6] ISO 9001 Quality Management Systems.

2.3 DEFINITIONS

Definition	Description
Acceptance	The *Employer* accept the condition or design but does not take responsibility from the Contractor
Approval	Written agreement or authorization by *Employer*. All requests for approval must be submitted in writing and any proposed deviation from specified requirements must be fully justified and agreed by *Employer*.
Contractor	Refers to the corporation appointed to perform the engineering, procurement, and construction Works required for the project.
Design freeze	Is a binding decision that defines the whole product, its parts or parameters and allows the continuation of the design based on that decision (no further changes can be made to the design, it is cut-off for the engineers)
Employer	Refers to Eskom Holdings State Owned Company
Eskom Engineering	Refers to the Eskom Engineering team who will perform the reviews and provide technical assistance for the work performed by the appointed *Contractor.*
Heating, Ventilating, and Air Conditioning (HVAC)	Relates to Systems that perform processes designed to regulate the air conditions within buildings for the comfort and safety of occupants. HVAC Systems condition and move air to desired areas of an indoor environment to create and maintain desirable temperature, humidity, ventilation, and air purity.
Interface	Interface in these document means either to hard wired or software interaction between the *Contractor*s and/or other Works
Maintenance	Maintenance can be defined as the function of keeping components or equipment in or restoring them to a serviceable condition so that they comply with design and statutory requirements and *Employer* standards. Maintenance includes the cleaning, removal of contaminants and waste, correct adjustment, and setting, tightening, testing, fixing, refill, lubrication, rust prevention, touch up, refrigeration charge, servicing, inspection, replacement, re-installation, troubleshooting, calibration, condition determination, repair, modification, overhaul and rebuilding of equipment. Maintenance can be either preventative or corrective of nature.
Maintenance Management	Maintenance Management can be described as the management (planning, organising, leading and control) actions needed to ensure effective maintenance execution to provide the most efficient and optimum availability (capable of being used) and reliability (consistent quality) of the equipment installed.

Definition	Description
Specification	The document/s forming part of the contract in which the methods of executing the various items of work to be done is described, as well as the nature and quality of the materials to be supplied and it includes technical schedules and drawings attached thereto as well as all samples and patterns
System	A set of things working together as parts of a mechanism or network in an organised manner or method such that the requirements of the System are achieved.
The Client	The end user will be Eskom who will be represented by Eskom Real Estate throughout the duration of the Project.
Unequipped spare	A functional unit that does not house any electrical components but is intended to be used in future by retrofitting/modifying the functional unit.

2.3.1 Classification

a. **Public domain:** published in any public forum without constraints (either enforced by law, or discretionary).

2.4 ABBREVIATIONS

Abbreviation	Description
AC	Alternating Current
AHU	Air Handling Unit
ASHRAE	American Society of Heating Refrigeration Air Conditioning Engineers
BS	British Standard
CA	Corrective Action
CAV	Constant Air Volume Terminals
CIBSE	Chartered Institution of Building Services Engineers
C&I	Control and Instrumentation
CM	Corrective Maintenance
CoE	Centre of Excellence
COP	Coefficient of Performance
DC	Direct Current
DGN	MicroStation CAD drawing, vector format
DWG	AutoCAD drawing, vector format
DX	Direct Expansion
ERE	Eskom Real Estate
FAT	Factory Acceptance Testing
FRA	Failure Report Analysis
FDS	Fire Detection System
GA	General Arrangement
HCFC	Hydro chlorofluorocarbon
HBS	Hardware Breakdown Structure
HMI	Human Machine Interface

Abbreviation	Description
HVAC	Heating Ventilation and Air Conditioning
ISO	International Organisation for Standardisation
LCC	Life Cycle Cost
LPS	Low Pressure Services
LV	Low Voltage
MTTF	Mean Time To Failure
MTTR	Mean Time To Repair
MV	Medium Voltage
O&M	Operating and Maintenance
OEM	Original Equipment Manufacture
OH&S	Occupational Health and Safety
PBS	Plant Break Down Structure
PFD	Process Flow Diagram
P&ID	Process Instrumentation Diagram
PM	Planned Maintenance/Project Manager
PTM	Protection, Testing and Maintenance
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control
QCP	Quality Control Procedure
RAM	Reliability, Availability and Maintainability
RCM	Reliable Centre Maintenance
RH	Relative Humidity
SANS	South African National Standards
SAT	Site Acceptance Testing
SLA	Service Level Agreement
TBC	To be Confirmed
TBF	Time between failures
V	Voltage

2.5 PROCESS FOR MONITORING

The primary process for monitoring will be governed by the Design Review Procedure (240-53113685), this entails assuring that the design achieves the requirements set out in this document. Any changes to this document will be performed as per Project Engineering Change Management Procedure (240-53114026).

2.6 RELATED/SUPPORTING DOCUMENTS

N/A

3. DESCRIPTION OF THE *WORKS*

3.1 SCOPE OF *WORKS*

The HVAC scope of *Works*, as detailed in this specification document, activity schedule and accompanying drawings; comprise of the engineering, the provision of all labour including materials and *Contractor's* equipment, manufacturing, supply, delivery, off-loading, hoisting, erection, testing, balancing, and commissioning to serve, guarantee and maintenance after final completion of the HVAC installation.

The engineering, quality control, inspections, plant and material selection, preparation of installation drawings, testing, balancing, commissioning, and preparation of operating and maintenance manuals, are to be managed and executed by the *Contactor* in a systematic manner as follows:

a) Detailed Design.
b) Plant and material selection.
c) Installation drawings.
d) Plant installation.
e) Testing, balancing, and commissioning documentation.
f) Quality control.
g) Operating Instruction and Maintenance Manuals; and
h) Inspection Record Cards/Checklists and final hand-over

The *Works* include the following:

a) Basement IT room 1 & 2 are to be equipped with running and standby down-blow type floor standing indoor units together with matching air-cooled outdoor units to replace existing under-ceiling type split units.
b) The basement office wing B to C and Information Management area are each to be equipped with one running (without standby) ceiling ducted type DX split unit together with matching air-cooled outdoor units (heat pump type) to replace existing system.
c) The ground floor office wing A to D blocks are each to be equipped with one running (without standby) DX ducted type Air Handling Units (AHUs) together with matching air-cooled outdoor units (heat pump type) to replace the existing system.
d) The First Floor Office Wing A to D blocks are each to be equipped with one running (without standby) DX ducted type roof-top type package units (heat pump type) to replace existing system.
e) The first-floor boardrooms are each to be equipped with one running (without standby) ceiling ducted type DX split unit together with matching air-cooled outdoor units (heat pump type).
f) First floor to basement floor atrium is to be equipped with one running (without standby) DX ducted type roof-top type package units (heat pump type) to replace existing system.
g) Associated Electrical *Works* for refurbished plant.
h) Associated Controls and accessories for refurbished plant.
i) Associated building and Civil *Works* for refurbished plant. Modification of structural supports to suit the installation of new energy efficient generation plant and all associated equipment or elements.
j) Re-testing, re-balancing, and re-commissioning of the complete HVAC system.
k) Provision of Painting and corrosion protection for complete Works
l) Updating of the existing operation & maintenance manuals and provision of new where required
m) Update the Plant Codification & Labelling and provide new where required for the complete Works
n) The Contractor makes provision for spares and maintenance support as per the requirements set out in this document.
o) Decommissioning and removal of all old equipment to allocated space at Eskom New Germany and make good where required for complete HVAC Works.
p) Quality assurance.
q) The Contractor is to execute maintenance and maintenance management under the supervision of Employer for a period of 12 (twelve) months from the date of handing over of the HVAC System.

The minimum intervals for the Contractor to be onsite for inspection and maintenance after handing-over of Works are to be 3, 6, 9 and 12 months respectively.

The construction of the *Works* will be undertaken while Ikhwezi Building remains live during the complete duration of the execution of works. Hence, the installation of new Works is to be carried out in a systematic manner to ensure no loss of services in essential areas can be accommodated at any stage.

3.2 *EMPLOYER*'S OBJECTIVES AND PURPOSE OF THE *WORKS*

3.2.1 Objectives

The HVAC system is to be replaced and refurbished to satisfy (need in terms of the functions the system must perform) the following:

a) That comfort areas are equipped with air-conditioning systems that will be able to control the ambient conditions according to 22°C±2°C.
b) That the IT rooms are equipped with air-conditioning systems that will be able to control the ambient conditions according to 20°C±2°
c) All rooms are to be maintained under a positive pressure, to minimise dust ingress.

The purpose of the *Works* includes the following:

a) To ensure that Eskom Building infrastructure function correctly and safely to comply with original design and statutory requirements/standards.
b) Provide adequate cooling, ventilation to ensure long term integrity of all process control electronic equipment is maintained during its operation and maximizes plant efficiency.
c) To provide & maintain good indoor air quality and dust control.
d) To provide a safe environment for occupants and keep escape routes safe.
e) To maintain internal temperatures to the limits as specified by mechanical ventilation and air conditioning.
f) To prevent the build-up of fumes, odours and other gases during the operation and maintenance life of the Ikhwezi Building.
g) To interface closely with the Fire Protection/Detection Systems to ensure integrity of fire compartments and fire zones.

4. ENGINEERING AND *CONTRACTOR'S* DESIGN

4.1 *EMPLOYER'S* FUNCTIONAL SPECIFICATION REQUIREMENTS

The design of the following related HVAC *Works* are to be provided as follows:

Table 1: Division of Work Schedule

Description of work	Responsible Discipline				
	HVAC *Works* (Excluding Electrical, controls and Building related *Works*)	**HVAC standalone equipment controls and BMS**	**Fire Detection Interface**	**HVAC Power Supply and distribution**	**Related Building *Works***
1. Functional Specification	*Employer's* HVAC discipline	*Employer's* HVAC discipline	*Employer's* C&I discipline	*Employer's* Electrical discipline	*Employer's* Civil/Structural discipline
2. Detailed Design	*Contractor's* HVAC discipline	*Contractor's* HVAC discipline	*Contractor's* Electronic/Fire discipline	*Contractor's* Electrical discipline	*Contractor's* Civil/Structural/ Builders discipline
3. Plant and material selection; installation and as built drawings; Testing, balancing, and commissioning Documentation; Operating Instruction and Maintenance Manuals; and Inspection Record Cards/Checklists	*Contractor's* HVAC discipline	*Contractor's* HVAC discipline	*Contractor's* Electronic/Fire discipline	*Contractor's* Electrical discipline	*Contractor's* Civil/Builders discipline

The *Employer* provides the following interfaces:

a) Existing HVAC Plants.
b) Concrete plinth (existing).
c) Potable water connection.
d) Drain water connection.
e) Existing HVAC electrical panels.

4.2 EXISITNG HVAC PLANT AND BMS DESCRIPTION

4.2.1 Existing HVAC System Information

The ablution facilities, and kitchen areas has been provided with mechanical ventilation which comprise of axial flow fans, ducting and air terminals.

The two IT rooms located on basement wing A are each equipped with under-ceiling type split units (evaporator 1-3) with dedicated condensing units located outside the respective rooms.

The 2-off basement office wings are each serviced by split type Direct Expansion (DX) ducted type hide away units 1 and 2 (located above basement floor ceiling) together with matching condenser units 1-2 (located on the roof).

The 4-off ground floor office wings are each serviced by split type DX Air Handling Units 3-6 (located various ground floor plant rooms) together with matching condenser units 3-6 (located on the roof).

The 4-off first floor office wings are each serviced by DX roof top type packaged air conditioning units 1-4 (located on the roof) with ducted distribution system together with matching air terminals. The first-floor boardrooms are each serviced by DX hide away evaporator 4-6 (located above first floor ceiling) together with matching condenser units (located on the roof).

The atrium from first floor to basement floor are serviced by DX roof top type packaged air conditioning unit 5 (located on the roof) with ducted distribution system together with matching air terminals.

4.2.2 HVAC System Visual Assessment Observations

The existing HVAC system was installed, commissioned, tested and has been in operation since year 2000. The HVAC system is over 21 years old and has exceeded its useful life span by 6 years to date. The net sensible cooling capacity of these HVAC systems can no longer be guaranteed due to the fact that cooling capacities of the HVAC system degrades exponentially with age, commonly estimated to be 1% per annum after its useful life span.

The HVAC system does not provide sufficient cooling when ambient temperature is high, and this is a sign of an aged system which can no longer be maintained to service the various areas at room conditions of 22+2°C.

