

	<b>Scope of Work</b>	<b>Technology</b>
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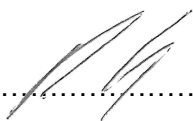
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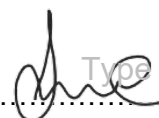
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## **1. INTRODUCTION**

Medupi Power Station Heating Ventilation and Air Conditioning (HVAC) Plants are currently under construction and some sections of the plants have been partially commissioned and tested but not complete; therefore, they have not been handed over to the Client (Eskom Generation) yet. This is global issue across three civil packages namely P35A, 35B and P35C as well as the cable tunnel ventilation system.

This document specifies and describes the supply, service, engineering, construction, modification as well as certification which are to be provided and any other requirements and constraints relating to the way the outstanding HVAC works is to be performed at Medupi Power Station.

This document further presents the overall statuses of each package and detailing the outstanding scope of each of the HVAC packages that need to be executed. Various issues exist on each package preventing the completion of the plants. A lot of these plants have subsequently been taken over because of being beneficially used to support unit operations.

To handover the various HVAC plants to the Client (Eskom Generation), the services of a Contractor are required to complete the various outstanding HVAC Works at Medupi Power Station.

### **1.1 SCOPE**

The outstanding HVAC scope of work as detailed in section 2 below and the accompanying drawings; comprise of the engineering, the provision of all labour including materials and Contractor's equipment, manufacturing (where required), supply (where required), delivery (where required), 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 (where required), preparation of installation drawings (where required), modification of existing plant/structures, testing, balancing, commissioning, and preparation of operating and maintenance manuals, are to be managed and executed by the Contractor in a systematic manner as follows:

- a) Cable tunnel ventilation system
- b) P35A and P35C Service and maintenance of the complete HVAC Works. Critical repairs and services are required to ensure the HVAC plant is available for commissioning & handover.
- c) Engineering of the complete HVAC Works, which include existing drawings and equipment submissions which are to be updated and approved to reach As-built status.
- d) Completion of construction (which might include modification), including quality control and assurance. All outstanding Works is to be completed to comply with Employer's requirements.
- e) KKS Coding.
- f) P35A and P35C outstanding defects to be fixed.
- g) Complete data books to Employer's requirements.
- h) Interface between local Network Control Panel (NCP) and Consolidated Building Management System (CBMS) to be engineered and implemented.
- i) Testing & commissioning of the complete HVAC system. HVAC System to be commissioned, witnesses and signed off according to approved procedures.
- j) Completion & handover which includes training, operation & maintenance, and As-built documentation (including testing, balancing, and commissioning documentation).
- k) Providing the relevant certification
- l) P35B outstanding documentation
- m) IT & Comms building HVAC modification

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### **1.1.1 Purpose**

The purpose of this document is to describe the minimum requirements for design (where required), engineering, drawings (where required), procurement (where required), manufacture (where required), modification of existing plant / structure, quality control & assurance, supply (where required), delivery (where required), installation (where required), certification, commissioning, testing, training, safety clearance, maintenance and handing over of outstanding HVAC and Civil Works at Medupi Power Station.

### **1.1.2 Applicability**

This document applies to Eskom Medupi Power Station.