R22 refrigerant gas is used as cooling medium for the air conditioning system. R22 and other chlorine containing Hydro-chlorofluorocarbons (HCFC's) refrigerants are currently being phased out. As from 1 January 2020 the use of HCFC's in the maintenance and servicing of air conditioning equipment will be prohibited with a complete phased out of the importation of HCFC's by the end of 2040. Further to this, from 1 January 2016 HCFC's cannot be used as refrigerant in virtually all newly made air conditioning systems.

Refrigerant piping is corroded resulting to recurrent leaks which results to high usage of R22 gas which is limited in the market as it is currently being phased out.

The air conditioning compressors have failed couple of times as detailed by service history and have been overhauled a couple of times from first installation and continue to fail now & then. This is an indication of an aged system which can no longer be maintained.

Spares availability is another big concern with regards to the existing HVAC compressor units & associated equipment since spares are obsolete resulting in long down times.

4.3 PARTS OF THE *WORKS* WHICH THE *CONTRACTOR* IS TO DESIGN

The plant and material is to be designed and selected with due regard to the installation site conditions, particularly with respect to altitude, ambient temperatures, and atmospheric conditions. The plant and material is to be selected to operate within the limits recommended by the manufacturers and where equipment will be required to operate at conditions deviating from the manufacturer's standard selection tables; re-rating is to be done strictly in accordance with the manufacturer's selection procedures.

The contractor's design is to comprise detailed design package (detailing the selection of the equipment) which will be reviewed and approved in accordance with Employer's design review procedure 240-53113685.

The design data specified in this specification and those dimensions shown on the tender drawings are intended for tendering purposes only. The *Contractor* is required to take the actual measurements onsite before proceeding with design & manufacture of the complete *Works* as dimension accuracy remains the responsibility of the *Contractor*.

The *Contractor* is to design, produce required drawings and select plant & material which satisfies:

a) The overall plant performance and efficiency specification.
b) The specified reliability; and keep maintenance costs to a minimum.
c) Local and statutory authorities and construction requirements.
d) Space constraints; and
e) Local content

Contractor produces self-explanatory operating and maintenance manuals suitable for staff training. The Operating and maintenance manuals are to include the following however not limited to:

a) Description of the complete HVAC system and BMS
b) Operating, control and maintenance philosophies
c) As Built drawings & Commissioning Results

The *Contractor* is to execute the following:

a) Concept design (where required)
b) Detailed design (where required)
c) Plant and material acceptance testing
d) Testing and commissioning
e) Training of operators, maintenance personal and engineering personal
f) Troubleshooting
g) Implementation of an overall quality assurance plan

The *Contractor* is responsible for the concept and detailed design (where required) of the *Works* and that such designs are submitted to the *Employer* for approval prior to procurement and manufacture of any plant and material.

The complete HVAC design is to be flexible to future growth and allow modular growth. 10% future growth has been built into the heat loads and selection of the equipment.

The complete HVAC system is to be designed and configured to allow ease of access for service and maintenance. Sufficient access space must be allowed for, between the HVAC equipment for operation and maintenance purposes.

4.3.1 Investigation, Survey and Site Clearance

The design data specified in this specification and those dimensions shown on the tender drawings are intended for tendering purposes only. The *Contractor* is required to take the actual measurements onsite before proceeding with design & manufacture of the *Works* as dimension accuracy remains the responsibility of the *Contractor*.

4.3.2 Outdoor Design Conditions

The outdoor design conditions for HVAC are based on the Weather Bureau data. The mean maximum temperature (DB) for summer and mean minimum temperature for winter is taken as a design condition. The New Germany in the Kwazulu Natal conditions are as follows:

a) Summer: Ambient Temperature = 30ºC DB 24ºC WB
b) Winter: Ambient Temperature = 14ºC DB

c) Site elevation: 316 m above sea level

4.3.3 Indoor Design Conditions

The HVAC system is to maintain indoor conditions as detailed by the table below 24hours, 7 days a week, and 365 days per year.

Table 2: Indoor conditions

Area/Building	Indoor Temperatures	Relative Humidity	Pressurisation Requirements
1. Offices	22°C±2°C	The relative humidity is to be controlled in accordance with the requirements of ASHRAE 55 (Thermal Environmental Conditions for Human Occupancy)	Positive pressure (minimum positive pressure of 5Pa with all doors closed)
2. IT (Server) Rooms	20°C±2°C	45% ± 5%	Positive pressure (minimum positive pressure of 5Pa with all doors closed)

4.3.4 HVAC System Design

The *Contractor's* HVAC discipline is responsible for the detailed design; plant and material selection; installation and as built drawings; testing, and commissioning documentation; operating instruction and maintenance manuals of the complete HVAC *Works*.

The *Contractor* is to submit the detail design for the HVAC scope for acceptance. *Employer's* HVAC department to review the designs submitted by the *Contractor* and sign it off for acceptance.

The complete HVAC performance figures obtained during testing and commissioning must be within a range of ±5% of the specified figures given during *Contractor* design, plant, and material selection phase.

4.3.4.1 IT Room 1 and 2 HVAC System

Basement IT room 1 & 2 are to be equipped with duty and standby down-blow type floor standing indoor units with matching air-cooled outdoor units together with integrated pressurisation filter unit as detailed by the table below:

Table 3: Down-blow Type Direct Expansion (DX) for IT rooms

Area	Unit Nominal Cooling Capacity each (kW)	Number Required (duty & standby)	Power Source (50Hz)	Estimated Weight of indoor equipment (kg)
1. Basement IT room 1	28	2	380V/3ph/12kW (each)	280
2. Basement IT room 2	22	2	380V/3ph/10kW (each)	260

4.3.4.1.1 IT Room 1 and 2 HVAC System Cooling Plant

Each room is to be equipped with duty and standby DX down-flow type floor standing AHUs together with matching air-cooled outdoor units.

The HVAC equipment is to be configured to operate on duty and standby mode for redundancy, including automatic change over between the units in case of failure of any one unit and at pre-set intervals to allow equal running time between the units.

The units are to have a cooling only mode of operation and are to provide cooling 24 hours a day, seven day a week throughout the year.

4.3.4.1.2 IT Room 1 and 2 HVAC System Fresh Air and Distribution System

Filtered and conditioned air is to be supplied from the units to the room via the existing raised false floor and matching air terminals. The air is to be returned to the unit via return air side which is located on top of the unit.

Fresh air is to be provided to IT rooms via the fresh air intake of the DX units, supplying a total of 120-l/s fresh air to the return air side. The fresh air unit is to be fitted with washable primary air filters and disposable secondary air filters (to 85% Dust Spot Efficiency – EU7).

4.3.4.1.3 IT Room 1 and 2 HVAC System Cooling Controls

The two (2)-off duty and standby DX units are to be controlled by manufacturer (networking and interfacing) wall or unit mounted common controller which controls the temperatures to 20±2°C and are to be programmed such that should the temperatures within the respective rooms rise above 26°C or should a fault occur on the running unit, the controller is to automatically start the standby unit. The room temperatures are to be sensed at wall or unit mounted thermostat which are to automatically adjust its cooling in order to maintain the room set point.

The HVAC equipment are to be configured to operate on duty and standby mode for redundancy, including automatic change over between the units in case of failure of any one unit and at pre-set intervals to allow equal running time between the units. In case of controller failure each unit must be able to run and control the set points on its own. For example, controls are to be able to switch over operation of the units at specified intervals, for instance once every week, to ensure equal operating time of both units. Manual override switch is to be installed to have any HVAC equipment switched on by maintenance when required.

The HVAC system interfaces with the Fire Detection System via hardwired interface.

The control system is to be able to generate alarms that will be routed to future Building Management System (BMS) for monitoring purposes.

4.3.4.1.4 IT Room 1 and 2 HVAC System Drip Trays and Drainage of Condensate

Custom build drain pans are to be provided underneath each air conditioning unit. The custom drain pans are to be manufactured from 1,2mm 316-stainless steel and are to accommodate a 32mm drain connection. The sides of the drain pan are to be 50mm high and are to extend 50mm larger than the footprint of the entire size of each room air conditioning unit.

The indoor unit's condensate is to be drained by both gravity and condensate lift pumps via PVC or galvanised drain piping to the nearest gullies. U-traps are to be installed in the Polyvinyl Chloride (PVC) drain or galvanised piping to prevent odours being drawn back into the units.

4.3.4.2 Basement Office Area HVAC System

The Basement Office Wing B to C and Information Management area are each to be equipped with one duty (without standby) ceiling ducted type DX split unit together with matching air-cooled outdoor units (heat pump type) as follows:

Table 4: Split Type Direct Expansion (DX) for Basement Office Area

Area	Unit Nominal Cooling Capacity each (kW)	Number Required (duty only)	Power Source (50Hz)	Estimated Weight of indoor equipment (kg)
1. Basement Office Wing B	40	1	380V/3ph/15kW (each)	245
2. Basement Office Wing C and Information Management Area	58	1	380V/3ph/25kW (each)	245

4.3.4.2.1 Basement Office Area HVAC System Cooling and Heating Plant

The ceiling ducted type DX units are to have a cooling and heating mode of operation and are to provide cooling & heating as required seven day a week throughout the year. The system configuration is to remains as is, and replacement to be on a like by like basis with ceiling ducted type DX units 1 to 2 located above basement floor ceiling and matching condenser units 1 to 2, located on the roof.

4.3.4.2.2 Basement Office Area HVAC System Fresh Air and Distribution System

Filtered and conditioned air is to be supplied from the ceiling ducted type DX to the different spaces via externally insulated ducting and matching new variable air volume terminals. The air is to be returned to the unit via existing return air ductwork and matching new return air grilles

Fresh air is to be provided to basement offices via the fresh air intake of the DX units, at 2 air changes per hour to the return air side of each unit. The ceiling ducted type DX unit fresh air intake side is to be equipped unit and be fitted with washable primary air filters and disposable secondary (bag type) air filters (to 85% Dust Spot Efficiency - EU7).

4.3.4.2.3 Basement Office Area HVAC System Controls

Temperature control in the office areas, is provided by either varying the supply air quantity of a diffuser, or a group of diffusers serving a specific area or zone. The design for this building is to be based on individual temperature control zones. These control zones are each to be served by a “master” diffuser incorporating an integral temperature sensor and a wall mounted remote controller.

The position and mounting detail of the temperature controllers and sensors is to be co-ordinated onsite during construction.

Each master diffuser is inter-connected with single “slave” diffuser or a series of slave diffusers, dependent on the size of the temperature control zone. The design is to be based on number of slave diffusers connected to each master diffuser & control station.

When heating is required in a specific space, heating is provided with electrical resistance heaters fitted in the VAV diffusers. Each diffuser has a heater element, allowing the occupants in a zoned area to adjust the temperature with a wall mounted hardwired controller. Temperature is adjusted up from set-temperature to within +-2°C.

4.3.4.3 Ground Floor Office Area HVAC System

The Ground Floor Office Wing A to D is to be equipped with one duty (without standby) DX ducted type Air Handling Units (AHUs) together with matching air-cooled outdoor units (heat pump type) as follows:

Table 5: Split Type Direct Expansion (DX) for Ground Floor Office Area

Area	Unit Nominal Cooling Capacity each (kW)	Number Required (duty only)	Power Source (50Hz)	Estimated Weight of indoor equipment (kg)
1. Ground Floor Office Wing A	58	1	380V/3ph/23kW (each)	800
2. Ground Floor Office Wing B	58	1	380V/3ph/23kW (each)	800
3. Ground Floor Office Wing C	58	1	380V/3ph/23kW (each)	800
4. Ground Floor Office Wing D	58	1	380V/3ph/23kW (each)	800

4.3.4.3.1 Ground Floor Office Area HVAC System Cooling and Heating Plant

The DX ducted type of Air Handling Units (AHUs) are to have a cooling and heating mode of operation and are to provide cooling & heating as required seven day a week throughout the year. The system configuration is to remains as is, and replacement to be on a like by like basis with Air Handling Units (AHUs) 3 to 6 located on various ground floor plant rooms and matching condenser units 3 to 6, located on the roof.

4.3.4.3.2 Ground Floor Office Area HVAC System Fresh Air and Distribution System

Filtered and conditioned air is to be supplied from the DX ducted type of Air Handling Units (AHUs) to the different spaces via externally insulated ducting and new variable air volume terminals. The air is to be returned to the unit via existing return air ductwork and matching new return air grilles

Fresh air is to be provided to first floor offices via the fresh air intake of the DX units, at 2 air changes per hour to the return air side of each unit. The DX ducted type of Air Handling Units (AHUs) fresh air intake side is to be equipped unit and be fitted with washable primary air filters and disposable secondary (bag type) air filters (to 85% Dust Spot Efficiency - EU7).

4.3.4.3.3 Ground Floor Office Area HVAC System Controls

Temperature control in the office areas, is provided by either varying the supply air quantity of a diffuser, or a group of diffusers serving a specific area or zone. The design for this building is to be based on individual temperature control zones. These control zones are each to be served by a “master” diffuser incorporating an integral temperature sensor and a wall mounted remote controller.

The position and mounting detail of the temperature controllers and sensors is to be co-ordinated onsite during construction.

Each master diffuser is inter-connected with single “slave” diffuser or a series of slave diffusers, dependent on the size of the temperature control zone. The design is to be based on number of slave diffusers connected to each master diffuser & control station.

When heating is required in a specific space, heating is provided with electrical resistance heaters fitted in the VAV diffusers. Each diffuser has a heater element, allowing the occupants in a zoned area to adjust the temperature with a wall mounted hardwired controller. Temperature is adjusted up from set-temperature to within +-2°C.

4.3.4.4 First Floor Office Area HVAC System

The First Floor Office Wing A to D blocks are to be equipped with one duty (without standby) DX ducted type roof-top type package units (heat pump type) as follows:

Table 6: Roof Top Type Package Direct Expansion (DX) for First Floor Office Area

Area	Unit Nominal Cooling Capacity each (kW)	Number Required (duty only)	Power Source (50Hz)	Estimated Weight of package unit (kg)
1. First Floor Office Wing A	54	1	380V/3ph/22kW (each)	1500
2. First Floor Office Wing B	54	1	380V/3ph/22kW (each)	1500
3. First Floor Office Wing C	54	1	380V/3ph/22kW (each)	1500
4. First Floor Office Wing D	54	1	380V/3ph/22kW (each)	1500

4.3.4.4.1 First Floor Office Area HVAC System Cooling and Heating Plant

The DX ducted type roof-top type package units are to have a cooling and heating mode of operation and are to provide cooling & heating as required seven day a week throughout the year. The system configuration is to remains as is, and replacement to be on a like by like basis with roof-top type package units 1 to 4, located on the roof.

4.3.4.4.2 First Floor Office Area HVAC System Fresh Air and Distribution System

Filtered and conditioned air is to be supplied from the roof-top type package units to the different spaces via externally insulated ducting and new variable air volume terminals. The air is to be returned to the unit via existing return air ductwork and matching new return air grilles

Fresh air is to be provided to first floor offices via the fresh air intake of the roof-top type package units, at 2 air changes per hour to the return air side of each unit. The roof-top type package units fresh air intake side is to be equipped unit and be fitted with washable primary air filters and disposable secondary (bag type) air filters (to 85% Dust Spot Efficiency - EU7).

4.3.4.4.3 First Floor Office Area HVAC System Controls

Temperature control in the office areas, is provided by either varying the supply air quantity of a diffuser, or a group of diffusers serving a specific area or zone. The design for this building is to be based on individual temperature control zones. These control zones are each to be served by a “master” diffuser incorporating an integral temperature sensor and a wall mounted remote controller.

The position and mounting detail of the temperature controllers and sensors is to be co-ordinated onsite during construction.

Each master diffuser is inter-connected with single “slave” diffuser or a series of slave diffusers, dependent on the size of the temperature control zone. The design is to be based on number of slave diffusers connected to each master diffuser & control station.

When heating is required in a specific space, heating is provided with electrical resistance heaters fitted in the VAV diffusers. Each diffuser has a heater element, allowing the occupants in a zoned area to adjust the temperature with a wall mounted hardwired controller. Temperature is adjusted up from set-temperature to within +-2°C.

4.3.4.5 First Floor Boardrooms HVAC System

The First-floor boardrooms are each to be equipped with one running (without standby) ceiling ducted type DX split unit together with matching air-cooled outdoor units (heat pump type) as follows:

Table 7: Split Type Direct Expansion (DX) for First Boardroom Area

Area	Unit Nominal Cooling Capacity each (kW)	Number Required (duty only)	Power Source (50Hz)	Estimated Weight of indoor equipment (kg)
1. First Floor Office Main Board Room	17.5	1	380V/3ph/8kW (each)	60
2. First Floor Office 15-Seater Board Room 1	10.5	1	380V/3ph/4.5kW (each)	36
3. First Floor Office 15-Seater Board Room 2	10.5	1	380V/3ph/4.5kW (each)	36

4.3.4.5.1 First Floor Boardrooms HVAC System Cooling and Heating Plant

The ceiling ducted type DX units are to have a cooling and heating mode of operation and are to provide cooling & heating as required seven day a week throughout the year. The system configuration is to

remains as is, and replacement to be on a like by like basis with ceiling ducted type DX units 4 to 6 located above basement floor ceiling and matching condenser units 4 to 6, located on the roof.

4.3.4.5.2 First Floor Boardrooms HVAC System Fresh Air and Distribution System

Filtered and conditioned air is to be supplied from the ceiling ducted type DX to the different spaces via externally insulated ducting and matching new constant air terminals. The air is to be returned to the unit via existing return air ductwork and matching new return air grilles

Fresh air is to be provided to basement offices via the fresh air intake of the DX units, at 2 air changes per hour to the return air side of each unit. The ceiling ducted type DX unit fresh air intake side is to be equipped unit and be fitted with washable primary air filters and disposable secondary (bag type) air filters (to 85% Dust Spot Efficiency - EU7).

4.3.4.5.3 First Floor Boardrooms HVAC System Controls

Temperature control in the office areas, is controlled by manufacturer (networking and interfacing) wall or unit mounted common controller which controls the temperatures to 20±2°C.

4.3.4.6 First Floor to Basement Floor Atrium HVAC System

The Atrium from first floor to basement floor is to be equipped with one duty (without standby) DX ducted type roof-top type package unit (heat pump type) as follows:

Table 8: Roof Top Type Package Direct Expansion (DX) for Atrium

Area	Unit Nominal Cooling Capacity each (kW)	Number Required (duty only)	Power Source (50Hz)	Estimated Weight of package unit (kg)
1. Atrium	45	1	380V/3ph/22kW (each)	1500

4.3.4.6.1 First Floor to Basement Floor atrium HVAC System Cooling and Heating Plant

The DX ducted type roof-top type package units are to have a cooling and heating mode of operation and are to provide cooling & heating as required seven day a week throughout the year. The system configuration is to remains as is, and replacement to be on a like by like basis with roof-top type package unit 5, located on the roof.

4.3.4.6.2 4.3.4.6 First Floor to Basement Floor HVAC System Fresh Air and Distribution System

Filtered and conditioned air is to be supplied from the roof-top type package units to the different spaces via externally insulated ducting and matching new air terminals. The air is to be returned to the unit via existing return air ductwork and matching new return air grilles

Fresh air is to be provided to first floor offices via the fresh air intake of the roof-top type package units, at 2 air changes per hour to the return air side of each unit. The roof-top type package units fresh air intake side is to be equipped unit and be fitted with washable primary air filters and disposable secondary (bag type) air filters (to 85% Dust Spot Efficiency - EU7).

4.3.4.6.3 First Floor to Basement Floor HVAC System Controls

Temperature control in the atrium, is controlled by manufacturer (networking and interfacing) wall or unit mounted common controller which controls the temperatures to 20±2°C.

4.3.4.7 Smoke Control in the Event of Fire

In addition to normal HVAC system, smoke control system is required to reduce concentration of smoke in fire incident, to prevent migration of smoke to adjacent areas and clear smoke after fire has been extinguished.

SANS 10400-T: States that any room of which the floor area is more than 500 m^2 is to be provided with mechanical ventilation or natural smoke ventilation.

The Atrium does not have openable windows to the outside, which only leaves an option of mechanical smoke ventilation to service the buildings. The atrium is to be provided with smoke extraction facility through mechanical ducted ventilation system.

The complete HVAC system is to be interfaced to the fire detection system. In the event of a fire break out, the fire detection system is to send a signal to the HVAC controllers to indicate that there is a fire in a specific zone; the HVAC controllers are to automatically stop the HVAC system serving the respective areas. After the fire has been extinguished, smoke evacuates by a manually operated switch in a break glass box positioned on each zone which re-opens fire dampers, re-starts extract fans and over-ride damper control, closing return air dampers and opening exhaust dampers in the air conditioning plant rooms. The HVAC system is to automatically return to normal operation once the fire alarm signal to the air conditioning switchboard is cleared.

The fire dampers are to be provided on the respective fire zones. The various floors are divided into fire zones. The system operation is that when fire is detected in a zone, the relevant fire dampers on the supply and return ducts feeding that zone are closed as well as the supply air handling.

4.3.5 Electrical System Design

The *Contractor's* Electrical discipline is responsible for the detailed design (where required); plant and material selection; installation and as built drawings; testing, and commissioning documentation; operating instruction and maintenance manuals of the complete HVAC related Electrical *Works.*

The *Contractor* is to submit the detail design for the electrical scope for acceptance. *Employer's* electrical department to review the designs submitted by the *Contractor* and sign it off for acceptance.

The *Contractor* is responsible for the design of the HVAC scope and provides the following, as a minimum:

a) Electrical Distribution Panels
b) Terminating to HVAC Electrical Control Panels
c) Power, Control Cabling and Racking

The selection and application of all the electrical equipment is to be in accordance with the current *Employer's* relevant standards referenced on the technical specification.

The HVAC related Electrical *Works* includes the following, however not limited to:

a) Detailed Design of HVAC related Electrical *Works*.
b) Plant and material selection; installation and as built drawings; Testing, balancing, and commissioning Documentation; Operating Instruction and Maintenance Manuals; and Inspection Record Cards/Checklists.
    i) Replace the existing and terminate new suitable power cables on the allocated spare circuits on the selected 380 V boards to supply the new HVAC Electrical Distribution Panels.
    ii) Testing and issuing of CoCs. One certificate is required per electrical DB completed, and the certificate is to cover all downstream works.
    iii) Removal and make safe existing installation
    iv) Wiring and wire ways
    v) Electrical cable / wiring, Cable ladders and trays, power and control cabling and racking, joint kits, earthing, hangers and mounting arms, risers and droppers measured as elbows etc. and isolators ending within 1meter reach to HVAC equipment and its controls.

vi) Testing and commissioning HVAC related Electrical *Works*

The associated Electrical *Works* includes the following but not limited to:

a) The *Contractor* is to utilise the existing circuits, functional units on the existing 380V Electrical panels (where required) and replace HVAC related 380V LV switchgear (where specified), distribution boards, control panels, contactors and overloads and fuse holders with circuit breakers in compliance with 240-75003876, Compliance to Arc Proof Requirements for Low Voltage Switchgear
b) All switchgear and distribution boards that forms part of the scope of this project must comply to LV Switchgear and Control Gear Assemblies and Associated Equipment for Voltage up to and Including 1000V AC and 1500V Standard (240-56227516). Schedule B from the "LV Switchgear and Control Gear Assemblies and Associated Equipment for Voltage up to and Including 1000V AC and 1500V Standard" must be completed for all distribution boards and switchgear to be supplied for this project. The schedules must be submitted when tendering. Distribution boards shall comply with the requirements of SANS 1973, Type testing and Safety of distribution boards. Type testing certificates is to be made available and Routine test certificates must be provided with each assembly.
c) The *Contractor* is advised to order the distribution boards and equipment from a reputable manufacturer, as inferior boards will not be accepted.
d) Clearly engraved labels are to be provided below the relevant isolators and circuit breakers. An engraved label is to be provided on the outside of the doors indicating the name of the distribution board.
e) All phase, neutral and earth busbars be adequately sized to accept all circuits and connections.
f) A comprehensive, neatly legend card identifying all circuits be provided before the distribution board is commissioned.
g) The positions of the distribution boards are indicated on all layout drawings. The *Contractor* to ensure that the distribution boards can fit into the space provided.
h) Distribution board signage such as danger signs shall be included in accordance with relevant regulations.
i) The outer frame, doors, face plates and internal frames shall be finished with high quality paint. Only baked enamel or electro statically applied powder coating shall be used and accepted. Powder coat quality shall be verified during distribution board inspections. Colour finish required for each distribution board is indicated on the drawings.
j) All distribution boards must be manufactured with a minimum of 30% spare space capacity.
k) Shop drawings and Type test certificates must be submitted to the engineer for formal acceptance before any manufacture commences.
l) The *Contractor* is to size, procure, supply, and install downstream cable termination box to distribute the power supply to the new Data Centre DX System Electrical Distribution Panels, new electronically controlled variable air volume terminals, diffuser re-heaters etc. control boxes
m) The *Contractor* is to size, procure, supply, and install/terminate the electrical cable / wiring, power and control cabling and racking, joint kits, earthing. All control and power cables to comply with 240-56227443_Requirements for Control and Power Cables for Power Stations Standard.
n) *Contractor* is to procure, supply and install fit for purpose earthing for the air conditioning system in compliance with 240-56356396_Earthing and Lightning Protection Standard.
o) The *Contractor* to test & overhaul and re-install motors on the same platforms, including cabling and earthing for the motors. New motors to be procured in an event where a motor fails functional test. All motors comply with the Procurement of Power Station Low Voltage Electric Motors Specification Standard (240-57617975).
p) The electrical works is to be carried out in compliance with the requirements of SANS 10142-1 (The wiring of premises Part 1: Low-voltage installations).
q) Wiring sizes are indicated on the relevant single line diagrams. Where wiring sizes are not indicated the *Contractor* shall inform the engineer.

r) The *Contractor* to ensure that all safety regulations and measures are applied and enforced during construction, and maintenance work on cabling, wiring, distribution boards and power outlets.
s) All work is to be executed and supervised by suitably qualified staff. Only “ACCREDITED PERSONS” are to be permitted to carry out and supervise work.
t) The works must be supervised by a full time registered “MASTER ELECTRICIAN”.
u) The *Contractor* to allow for the removal, making safe, interim safe keeping and returning to the client, all existing electrical equipment, distribution boards, wiring, cabling, socket outlets and isolators.