## **1.2 NORMATIVE/INFORMATIVE REFERENCES**

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

### **1.2.1 Normative**

- [1] Specifications - 200-73113 & 200-71707
- [2] ISO 9001 – Quality Management Systems.
- [3] 32-421 – Eskom Life Saving Rules
- [4] 36-681 – Eskom Plant Safety Regulations
- [5] KKS Key Part – Fossil power station (NPSZ 45-45) – 200-18202
- [6] The application of KKS plant coding (NMP 45-7) – 200-4190
- [7] 36-776 Rev 0 – Environmental Conditions for Process Control Electronic Equipment Used at Power Stations (GGS 1426 Rev 0)
- [8] 36-817 Eskom UPS Standard
- [9] GGS 0456 Rev 4 – Specification for LV Switchgear and Control Gear Assemblies and Associated Equipment for Voltages up to And Including 1000 V Ac and 1500 V DC
- [10] ESKSCAAC6 Rev 0 – Specification for the Identification of the Contents of Pipelines and Vessels.
- [11] 240-53113685, Design Review Procedure
- [12] Occupational Health and Safety Act, (Act No. 85 of 1993)
- [13] 240-53113685 – Eskom Design Review procedure
- [14] 240-56536505 – Hazardous Location Standard
- [15] 240-49230046 – Failure Mode and Effect Analysis (FMEA) Guideline
- [16] 240-49230111 – Hazard and Operability Analysis (HAZOP) Guideline
- [17] 240-86973501 – Engineering Drawing Standards
- [18] 240-61227631 – Piping and Instrumentation Diagram (P&ID) Standard
- [19] 240-56227443 – Requirements for Control and Power Cables for Power Stations
- [20] 240-56355754 – Field Instrument Installation Standard
- [21] 240-56355815 – Junction Boxes and Cable Termination Standard

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- [22] 240-56355888 – Temperature Measurement Systems Installation Standard
- [23] SANS 10108 – The Classification of Hazardous Locations and Selection of Equipment for Use in Such Locations
- [24] SANS 10400 – All Parts National Building regulations
- [25] SANS 60439 – Low-voltage switchgear and control gear assemblies
- [26] SANS 1424 – Filters used in air conditioning and general ventilation
- [27] SANS 1238 - Standard Specification for Air Conditioning Ductwork
- [28] SANS 10173 – Code of Practice for the Installation, Testing and Balancing of Air Conditioning Ductwork.
- [29] SANS 10147 – Refrigerating systems including plants associated with air-conditioning systems
- [30] SANS 60079 Part 15 – Electrical apparatus for explosive gas atmosphere
- [31] SANS 0108-1974 – Classification of hazardous locations
- [32] ASHRAE 15-2010 – Safety Codes for mechanical refrigeration
- [33] ASHRAE 34-2010 – Designation and safety classification of refrigerants
- [34] ASHRAE 62 – Ventilation for acceptable indoor air quality
- [35] ASHRAE 55 – Thermal environmental condition for human occupancy
- [36] ASHRAE 52/76 – Standard test method
- [37] ASHRAE G1 – Guideline for commissioning air conditioning systems
- [38] BS 5720 – British Standard: Code of practice for mechanical ventilation and air conditioning in buildings
- [39] BS 8233 – British Standard: Code of practice for sound insulation and noise reduction in buildings
- [40] 200-6166 - Medupi Power Station Backfill Specification
- [41] 348-880042 Medupi Concrete specification for structural concrete (84CIVL053)
- [42] SANS 2001 - Construction works (complete series)
- [43] SANS 1200 - Standardized specification for civil engineering construction (complete series)
- [44] 240-57127955 - Geotechnical and Foundation Engineering Standard
- [45] 240-56364545 Structural Design and Engineering Standard
- [46] 240-53113685 - Design Review Procedure
- [47] 240-56356376 – Site commissioning for low pressure services
- [48] 200-1689 - Medupi Quality Specifications
- [49] SANS 10400 - All Parts--National Building regulations
- [50] 240-70164623 Design Guideline for HVAC in the Eskom Coal Fired Power Stations
- [51] 240-102547991 General Technical Specification for HVAC Systems Standard

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## 1.2.2 Informative

N/A

## 1.3 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 Plant 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 Contractors 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.
Major defect	Refers to a defect that is likely to create failure of the system for its intended purpose.
Minor defect	Refers to discrepancy from the standards, but one that is not likely to affect the usability of the system.
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.

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Definition	Description
The Client	The end user will be Eskom who will be represented by Medupi Power Station throughout the duration of the Project.