4.3.6 Control and Instrumentation System Design

The *Contractor’s* HVAC/Electronic discipline is responsible for the detailed design; plant and material selection; installation and as built drawings; testing, and commissioning documentation; operating instruction and maintenance manuals; and inspection record cards/checklists of the complete HVAC standalone equipment controls that are to interface with future Building Management System (BMS) and existing Fire Detection System (FDS)

The *Contractor* is responsible for all logical programming in accordance with *Employer’s* Operating and Control Procedures. If the plant OEM provides field controllers for their plants, the *Contractor* is responsible for the interface of these field controllers to the HVAC controllers.

The control system for HVAC is to be a stand-alone system. The system is to be designed to utilise standard sensors, transducers and actuators for the industry which have been field tested for the last two years. The control system must have capability to communicate with the standard HVAC equipment supplied, so that the sub-system can be tested, logged, stopped, started, load shed, reset temperature, and commanded at the central operator’s terminal and locally, so as to manage the relevant sub-systems in terms of operation, energy and maintenance.

The monitoring (including control and operation when required) of the air conditioning and ventilation system is to be managed by means of HVAC controllers. Field controllers are to operate independently of the Human Machine Interface (HMI) system.

The HVAC controllers and associated instruments, if not contained within temperature and humidity-controlled environments, must be suitable for the environmental conditions prevailing at Eskom Academy of Learning, without any negative impact on the performance, reliability, availability, or life expectancy of the equipment. All equipment will also be provided.

The HVAC controllers are to be designed to utilise standard sensors, transducers and actuators for the industry which has been field tested within the last two years.

The HVAC controllers is to have a capability to communicate with the standard equipment supplied such as fans to enable monitoring of performance of the components and allow for subsystems to be tested, logged, and commanded at the central operator’s terminal.

4.3.7 HVAC System Related Building, Civil and Structural *Works* Design

The *Contractor*’s Civil/Structural/Builder’s discipline is responsible for the detailed design; plant and material selection; installation and as built drawings; testing, and commissioning documentation; operating instruction and maintenance manuals; and inspection record cards/checklists of the complete HVAC related building *Works.*

Any civil works that requires changes/ modifications to the building structure must be signed of by a professionally registered Structural/Civil engineer.

The HVAC related civil, structural, and building *Works* includes the following but not limited to:
a) HVAC equipment supports
b) Penetration pipe work and cabling through walls.

c) Drains connections.
d) Hoisting and rigging of HVAC equipment.
e) Removal, re-instating and replacing of ceiling panels where required.

4.3.7.1 HVAC Supports

Floor mounted HVAC equipment is to be mounted onto concrete plinth, which protrudes at least 50mm above finished floor level. Vibration elimination rubbers are to be provided between HVAC equipment and the concrete plinth.

Roof mounted HVAC equipment is to be mounted onto galvanized frame with vibration springs.

All piping and cabling is to be mounted onto cantilever brackets or equivalent means with vibration elimination rubbers provided between the units and the brackets.

Utilise the existing HVAC equipment concrete plinths and equipment supports. A structural integrity assessment is to be carried out by the *Contractor's* Structural Engineer to verify that the existing structures can support the HVAC equipment. The assessment report is issued to the *Employer* along with the relevant recommendations for acceptance. The *Contractor* conducts all remedial works as per the accepted assessment report.

All the Civil and Structural design and construction work required during the execution of the scope is the responsibility of the *Contractor*. The Civil and Structural design and construction work is executed in accordance with 240-56364545 - Structural Design and Engineering standard. Design loading is in accordance with SANS 10160, structural steel design is in accordance with SANS 10162 and structural concrete design is in accordance with SANS 10100.

4.3.7.2 Penetration of Pipe Work and Cabling Through Walls and Floors

The *Contractor* ensures that all openings created in the walls and floors to accommodate pipe work and cabling are adequately secured to ensure that the existing fire rating of the building is maintained.

The *Contractor* ensures that all openings created on load bearing walls and floors do not compromise the structural integrity of the walls and floors. The *Contractor* ensures that all openings created do not compromise or impact any steel reinforcement existing in the structural walls.

The *Contractor* ensures that all openings created on the walls and floors to accommodate duct work, pipe work and cabling are adequately sealed to ensure that the existing fire rating of the buildings are maintained. All the fire barriers and seals are in accordance with 240-54937450 - Fire Protection & Life Safety Design Standard.

4.3.7.3 Drains Connections

The *Contractor* provides drainage points necessary for the operation of the HVAC System.

4.3.7.4 Hoisting and rigging of HVAC equipment

The *Contractor* provides the following to complete the *Works*:
a) All scaffolding required.
b) Any equipment necessary to complete the *Works.*
c) Lifting facilities.

The *Contractor* supplies, installs, maintains, and removes all temporary construction facilities and utilities necessary to provide the *Works.*

4.4 HVAC PLANT AND MATERIAL SELECTION

The complete HVAC system is to be procured, manufactured, supplied, delivered, installed, commissioned, and tested in accordance with the requirements of Eskom General Technical Specification for HVAC Systems (240-102547991).

4.5 PROCEDURE FOR SUBMISSION AND ACCEPTANCE OF *CONTACTOR'S* DESIGN

The procedure for submission and acceptance of Contractor's Design is detailed under section 8 of the specification.

The following documents are supplied to the *Employer* by the *Contractor* as a minimum.

a) Detailed design report, including detailed calculations such as hydraulic and pipe stress analysis (where required), pipe supports, handers and racks. The detailed design report is to be signed by PrEng/PrTech from each of the relevant disciplines.
b) Documents including equipment data sheets and specification for selected equipment, electrical cabling and other associated equipment.
c) Lightning and Surge Protection plus Earthing resistance methodologies
d) Dimensioned shop drawings showing the general arrangement of all plant and equipment including isometrics and P&ID's or PFD's where required. Sufficient views must be given to ensure clarity and the drawings are to have at least a plan and two different elevations or sections giving overall dimensions.
e) Dimensioned shop drawings showing proposed method of fixing of all the plant and equipment
f) Detailed electrical wiring diagrams including schematic and control circuits.
g) Detailed sequencing manner for installation procedure of *Works*
h) Detailed programme for the *Works* in sufficient detail as to represent the units of work to enable the representative to assess the progress of the *Works*
i) Technical specification and literature for all items of equipment that forms part of the complete installation
j) Proposed corrosion protection systems, including data sheets for coating proposed of equipment
k) List of recommended spares and technical specifications for the spares, part numbers and the stock levels required
l) Detailed building *Works* for complete *Works.* All building works calculations and analysis models to be submitted in native format as wall is in doc/pdf format as part of the detailed design report.
m) Detailed maintenance, reliability, control, and operating philosophies
n) Testing, balancing, and commissioning procedures
o) Plant and material acceptance testing
p) Detailed operation & maintenance manuals with As-Built drawings & Commissioning Results
q) Plant codification lists for each section of the *Works*
r) Construction competition reviews
s) Acceptance testing reviews
t) Quality assurance reports
u) Close out reports

4.6 OTHER REQUIREMENTS OF THE *CONTRACTOR*'S DESIGN

The *Contractor* is to comply with all legislated safety requirements as well as *Employer's* health and safety standards.

The decommissioning, removal of all redundant equipment and making good where required is to include the following, however not limited to:

a) The *Contractor* is responsible for decommissioning, dismantling, removal, lifting, transport and storing (including making good thereof) of existing redundant or retired equipment to the allocated space provided by the *Employer.*
b) The scrapping of the existing equipment to the nearest scrapyard outside of New Germany will be the responsibility of the *Employer*. The responsibility of the *Contractor* is the removal of existing equipment, storing it and making good thereof.

The term “making good” refers to the following, however not limited to:
a) All areas where old plant or material is removed on the plant are made neat by means of closing of holes, grinding of old anchor points and welding, repainting, and resurfacing.
b) The interface point between the new system and existing plant or material is made neat and functional to prevent weak points in the final delivered product e.g. the fixing of brackets and supports of interface boxes, covers, locking nuts etc.

The *Contractor* provides all scaffolding, crane, transport, etc necessary for decommissioning, dismantling, removal, lifting, transport and storing of existing redundant or retired equipment to the allocated space provided by the *Employer*; and scraping thereof.

The *Contractor* provides dust sheets and everything necessary for clearing and removal of all rubble due to the work, for the protection of the work from damage due to the operations. *Contractor* is to take adequate precautions to the satisfaction of the *Employer* to prevent damage to existing apparatus during erection operations.

The retired HVAC equipment is to be decommissioned and dismantled according to the manufactures’ instructions and the relevant codes & standards. The retired HVAC equipment containing a refrigerant is to be pumped down of both refrigerant & oil and should be labelled as containing no refrigerant as soon as it’s been decommissioned, dismantled, and stored away.

Items to be removed are marked clearly before decommissioning start in order to avoid the removal of incorrect plant or material.

All existing plant that is removed is deemed re-usable and remains the property of the *Employer*.

Decommissioning and dismantling of retired HVAC equipment that maybe required for future use should include the following however not limited to:
a) Disconnection of power supply and making safe thereof.
b) Disconnecting of water supply and draining of, to nearest drain point.
c) Removal of all refrigerants into approved recovery approved containers for retention or returned to the supplier or manufacturer for reclaiming as defined by SANS 10147, SANS 10250, ISO 11650, BS EN 378-4 or any relevant standard.
d) Charging of the closed loop with dry nitrogen to help prevent contamination of the system.
e) Inspection of the equipment at regular intervals to ensure that adequate pressures are maintained, to prevent contamination during the one (1) year maintenance period.
f) The refrigerant charge where required, on larger equipment should be pumped down and isolated in the receiver or receiver condenser storage, providing valves are holding and there is a pressure relief device to protect the vessel in accordance with the appropriate code requirements.
g) Safe dismantling of the existing machines and the safe removal from site to the allocated storage area provided by *Employer*.

4.7 DESIGN OF EQUIPMENT

The minimum general HVAC equipment design criterion that is to be met is as follows:
a) The equipment is to be designed to facilitate efficient manufacture, inspection, transportation, installation, maintenance, cleaning, and repairs.
b) The equipment is to be designed to ensure safe and satisfactory operation for at least 15 years for DX system; under the conditions prevailing at New Germany in the Kwazulu Natal.

c) The equipment is to be designed to prevent undue stresses being produced by expansion and contraction due to temperature change and other local natural and manmade conditions.
d) The equipment is to be designed to keep maintenance costs to a minimum.
e) The equipment is to be designed to comply with all the legal requirements in respect of safety and the prevention of environmental pollution.
f) The equipment is to be designed to satisfy any specific requirements contained in the relevant statutory codes and standards.
g) The equipment is to be designed for operation of 365 day per annum, 24hrs per day.
h) The equipment is to be designed such that all material from which the equipment is manufactured from is compatible with the intended duty and service conditions. All equipment is suitable treated and protected from corrosion.
i) After the design freeze, the information stated in the data sheets is to be fully complied with through the installation, unless otherwise agreed upon by both *Eskom* & *Contractor* in writing.

4.8 EQUIPMENT REQUIRED TO BE INCLUDED IN THE *WORKS*

The *Contractor* is required to provide lifting facilities and other equipment required for the execution of the complete *Works*.

4.9 AS-BUILT DRAWINGS, OPERATING MANUALS AND MAINTENANCE SCHEDULES

The importance of managing the "as-built", "operate-to" and the "maintain-to" operation and maintenance manuals including maintenance schedules for each piece of equipment is critical to the life of the plant. The operating & maintenance manuals are to be detailed enough to operate, maintain, dismantle, reassemble, adjust, and repair plant & equipment.

4.9.1 As-built Drawings

The *Contractor* is to provide "As Built" drawings based on the shop drawings embodying all modifications made during construction. The "As Built" drawings are to include general arrangement and sections of all plant and equipment including isometrics and P&ID's or PFD's. Safety, instrumentation, control, and operation drawings are to also be included "As Built" drawings indicating the intended functioning, capacity data and control functioning of all Systems.

The As Built drawing is to indicate all relevant plant coding and labelling. The determination of these codes and labels are to be done in accordance with the documents listed in this Technical Specification.

Two hard copies and one soft copy of "As Built" drawings are to be submitted to the *Employer* for approval.

4.9.2 Operating Manuals and Maintenance schedules

The Operating & Maintenance Manual must describe how the facility is to be operated and by whom, as well as the desired level of training and orientation required for the building occupants.

The operation and maintenance manuals are to consist of the following as the minimum:
a) List of Contents (Index)
b) Introduction
c) General description of the functions of each of the Systems including detailed description of each element of each System, how it functions, how it operates and how to maintain it and what attic stock or tools to carry.
d) Full as-built drawings and detailed drawings, brochures and catalogues for each System and each element of each System.
e) The format of the O&M documentation is to be A4 and is to be a specially bound document with hard cover and with metal ring binding. (All drawings folded into A4 format.)

f) The names, addresses and telephone/fax numbers/email addresses of all responsible persons and manufacturers/suppliers are to be listed in the O&M document.
g) A full list with reference numbers are to be included to enable the *Employers* O&M staff to order materials and equipment.
h) Colour diagrams are be provided to illustrate the operation and function of each System with reference to the relevant as-built drawings or brochures of equipment. These diagrammatic drawings are to also indicate the locations of valves with their numbers.

5. PROCUREMENT

5.1 PLANT AND MATERIAL

5.1.1 Quality

The *Contractor* is not use Plant or Materials which are generally recognised as being unsuitable or otherwise to be avoided for the purpose for which they are intended.

Only components of high reliability are to be utilised, with a proven operating history, to enable the Plant to achieve required reliability and availability. Plant and Material design, engineering, and manufacture to accord with the best modern practice applicable to high-grade products of the type to be furnished, so as to ensure the efficiency and reliability of the *Works* and the strength and suitability of the various parts for the *Works*.

Plant and Materials withstands ambient conditions and the variations of temperature arising under working conditions without distortion, deterioration, or undue strains in any part.

All parts are made accurately, and where practicable, to standard gauges so as to facilitate replacement and repairs. Like parts are interchangeable.

No repair of defective Plant and/or Materials are to be permitted without the *Employer's* approval and any such repair, if approved, are to be carried out to the satisfaction of the *Employer*.

The *Employer* is free to specify hold and witness points during the installation and on-site testing stages of the project. The *Contractor* issues preliminary notification of such hold and witness points as per agreed schedule to the *Employer* and confirms such hold and witness points at least seven working days prior to the activity.

Typical hold points are listed below:
a) Design Review
b) Factory Acceptance Test
c) Delivery to Site
d) Erection
e) Site Acceptance Test
f) All manuals and drawings (in the specified format)
g) Commissioning

In addition to maintaining appropriate inspection and test records to substantiate conformance to requirements, the following records are safely stored for a minimum period of seven (7) years following the final completion of the *Works*:
a) Construction, layout and component approvals
b) Type and routine test certificates
c) Construction drawings and approvals

After this period, the *Contractor* offers these records to the *Employer* (in writing) and obtains a disposal instruction.

Documentation regarding quality procedures is submitted as per agreed schedule after Contract Award. The *Employer* is review and comment on the acceptability of these documents in a time frame as per the requirements of the contract for contractual correspondence. If controlled copies of these documents have been submitted to the *Employer*, then the controlled copy numbers may be quoted in the submission.

5.1.2 Plant & Materials Provided "free issue" by the *Employer*

None.

5.1.3 *Contractor's* Procurement of Plant and Materials

The *Contractor* is to take all necessary steps to ensure that all Plants and Materials are adequately protected against damage during shipping, transport, and storage.

5.1.4 Spares and Consumables

The *Contractor* provides as part of the operating & maintenance manual, a recommended parts list as well as a proposal for the execution thereof:

a) The *Employer* is responsible for procurement of recommended spares.
b) The *Contractor* is responsible for ensuring that consignment spares are available in time of need.

Each recommended spare part is to be uniquely identified with a part number, which can be cross referenced to a part list and associated drawing. The *Employer* prefers that support from the OEM is available locally in South Africa.

5.2 TESTS AND INSPECTION BEFORE DELIVERY

The *Employer* carries out quality inspections at own discretion. The *Employer* is to inspect and approve stages of manufacture of all equipment necessary to ensure the correct quality of equipment as prescribed in the approved project quality plan.

All inspections and testing to be performed in accordance with the Quality Control Procedure (QCP) developed by the *Contractor* after approval by the *Employer*.

The *Contractor* is to provide facilities for inspection of all items of equipment at the place of the manufacture and this requirement is to be extended to all *Sub-contractors* and suppliers. All material labour or assistance, tools, gauges, articles or apparatus that the *Employer* may require for the purpose of testing, gauging and inspection, are to be provided by the *Contractor*. The *Contractor* is to provide all such facilities for testing and the contract price is to include for this.

The *Employer* reserves the right to reject items that do not conform to the *Employer's* requirements. When the plant has passed the test referred to in this specification, the *Employer* is to furnish to the *Contractor* a certificate or endorse the *Contractor's* test certificate to that effect. Examination by the *Employer* is not to relieve the *Contractor* from the responsibility of carrying out all tests which may be necessary to ensure the required standard of manufacture or from any obligations in terms of the contract.

The achievement of adequate standards during the tests at the place of manufacture, if performed, is only the first requirement. The final criterion is the performance onsite, and any of the requirements which prove defective due to bad workmanship or material are to be replaced forthwith by the *Contractor* at his/her own cost on the instruction of the *Employer*.

The following tests are conducted by the *Contractor* and are to be witnessed by the *Employer* at the manufacturer's *Works* or *Contractor's* premises as a minimum requirement:

a) Visual inspection of the equipment.
b) Review of the certification requirements.

c) Functional tests of the systems and controls including starting & stopping procedures.
d) Inspection of paint work and corrosion protection.
e) Verification that all components are delivered to the *Contractor's* premises.
f) Verification that all power plugs is correct.
g) Verification that components installed is correct.
h) Verification that all labels are correct.
i) Phase rotation.

5.3 MARKING PLANT AND MATERIAL OUTSIDE THE WORKING AREAS

All Plant and Material paid for by the *Employer* must be clearly labelled as being the *Employer's* property.

5.4 *CONTRACTOR'S* EQUIPMENT (INCLUDING TEMPORARY *WORKS*)

The *Contractor* provides the following to complete the *Works*:
a) All scaffolding required.
b) Any equipment necessary to complete the *Works.*
c) Lifting facilities.

The *Contractor* supplies, installs, maintains, and removes all temporary construction facilities and utilities necessary to provide the *Works.*

6. CONSTRUCTION

6.1 CONSTRUCTION OF HVAC *WORKS*

The construction of the new HVAC system is to be undertaken while Eskom New Germany in the remains live during the complete duration of the execution of works. Hence, the installation of new HVAC system is to be carried out in a systematically manner to ensure no loss of air conditioning in essential areas can be accommodated at any stage.

6.2 COMPLETION, TESTING, COMMISSIONING AND CORRECTION OF FAULTS

6.2.1 Work to be done by the Completion Date

The contract is deemed to be complete when the following have been completed in accordance with the relevant specifications:
a) The Plant is erected, and commissioned
b) Signed erection and safety clearance certificates.
c) The final as built drawings have been submitted.
d) All documentation has been submitted including testing reports and the associated certificates received. All Quality Control Plan (QCP) documentation received. Final draft of the technical, operating, maintenance manuals delivered.
e) The plant and all documentation, drawings are coded and labelled.
f) All special tools have been supplied.

6.2.2 Materials Facilities and Samples for Tests and Inspections

The *Contractor* provides all Materials, facilities and/or samples required for tests and inspections.

The *Employer* reserves the right to call for samples of equipment offered to inspect the workmanship as the work proceeds and either accept or reject the equipment or workmanship. The *Employer's* approval of

the design, material and workmanship are to in no way reduce the *Contractor's* liability to provide a complete and proper working plant which is abreast with modern technology.

The *Contractor* must allow for control samples of the following which are to be approved by the *Employer* and are to be held in the site office to establish the quality standards:

a) Control sample of ducting to establish the ductwork quality standard.
b) Control sample of welded, insulated, and cladded piping to establish the pipework quality standard.
c) Air terminals

6.2.3 Commissioning

The complete HVAC system with interfaces are to be commissioned in accordance with the following SANS and Chartered Institution of Building Services Engineers (CIBSE) codes or such other recognized commissioning procedure or code approved by the client:

a) Air distribution systems
    i. SANS 10173: Code of Practice for the Installation, Testing and Balancing of Air Conditioning Ductwork, or
    ii. CIBSE Commissioning Code A: 2006 or latest revision
b) Automatic controls: CIBSE Commissioning Code C: 2001 or latest revision
c) Refrigerating Systems: CIBSE Commissioning Code R: 2002 or latest revision
d) Water Distribution Systems**:** CIBSE Commissioning Code W: 2002 or latest revision

The *Contractor* does comprehensive pre-commissioning, commissioning as well as quality monitoring on all the HVAC and its sub-systems and is to provide a report with the following details.

a) Demonstrate that the services were commissioned in compliance with SANS OR CIBSE Commissioning Codes or ASHRAE Commissioning Guideline for all mechanical services.
b) Include commissioning dates, records of all functional/commissioning testing undertaken, a list of any future seasonal testing, and a written list of outstanding commissioning issues.
c) Include the outcomes and changes made to the building as a result of the commissioning process, accounting for all of the recommendations; and
d) Reference appended extracts of commissioning records for major plant and equipment.
e) Ensures that the correct performance of the equipment, safety of plant and personnel, and compliance with the Technical Information before commissioning of plant commences is achieved.

The commissioning procedure to be adopted is prepared by the Commissioning Authority. During commissioning the *Contractor* set the installation to work and competent personnel demonstrates and explain the operation and maintenance procedures for the installation and for each item of plant to the *Employer*. During commissioning if any item is found to be unsatisfactory the fault is rectified and/or new components fitted and commissioned by the *Contractor* at their own expense. The *Contractor* then rebalances and commission the system or part thereof affected at their own expense.

After successful completion of the commissioning and proof period of the installation and any maintenance materials as listed in the Specification and those normally supplied by equipment manufacturer are handed over, the maintenance period commences. Items of equipment which are of a specialist nature e.g. automatic controls etc. are to be commissioned by the manufacturer's representative who instruct the *Employer* on the function and proper operation of the equipment.

6.2.4 Start-up Procedures required to put the *Works* into Operation

No alterations or adjustments are to be made to the *Works* after functional checks are done without the *Employer's* written permission.

At this stage the following is to be achieved:

a) Installation and pre-commissioning completed.

b) Testing report and the associated certificates received.
c) Signed erection and safety clearance certificates.
d) Final draft of the technical, operating, maintenance manuals delivered.
e) All Quality Control Plan (QCP) documentation received.

6.2.5 Take Over Procedures

The *Employer* takes over the *Works* on the date of safety clearance of the HVAC and its sub-systems in accordance with the sectional completion dates of the Accepted Program.

6.2.6 Performance Tests after Completion

All HVAC systems are to be subjected to performance tests under full working conditions as follows:
a) The *Contractor* is to supply the necessary field-testing instruments (thermometers and flow meters etc) and detailed description of field-testing arrangement to prove a capacity/performance measurement accuracy of ± 5% for equipment supplied.

6.2.7 Training and Technology Transfer

After completion of the contract, the *Contractor* is required to provide training and transfer system knowledge to the *Employer* by submitting documented Design Intent, As-built drawings, Operational and Maintenance Manual, Commissioning Records, Commissioning Report and by providing training on all the systems to the *Employer's* personnel to ensure that they have all the information and understanding needed to operate and maintain the features and systems in the various areas.

The *Contractor* is to provide on-site training and training material to the Engineers, Operators and Maintenance personnel prior to taking-over of the *Works*. The training is preferable to be offered during the commissioning and testing for a minimum of ten (10) personnel. The *Contractor* is to, prior to handing over of the *Works*, satisfy the *Employer* that maintenance, engineering, and operational personnel are competent and adequately trained to maintain and operate the equipment supplied.

The training is to cover the following, however not limited to:
a) Information provided in the design intent report (including energy/environmental features)
b) Review of controls set up, programming, alarms, and troubleshooting
c) Review of O&M manuals
d) Building operation (start up, normal operation, unoccupied operation, seasonal changeover, shutdown)
e) Measures that can be taken to optimise energy efficiency
f) Occupational health and safety (OH&S) issues
g) Maintenance requirements and sourcing replacements
h) Obtaining and addressing occupant satisfaction feedback
i) Development and creation of HMI mimics, logic, and parameters

Steps for conducting On-site Training are to include:
a) Preparation
b) Introduction
c) Explanation
d) Demonstration
e) Practice Under Supervision
f) Conclusion

The operating and maintenance manual are to be available during the training of *Employer's* personnel. *Employer's* personnel are to be made familiar with the contents of that manual.

6.2.8 Operational Maintenance after Completion

After successful completion of the commissioning and proof period of the installation and any maintenance materials as listed in the Specification and those normally supplied by equipment manufacturer are handed over, the maintenance period commences. The *Contractor* is to execute maintenance and maintenance management under the supervision of *Employer* for a period of 12 (twelve) months from the date of handing over of the Data Centre HVAC System and Hot Water Heat Pump *Works.*

The *Contractor* is to return to site following the issuing of the Taking over Certificate whenever is required or as defined by the detailed maintenance schedule submitted on Operating & Maintenance manuals. The minimum intervals for the *Contractor* to be onsite for inspection after taking-over of *Works* are to be 3, 6, 9 and 12 months respectively.

A report after each visit is to be submitted to the *Employer* in writing. The *Contractor* is to rectify such items in accordance with the requirements of the conditions of Contract. The *Contractor* is responsible for any faults that may arise during the guarantee and maintenance period and will be called out to repair such faults as required; therefore, it is important that a responsible/contact person and alternatives are to be provided as part of the Operating & Maintenance manual submissions.

The *Contractor* is to make all adjustments necessary for the correct operation of the plant and equipment for a period of 12 (twelve) months after the date of issue of taking-over certificate. The *Contractor* is to make good any faults due to inferior material or workmanship that may arise during this period. If during this period, the plant is not in working order for any reason for which the *Contractor* can be held responsible or if the plant develops faults, the *Contractor* will be notified, and immediate steps are to be taken by him to remedy the faults or to make any adjustments required. Should such faults occur so frequent as to become objectionable or should the equipment otherwise prove unsatisfactory during the above-mentioned period, the *Contractor*, if called upon by the *Employer*, is to replace at his/her own expense the whole or such parts thereof as the *Employer* may deem necessary, with apparatus to be specified by the *Employer*.

Final acceptance is to be taken once all the equipment has been replaced and the plant is in working order again. The *Contractor* is to confirm by means of instrumentation that the plant is delivering the same duty that it was at first acceptance. These readings and measurements are to be witnessed by the *Employer*.

6.2.8.1 Principles of effective maintenance and maintenance management

The following principles are to prevail to ensure effective maintenance management and maintenance of the HVAC facilities/equipment, namely:

a) The principle of disciplined configuration management/control is to be complied with during this period. The maintenance execution should apply strict control/discipline not to change/alter the configuration status of the equipment without either approval by or notification of the change. The importance of managing the “as-built”, “operate-to” and the “maintain-to” information data packs (operation and maintenance manuals including maintenance schedules for each piece of equipment) of the equipment. Any discrepancies between the actual configuration and the information data pack information could lead to cost-inefficient maintenance (wrong information on equipment leads to wrong maintenance execution and therefore the operation and maintenance manual will be 100% correct.

b) The principle of applying optimum maintenance management and the desire to continuous improvement, learning from lessons of the past and wanting to apply intelligent maintenance management principles, should be accommodated as the driving force for maintenance management. The *Contractor* will therefore start with the built of each HVAC Systems history for future continuous improvement.

c) The sound principle of the maintenance Contractor having an independent quality assurance (QA), quality control (QC) and even an inspectorate service of the maintenance execution, where the *Employer* should only execute quality assurance (check a % of the QA and QC of the *Contractor*). It is therefore the responsibility of the *Contractor* to provide the *Employer* with maintenance QC lists and QA methods that are to be used during the one-year maintenance period.

d) Management information is of the utmost importance, especially in areas where huge sums of money are spent or where decisions are highly dependent on accurate information. Good performance measurement and management is highly dependent on accurate information (Maintenance report back information). The *Employer* will determine with the *Contractor* before *Works* completion, the maintenance information requirements and format that will be provided by the *Contractor* during the maintenance period.

e) Given the complexity/diversity of the HVAC equipment, it becomes obviously important to name and number the different System equipment to determine the exact maintenance history of each piece of equipment during the maintenance year and thereafter. The *Contractor* will therefore number each unit of each System in accordance the numbers that will be provided by the *Employer* before the *Works* commences.

f) Statutory regulations and Eskom standards should be adhered to in the maintenance execution period in conjunction with the normal preventative and corrective maintenance actions. Where facilities/equipment is found that do not comply are to be rectified to create a working environment that is safe and without risk to safety and health. The SANS 10147 is an OHS Act Regulation and should always be complied with during the maintenance period.

g) Although the initial focus of maintenance management should be on optimising/reducing the maintenance-cost, the focus should shift to incorporate optimising/reducing of the entire operating cost and ultimately optimising/reducing the life cycle cost (LCC). The *Contractor* will therefore incorporate measurements such as “Coefficient of Performance” (COP) measurements as part of the year’s PM maintenance program. Other energy saving methods will be provided by the *Employer* to the *Contractor* to be included in *Contractor*s PM schedule. Power consumption readings of each System provided with meters will be part of the *Contractor*’s monthly Planned Maintenance (PM) schedule.

h) Trade-off studies should continuously be analysed or conducted to ensure optimal use of preventative maintenance and corrective maintenance for each respective/individual situation (e.g. - more preventative, less corrective to increase item MTTF/MTTR).

i) Trade-offs regarding repair or replace decisions should continuously be made, as well as decisions on whether equipment/Systems should be phased out due to too high operating cost. Trade-offs involving decisions to purchase more reliable equipment with lower maintenance cost versus less reliable (also less costly) equipment with higher maintenance-cost will be executed.

j) A strategy will be developed by the *Contractor* regarding different standard levels of repair during the maintenance period in order to ensure focus/cost-effectively of the *Contractor*’s service (supplier cost versus *Contractor* cost).

k) Re-commissioning of equipment after System breakdowns will be implemented as part of the *Contractor*’s Corrective Maintenance (CM) procedure.

l) The *Contractor* will provide a maintenance service to the level defined in a quality plan (service level agreement standard). All the activities performed will comply with the required standard. The *Contractor* will supply procedures, documentation, and testing methods to support the committed level of service. The *Contractor* will have a documented process that verifies that all New Germany requirements (maintenance specification requirements and standards) are met. The PM and CM response times as required by *Employer* will be applied by the *Contractor* during

the year maintenance period. Refer to *Employer* maintenance response times in accordance with the Service Level Agreement (SLA) between *Contractors* and *Employer*.

6.2.8.2 Service Level Agreement

The *Employer* expects the *Contractor* to at least meet the following service requirements however not limited to:

a) Ensure a continuous supply of conditioned air to all the facilities requiring conditioned air and that are fitted out with HVAC equipment.
b) Restore any interruption to conditioned air supply within the agreed restoration times.
c) Maintain an accurate database of all assets maintained.

6.2.8.3 Maintenance requirements after completion of *Works*

The *Contractor* is to be responsible for any failures as a result of the installation during this period.

A maximum response time of 4 hours will be allowed for all failures from the time the notification had been delivered to the *Contractor*.

The planned maintenance is to be execution in 3-monthly maintenance service, except if the OEMs recommend a different service interval; the later are to take preference. The *Contractor* will provide a PM schedule that will include the following:

a) Inspections time periods of applicable HVAC equipment/items including manufacturer's inspection requirements.
b) All HVAC equipment/items that require cleaning, removal of contaminants and waste, correct adjustment and setting, tightening, testing, fixing, refill, lubrication, rust prevention, touch up, refrigeration charge, servicing, inspection, replacement, re-installation, troubleshooting and calibration during a specific period e.g. weekly, monthly, 3 or 6 monthly, yearly or when required such as dirty filters, evaporators, etc. This is to include the manufacturer's maintenance requirements.
c) The schedule will be associated with PM guides/instruction list indicating the function to be executed and the material to be used for each piece of HVAC equipment that will be used by the *Contractor* during the one-year maintenance period. Each guide/instruction list will include the General instructions, Special instructions, Tools, and materials to be used, List of codes/standards that are applicable to the equipment being maintained and Maintenance check points & maintenance execution including manufacturers maintenance requirements.
d) The *Contractor* will indicate all materials to be used for each instruction e.g. "Replace or clean filters if required" – Material required = Three (3) panel filters (600mm X 600mm X 50mm).

A process used to determine maintenance requirements of any physical asset in its operating context is to make use of the "Reliable Centre Maintenance" (RCM) process (RCM by John Moubray – distributed by Butterworth-Heinemann) or similar. The RCM process entails asking seven questions about the asset or System under review, as follows:

a) What are the functions and associated performance standards of the asset in its present operating context?
b) In what ways does it fail to fulfil its functions?
c) What causes each functional failure?
d) What happens when each failure occurs?
e) In what way does each failure matter?
f) What can be done to predict or prevent each failure?
g) What should be done if suitable proactive task cannot be found?

To apply the above questions a table should be drawn up of each HVAC unit's component/item function, function failure, failure cause, failure consequences and proactive tasks. The *Contractor* will provide detail

tables of each installed HVAC units items which will be discussed and agreed with the *Employer* before any maintenance tasks e.g. inspection period (e.g. daily inspections) or preventative maintenance tasks is taken up in the maintenance schedule (drawn up by the *Contractor*) that will be executed by the *Contractor* during the one year maintenance period.

6.2.8.4 Maintenance information requirements

The *Contractor* will provide maintenance information on each PM and CM executed during the one-year maintenance period. The report template to be used for providing the required reporting will be agreed upon between the *Employer* and *Contractor* before execution of the maintenance & servicing commences.

All PM's are to be executed by means of *Employer* request number which is to form part of the procedure.

Although maintenance is executed on a unit/System more detail is required of that unit/System and specific detail is required of the components/items of that unit/System as follows:

a) Time reported or request/order generated
b) Time in - Time *Contractor* arrived on site
c) Time out - Time *Contractor* finished breakdown/complain
d) Total time spend on breakdown maintenance
e) Components/item description maintained
f) Was component/maintenance item:
    i. Repaired
    ii. Replaced
    iii. Inspected
g) Remarks on repair, replace or inspection and quantity/number of materials used
h) Power measured
i) Cooling capacity measured
j) COP (if applicable)
k) Cost of maintenance or servicing

6.2.8.5 Maintenance management

From information received on the PM`s and CM`s reports, logbook (produced by the *Contractor*) and *Employer* service requests, maintenance management will be executed by the *Contractor* in conjunction with the *Employer*. A maintenance meeting will be held once a month during the maintenance period where the *Contractor*, *Employer* will discuss all areas of the maintenance execution process, problems, maintenance information, and non-compliances and introduce maintenance management processes to be implemented by the *Contractor* during the maintenance period.

The following are some of the areas of maintenance on which maintenance management will be executed:

6.2.8.5.1 Improve maintenance cost-effectiveness

The capability to improve maintenance cost-effectiveness will be developed by all parties at the monthly maintenance meeting, based on the data received from the *Contractor* and *Employer* requests. The following minimum capability will be developed:

a) Failure Report Analysis (FRA). FRA will be done for each specific piece of equipment and the following analysis will be carried out:
    i. Time between failures (TBF), draw a process control chart of the TBF showing the MTBF, each TBF as recorded in sequential order and TBF control limits.
    ii. Monthly preventative and corrective maintenance times/cost. Draw a process control chart of the monthly time/cost showing average monthly time/cost spend on PM`s and CM`s.
    iii. Draw a process control chart of the downtime showing the average downtime; each downtime as recorded in sequential order and downtime control limits.

iv. Draw a process control chart of the average availability, availability as calculated in sequential order and availability control limits.
v. Identify those entire specific pieces of equipment of which the most recent TBF, monthly cost, downtime or availability is outside the control limits of the specific of generic equipment type or downtime is not within specified/contracted levels.
vi. List the following for each of the above identified pieces of equipment for the most recent failure, as well as all previous failures:
- All the failure descriptions
- All the failure causes

b) Corrective Action (CA). From the FRA, the activity report obtained from the maintenance contractor, as well as standardisation considerations, one of the following actions will be taken for each of those equipment identified in the previous section a).:
i. Don't do any corrective action and monitor the performance of the specific piece of equipment.
ii. Replace the specific piece of equipment or phase the equipment out.
iii. Updates the "maintain to" info data pack (improve preventative maintenance such as more frequent lubrication etc. or specify a more realistic downtime values).
iv. Do maintenance concept trade-off studies and update the maintenance concept (i.e. improve the lines of repair, maintenance processes, inventory levels/contents (e.g. filters), etc.).
v. Carry out an equipment design/application analysis and/or a LCC analysis to determine whether it is cost-effective to change the equipment configuration (i.e. a different model/producer in need of more/less reliability, performance, capacity, etc.).

6.2.8.5.2 Replace identified equipment as soon as possible

This task comprises that specific part of maintenance improvement whereby it is determined as soon as possible that the existing equipment should be replaced by other or new identical piece of equipment, mainly due to a result of an analysis showing that the existing equipment requires excessive maintenance and excessive costs. The disciplined replacement needs to be managed together with its configuration control regarding series number and warranty control. The equipment database needs to be updated and controlled

6.2.8.6 Maintenance guide for three monthly service or as required

"Maintenance" or "CHECK" in the guide are to mean the efficient and effective examination, inspection, service, repair and replacement of components and parts of an air conditioning unit or System so that the air conditioning unit or System complies to the manufacturers, design and commissioning operational specifications and statutory/company requirements. This includes the cleaning, removal of contaminants and waste, correct adjustment, and setting, tightening, testing, fixing, refill, lubrication, balancing, rust prevention, touch up and refrigeration charge of the air conditioning unit or System.

The guide indicates maintenance check points, components and items that are all applicable to the different HVAC units and Systems of the company. When maintenance is executed in accordance to the guide the maintenance check points, components and items not applicable to the specific HVAC unit and System, are to be excluded from the service to be executed. The exclusion of any maintenance check points, components and items are to be the responsibility of the *Contractor*. Any error exclusions are to be the responsibility of the *Contractor* and no considerations are to be given to claims made by the *Contractor* for the rectification thereof.

The following schedule is to be used for execution of maintenance and commissioning tests.

Table 9: Guide for execution of maintenance and commissioning tests

Check Points	Action
Compressor	Suction and discharge pressures, leaks, high- and low-pressure setting, mountings, current drawn
All coils	Finned surface area, coils fins, coils and plates, coil and plate mountings, leaks, temperature of refrigerant in, temperature of refrigerant out, air on coil temperature and air off coil temperature
Refrigeration circuits and accessories	Valves, piping, leaks and ice formation
All motors	Bearings, current drawn, speed, coupling, guards, shaft, protection, housing, mountings, belts, pulleys, gaskets, seals, nuts and bolts
All fans	Volume flow, bearings, seals, shaft, pulley, belts, protection, mounting, housing, blades, dampers, current drawn, bolt and nuts
Casing and frame	Openings, nuts, bolts, rust, paint, mounting brackets and covers
Filter(s)	Media condition, pressure difference, no bypass of air, seals, holding frame, catches and mountings
Louvers, dampers and grilles	Frames, blades, fixing, air throw, direction of discharge, mountings and supports
Heaters	Elements, protection, safety, heating steps and mountings
Electrical	Compliance with regulations, electrical supply, conduit, joints, thermal blocks, wiring, cables, insulation, trunking, switchgear and protection
Controls	Wiring, sensors, set points, indicators, alarms and signalling
Sound	Required NC level.
Drainage	Piping, leaks, connections, fittings, joints, water flow, trap and clamps
Ductwork and insulation	Sheet metal, material, joints, seals, fasteners, seams, hangers, supports and clamps
Alarms	Casing, controls, wiring, indicators, communication and faceplates
Other actions however not limited to.	Clean condenser, cooling coil fins, drain pan and fans. Slime or mould found on the coils or drain pan are to be cleaned with appropriate solution
	Inspect all coil fins. Straight with a fin comb as required
	Remove dirt or rust from parts, casing and frame. Touch up as necessary
	Replace or clean filter if required
	Inspect and adjust air damper
	Lubricate motor and fan bearings
	Inspect gaskets. Look for leaks between unit and frame. Caulk as necessary
	Check for refrigeration leaks with leak detector and correct. Refrigerant charge as required
	Drain and clean humidifier if applicable

Check Points	Action
	Start unit and observe operation including all controls and set properly
	Check all temperatures and record (see general checkpoints)
	Check frame of unit for proper electric ground
	Replace covers, clean casing and louvres
	Check ductwork and alarms if applicable (see general checkpoints)
	Clean-up work area
	Fill in and complete maintenance report

7. CONFIGURATION AND DOCUMENTATION MANAGEMENT

7.1 DOCUMENT MANAGEMENT

All documents supplied by the *Contractor* are to be subject to Eskom's approval. The language of all documentation is to be in English. All documentation is to be controlled and managed in accordance with Document and Records Management Procedure (32-6).

7.2 DOCUMENT IDENTIFICATION

The *Contractor* is required to submit the Vendor Document Submission Schedule (VDSS) as per agreed dates to the delegated *Employer's* Representative. *Employer* will allocate document numbers on the VDSS and send back to the *Contractor* through the delegated *Employer's* Representative. The VDSS is revisable, and changes must be discussed and agreed upon by all parties. Changes in the VDSS can be additional documentation to be submitted, changes in submission dates or corrections in documentation descriptions, document numbers, etc. The *Contractor's* VDSS is to indicate the format of documents to be submitted.

7.3 DOCUMENT SUBMISSION

All project documents must be submitted to the delegated *Employer's* Representative with transmittal note according to Project / Plant Specific Technical Documents and Records Management Work Instruction (240-76992014). In order to portray a consistent image, it is important that all documents used within the project follow the same standards of layout, style and formatting as described in the Work Instruction. The *Contractor* is required to submit documents as electronic using SharePoint transmittal and hard copies and both copies must be delivered to the *Employer's* Representative.

In addition, the *Contractor* is to be provided with the following standards which must be adhered to:

- Project Plant Specific Technical Documents - Handover Works Instruction 240-124341168
- Project Documentation Deliverable Requirement Specification 240-65459834
- Technical Documentation Classification and Designation Standard 240-54179170
- Project/ Plant Specific Technical Documents and Records Management Work Instruction 240-76992014

The *Contractor* list all project soft copies and hard copies for submittal on the transmittal with the following metadata fields, use *Employer's* transmittal template (240-71448626*)*:

a) Title of the document
b) Document unique identification number

c) Revision number
d) Name of discipline
e) Reason for issuing/submission
f) Sender's details
g) Sent date
h) Recipient's details
i) Date received
j) Quantity of documentation referenced on the transmittal
k) Number of copies
l) Format/medium submitted (e.g. paper, CD/USB Stick, etc)
m) Sender signature
n) Recipient signature, once submitted, to acknowledged receipt

The format of the final documentation handover will be specified in the Vendor Document Submittal Schedule. The Vendor Documentation Submittal Schedule (VDSS) specifies the following:

a) The limits of supply of the documentation, i.e. whether the documentation is provided / maintained by the *Contractor* or the *Employer*.
b) The type of documentation provided.
c) The software format (where applicable) in which the documentation is provided.
d) The stage in the project execution during which the documentation is provided as a deliverable.
e) The *Contractor* is to be responsible for planning the supply of the documentation during the various project stages and to provide the documentation in accordance with the Vendor Documentation Submittal Schedule (VDSS).

The documents are to be submitted to the Eskom Representative accompanied by the Transmittal Note. The *Contractor* submits all documentation to the Eskom Representative as well as the Project's Documentation Centre in the following media:

7.3.1 SharePoint Transmittal

Electronic copies will be submitted to Eskom Documentation Centre via the SharePoint Transmittal space that will be setup for the project.

7.3.2 Bulk Submission

Electronic copies large for transmitting via SharePoint (>700MB) will be delivered on CD/USB Stick, large file transfer protocol and/or hard drives to the Project Documentation Centre. For bulk document submission, the following link can be used https://zendto.eskom.co.za/

7.3.3 Emails and other submission methods

Where applicable and contractually agreed, e-mail submissions can be used, as well as other submission methods employed in the relevant project e.g. Box; Norman Secure, etc

7.3.4 Hard Copies

Two hard copies of documents are to be submitted to the Employer's Representative accompanied by the Transmittal Note.

7.4 DRAWINGS FORMAT AND LAYOUT

The creation, issuing and control of all Engineering Drawings will be in accordance to the latest revision of engineering drawing Standard 240-86973501. Drawings issued to Eskom will be a minimum of two hardcopies and an electronic copy that is editable. The *Contractor* is required to submit electronic drawings in Micro Station (DGN) format, and scanned drawings in pdf format. No drawings in TIFF, AUTOCAD or any other electronic format will be accepted. Drawings issued to Eskom may not be “Right Protected” or encrypted. The *Employer* reserves the right to use these drawings to meet other contractual obligations. The *Contractor* is to include the *Employer’s* drawing number in the drawing title block. Drawing numbers will be assigned by the *Employer* as drawings are developed.

The *Contractor* submits all drawings in accordance with the requirements stipulated in the *Employers* Engineering Drawing Standard 240-8673501. Manufacturing of the equipment commences when drawings are accepted for construction, by the *Employer*. Two paper print, editable native CAD format (.dgn, .dwg) and in .pdf format of each drawing are submitted to the *Employer* for acceptance as per agreed schedule before manufacturing of equipment commences, by the *Contractor*.

The *Contractor* submits a 3D Model in DGN or DWG format. The structure of the 3D model is to be according to the Plant Breakdown Structure. The 3D model is to clearly indicate all interfaces.

The *Contractor* submits all relevant drawings, documents and design information for approval before commencing any work. After the *Employer* accepts the drawings and design information, the *Contractor* is not allowed to depart from the accepted drawings in any way except when it is with the written consent of the *Employer*.

The *Contractor* is responsible for any error or deficiency in any drawings or documents supplied by him and for any loss, damage or expense arising out of such error or deficiency, notwithstanding that such drawing or document may have been accepted by the *Project Manager*.

Drawings are submitted to *Employer* in editable native CAD format (.dgn) and in .pdf format, after commissioning of the equipment. The drawings reflect any changes made during commissioning and are submitted as "As built” drawings.

The *Contractor* notes that all General Arrangement (GA) and detailed manufacturing and erection drawings become the property of the *Employer*. The *Employer* is permitted to purchase replacement parts off these drawings from the lowest cost suppliers.

7.5 CONFIGURATION MANAGEMENT

7.5.1 Plant Coding and Labelling

Coding and labelling of all Plant & Materials and documentation supplied is part of the *Works* and is the responsibility of the *Contractor*. The *Contractor* is to propose a plant and labelling system which is to be accepted by the *Employer* before any coding and labelling is to be undertaken.

7.5.2 Change Management

All Design change management is to be performed in line with the Eskom Project Engineering Change Management Procedure 240-53114026 and the *Employer* ensures that *Contractor* is provided with latest revisions of this procedure. Any uncertainty regarding this procedure is to be clarified with the *Employer* and clarification updates should be reflected in updated versions of this procedure.

7.5.3 Design Review Documentation

The *Contractor* conducts design reviews as per the *Contractor*s official design review procedure. *Contractor* further takes note of the *Employers* Design Review Procedure 240-53113685 and participates in all design reviews as specified by the *Employer*. The *Employer* may “Accept”; “Accept with Comments” or “Reject”. If required, the *Contractor* makes the necessary revisions on the documentation and ensures acceptance is obtained from *Employer*. The *Contractor* includes these design reviews as part of the schedule and suggests appropriate timing for such reviews.

7.5.4 Procedure for Submission and Acceptance of Contractor’s Design

The *Contractor* ensures the following:

a) The design is prepared, supervised, and managed in accordance with the *Employer*’s principles and quality procedures.
b) The design is prepared, reviewed, and verified by individuals who are competent and are registered with ECSA or other international recognised bodies.
c) The design of the *Works* complies with the Contract Specification, generic specifications, standards, drawings, the *Project Manager*’s instructions, and other documents.
d) The design is accurately recorded in the design submissions including calculations, verifications, detailed construction drawings, specifications, test and commissioning plans and operation and maintenance manuals.
e) The design is reviewed and endorsed as compliant by an internal Reviewer prior to sending it for verification by the *Employer*.
f) The design is developed and submitted for review in accordance with the Contract Specification and agreed schedule.
g) All design information, data, drawings, and other documentation is produced for the *Works* in accordance with the Contract.
h) The Detail design report is to be according to the *Employer*’s Detail Design Report Template, 240-49910707.

7.5.5 Design Review Procedure

The *Contractor* is the Design Authority for HVAC System, Controls, Electrical, Civil, Structural and Building related *Works* of the contract as defined in the *Employer’s* Design Review Procedure 240-53113685. The *Contractor* is responsible for following this design procedure and conducts all the design reviews as specified in this procedure. The *Contractor* is responsible for conducting the following reviews:

a) Design Freeze Review (Detail Design)
b) Pre-Commissioning Review
c) Acceptance Testing Review
d) Handover Review

For design review purposes the designs will be reviewed per part of the *Works* as well as an integrated design where all interface issues between the various parts are addressed as follows:

a) The interim design stage will be an iterative process between the *Employer* and the designer with regular progress meetings.
b) The interim design stage will culminate with the submission of a report.
c) After receipt of the design report, the *Employer* will have ten (10) working days to review and submit comments to the designer.
d) The designer will then have five (5) working days to submit the updated final design report.
e) The submission will then constitute the End of Phase review and the *Employer* will accept the final design report with comments by the *Employer* and updates by the designer within five (5) working days.

7.5.6 Process for Submission of Documents

The *Contractor* submits all documents according to the templates that are referenced on the list of Standards. The process for the submission of documents is described below:

a) The *Contractor* submits the documents/drawings to the *Employer*.
b) The *Employer's* Document Controller registers the documents.
c) The *Employer's* Document Controller will supply the documents/drawings to all relevant parties within the *Employer*'s project team.
d) The *Employer's* project team reviews the documents/drawings and will submit all comments or inputs to the *Employer* and the *Employer* submits to the *Contractor* for consideration.
e) If the *Employer* finds major deficiencies in the submitted documents/drawings, the *Contractor* revises the documents/drawings and resubmits to the *Employer*.
f) The *Employer* reviews the documents/drawings and if no major deficiencies are found, the *Contractor* organises a Design Review session.
g) The *Employer* and the *Contractor* conduct a Design Review.
h) If any fundamental errors were found in the designs or further actions are required, the *Contractor* record all concerns raised and revises the designs.
i) The *Contractor* organises a Design Review session once all designs were revised according to the concerns raised by the *Employer*.
j) If no fundamental errors were found in the designs during the Design Review session, the *Contractor* compiles the Design Review minutes or report and submits it to the *Employer*.
k) The *Employer's* Document Controller registers the report.
l) The *Employer's* project team reviews the *Contractor's* report/minutes. If the report/minutes are not acceptable, the *Contractor* revises the report/minutes and resubmits to the *Project Manager*.
m) The *Project Manager* accepts the *Contractor's* design once the report/minutes are accepted by the *Employer's* project team.

The *Contractor* is to implement the following activities for approval:

a) The *Contractor* reviews, stamps, dates, and signs to signify his/her approval and submit in the manner required by the *Employer* in orderly sequence so as to cause no delay in the work, all *Contractor's* drawings, equipment selections and/or samples required by the *Works* or subsequently by the *Employer*. *Contractor's* drawings, equipment selections and samples are to be properly identified as specified or as the *Employer* may require.
b) At the time of submission, the *Contractor* informs the *Employer* in writing of any deviation in the *Contractor's* drawings, equipment selection or samples from the requirements of the *Works*.
c) Each individual plant & material selection submission is to be accompanied by a copy of the applicable detailed technical specification. Each clause of this specification to be marked "Complies" or "Does not comply", complete with reason stated, alternative offered and countersigned by the *Contractor*.
d) Plant & material selection submissions are to be indexed similar to the index for plant & material part of the "Operating Instructions and Maintenance Manual".
e) The *Contractor* is to submit two copies of drawings and plant & material selections along the channels agreed.
f) By submitting drawings, plant & material selections and/or samples, the *Contractor* represents that he/she has determined and verified all site measurements, site instruction criteria, materials, catalogue numbers and similar data, and that he/she has checked and co-ordinated each services drawing and sample with the requirements of the *Works*.
g) The *Employer* reviews *Contractor's* drawings, plant & material selections and samples so as to cause no delay, but only for conformance with the design of the *Works*. The *Employer's* approval of a separate item does not indicate approval of an assembly in which the item functions.
h) The Contractor makes any corrections required by the Employer and re-submits the required number of corrected copies of the Contractor's drawings, plant & material selections or new samples until approved. The Contractor directs specific attention in writing on resubmitted

drawings to revisions other than the corrections required by the Employer on previous submissions.

The following documents are supplied to the *Employer* by the *Contractor* as a minimum:

a) Documents, including detailed calculations such as hydraulic and pipe stress analysis (where required), pipe supports, handers and racks,
b) Documents including equipment data sheets and specification for selected equipment, electrical cabling and other associated equipment.
c) Dimensioned shop drawings showing the general arrangement of all plant and equipment including isometrics and P&ID's or PFD's where required. Sufficient views must be given to ensure clarity and the drawings are to have at least a plan and two different elevations or sections giving overall dimensions.
d) Dimensioned shop drawings showing proposed method of fixing of all the plant and equipment
e) Detailed electrical wiring diagrams including schematic and control circuits.
f) Compliance and Electrical Certificates
g) Detailed sequencing manner for installation procedure of *Works*
h) Detailed programme for the *Works* in sufficient detail as to represent the units of work to enable the representative to assess the progress of the *Works*
i) Technical specification and literature for all items of equipment that forms part of the complete installation
j) Proposed corrosion protection systems, including data sheets for coating proposed of equipment
k) List of recommended spares and technical specifications for the spares, part numbers and the stock levels required
l) Detailed building *Works* for complete *Works*
m) Detailed maintenance, reliability, control and operating philosophies
n) Testing, balancing and commissioning procedures
o) Plant and material acceptance testing
p) Detailed operation & maintenance manuals with As-Built drawings & Commissioning Results
q) Plant codification lists for each section of the *Works*
r) Construction competition reviews
s) Acceptance testing reviews
t) Quality assurance reports
u) Close out reports

7.6 TIME REQUIRED FOR ACCEPTANCE OF DESIGNS

The *Project Manager* will return one copy of the drawing marked "Accepted"; "Accepted with Comments" or "Rejected". as may be appropriate.

The notations "Accepted" and "Accepted with Comments" authorize the *Contractor* to proceed with the manufacture of the Plant covered by such drawings subject to the corrections, if any, indicated thereon.

Where prints or drawings have been "Rejected" or "Accepted with Comments" the *Contractor* makes the necessary revisions on the drawings and submit further copies for acceptance in the same procedure as for the original submission of drawings.

Every revision shows by number, date and subject in the revision block on the drawing.

The *Contractor* is to allow for 10 calendar days for review of documentation by the *Project Manager.*

8. APPLICABLE STANDARDS AND CODES

Table 10: List of Applicable Standards and Codes

Number	Title
ASHRAE 15	Safety Code for mechanical refrigeration
ASHRAE 62	American Society of Heating Refrigeration and Air Conditioning Engineers. Ventilation for acceptable indoor air quality
ASHRAE 55	Thermal environmental condition for human occupancy
ASHRAE 52/76	Standard test method for filters
ASHRAE G1	Guideline for commissioning of air conditioning system
BS 8233	British Standard code of practice for sound insulation and noise reduction in buildings
BS 5720	British Standard Code of practice for mechanical ventilation and air conditioning
CIBSE Commissioning Code A	Air Distribution Systems
CIBSE Commissioning Code C	Automatic Controls
CIBSE Commissioning Code M	Commissioning Management
CIBSE Commissioning Code R	Refrigeration
CIBSE Commissioning Code W	Water Distribution Systems
ISO 900	Quality Management Systems
OHSACT	Occupational Health and Safety Act 85 of 1993
SANS 10400	The Application of the National Building Regulations
SANS 10108	The Classification of Hazardous Locations and the Selection of Equipment for Use in Such Locations
SANS 10103	The measurement and rating of environmental noise with respect to annoyance and to speech communication
SANS 61800	Adjustable speed electrical power drive Systems
SANS 10140-3	Identification color marking Part 3: Contents of pipelines
SANS 10142-1	The wiring of premises Part 1: Low-voltage installations
SANS 10147	Refrigerating Systems including plants associated with air-conditioning Systems
SANS 10173	The installation, testing, and balancing of air-conditioning duct work
SANS 193	Fire dampers
SANS 1238	Air-conditioning ductwork
SANS 1287-1	Ventilation brattices and ducting Part 1: Flexible ducting
SANS 1287-2	Ventilation brattices and ducting Part 2: Brattices, unsupported
SANS 1424	Filters for use in air-conditioning and general ventilation
SANS 10139	Fire detection and alarm systems for buildings – System design, installation and servicing
32-6	Document and Records Management Procedure

Number	Title
240-53114186	Project Plant Specific Technical Document and Records Management Procedure
240-124341168	Project Plant Specific Technical Documents – Handover Works Instruction
240-76992014	Project Plant Specific Technical Documents and Records Management Work Instruction
240-65459834	Project Documentation Deliverable Requirement Specification
240-54179170	Technical Documentation Classification and Designation Standard
240-71448626	Project Plant Specific Technical Documentation Transmittal Template
240-53114026	Project Engineering Change Management Procedure
240-53114002	Engineering Change Management Procedure
240-53113685	Design Review Procedure
240-86973501	Engineering drawing Standard
240-53665024	Engineering Quality Manual
240-102547991	Eskom General Technical Specification for HVAC Systems
240-143112846	Heating Ventilation and Air Conditioning (HVAC) System Work Instruction
240-56536505	Hazardous Locations Standard
240-56227443	Requirements for Control and Power Cables for Power Stations Standard
240-56356396	Earthing and Lightning Protection Standard
240-56364545	Structural Design and Engineering Standard
240-57617975	Procurement of Power Station Low Voltage Electric Motors Specification Standard
240-107981296	Constructability Assessment Guideline
240-56737448	Fire Detection and Life Safety Design Standard
240-54937439	Fire Protection – Detection Assessment Standard
240-54937450	Fire Protection & Life Safety Design Standard
32-95	Occupational Health and Safety Incident Management Procedure
32-727	Safety, Health, Environment and Quality (SHEQ) Policy

9. LIST OF DRAWINGS ISSUED BY THE *EMPLOYER*

The drawings prepared by the *Employer* show general layout of all equipment and distribution Systems, complete with schematic arrangements. These, together with the specification, give sufficient information to enable the *Contractor* to estimate the cost and to determine how the System must be installed, tested, balanced, inspected, operated, serviced, and maintained. These drawings are not dimensioned shop drawings and cannot be used as shop drawings. Location dimensions shown are only indicative of the routes and zones in which the service must be installed.

The following drawings are applicable to the contract and issued with this tender documentation for tendering purposes only:

Table 11: Existing HVAC Layout Drawings

Drawing No.	Sheet No.	Revision	Title
			Level 2 HVAC Layout
			Level 3 HVAC Layout
			Level 4 HVAC Layout
			Roof Level HVAC Layout

10. AUTHORIZATION

This document has been seen and accepted by:

Name	Designation
Andrew Koenane	Senior Engineer, Electrical Engineering
Kameel Burath	Engineer, Civil and Structural Engineering
Byron Thomas	Engineer, Civil and Structural Engineering
Andre Van Den Berg	Senior Engineer, C&I Engineering
Mboniseni Dhlamini	ERE Project Manager

11. REVISIONS

Date	Rev.	Compiler	Remarks
July 2023	0.1	N Ndika	First Draft for Review
July 2023	0.2	N Ndika	Document updated to incorporate various stakeholders' inputs and comments
July 2023	1	N Ndika	Final Document for Authorisation and Publication

12. REVIEW TEAM

The following people were involved in the review of this document:

- Kameel Burath
- Andrew Koenane
- Andre Van Den Berg
- Byron Thomas
- Charles Herrington
- Mboniseni Dhlamini

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