### 1.3.1 Disclosure Classification

**Controlled disclosure:** controlled disclosure to external parties (either enforced by law, or discretionary).

### 1.4 ABBREVIATIONS

Abbreviation	Description
ACC	Air Cooled Condenser
AFS	Air Flow Schematic
AHU	Air Handling Unit
AUX	Auxiliary
BFO	Bulk Fuel Oil
CAD	Computer-Aided Drawing
CBMS	Consolidated Building Management System
CoC	Certificate of Completion
CoE	Centre of Excellence
CPP	Condensate Polishing Plant
C&I	Control & Instrumentation
ECSA	Engineering Council of South Africa
EDWL	Engineering Design Work Lead
ER	Engineering Response
H1	Manufacturing Data Books (MCC and NCP)
H2	Construction Data Books (HVAC Mechanical, Electrical and C&I)
H3	Commissioning Data Books (Entire HVAC System in each building)
HMI	Human Machine Interface
HVAC	Heating, Ventilation, and Air Conditioning
LDE	Lead Discipline Engineer
LOSS	Limit of Supply and Services
MCC	Motor Control Centre
MPS	Medupi Power Station
MPSJV	Medupi Power Station Joint Venture
NCP	Network Control Panel
O&M	Operations and Maintenance
PEM	Project Engineering Manager
P&ID	Piping and Instrumentation Diagram
PJFF	Pulse Jet Fabric Filter Plant

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Abbreviation	Description
P08	Package 08
P35A	Package 35A
P35C	Package 35C
SANS	South African National Standards
SLD	Single Line Diagrams
TM	Team Medupi
VO	Variation Order
WTP	Water Treatment Plant

## 1.5 ROLES AND RESPONSIBILITIES

It is the responsibility of the Eskom Balance of Plant (BoP) Department to ensure that the content of this scope document is executed accordingly. Similarly, it is the responsibility of the other applicable multidisciplinary LDE's to ensure that their respective scopes are executed in accordance with this Scope of Work.

## 1.6 PROCESS FOR MONITORING

The Eskom Design Review Procedure, 240-53113685 shall be the governance document used to conduct reviews of the design verification produced by the appointed HVAC Contractor.

## 1.7 RELATED/SUPPORTING DOCUMENTS

N/A

## 2. SCOPE OF WORK

The scope of work encompasses the area as mentioned below namely package 35A, 35C and specific cable tunnel ventilation.

### 2.1 CABLE TUNNEL VENTILATION SYSTEM

The cable tunnels are to be ventilated at 2 air changes per hour. The construction of the Works will be undertaken while Medupi Power Station 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.

#### 2.1.1 Cable Tunnel Ventilation Scope of Works

The cable tunnel ventilation 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 Contractor in a systematic manner as follows:

- Detailed Design
- Plant and material selection.
- Installation drawings.
- Plant installation.
- Testing, balancing, and commissioning documentation.

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- 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) Ducted supply and extraction system together with matching fire doors/hatches and fire dampers.
- b) Associated Electrical Works for complete tunnel ventilation system.
- c) Associated Controls and accessories for complete tunnel ventilation system.
- d) Associated building and Civil Works for complete tunnel ventilation system.
- e) Interfacing with fire detection system and CBMS
- f) Testing, balancing, and commissioning of the complete tunnel ventilation system
- g) Provision of Painting and corrosion protection for complete tunnel ventilation system.
- h) Provision of operation & maintenance manuals.
- i) Plant Codification & Labelling and provide for complete tunnel ventilation system.
- j) The Contractor makes provision for spares and maintenance support as per the requirements set out in this document.
- k) The Contractor is to execute maintenance and maintenance management under the supervision of Employer for a period of 12 (twelve) months during defects period. The minimum intervals for the Contractor to be onsite for inspection and maintenance after taking-over of Works are to be 3, 6, 9 and 12 months respectively.

### **2.1.2 Fire Protection Philosophy**

The tunnel ventilation system is interfaced to the fire protection system. The extraction fans will run continuously and facilitate smoke extraction in the event of a fire. The system operation is that when fire is detected in a zone, the relevant fire dampers on the supply side of the tunnel ventilation of that zone are closed.

### **2.1.3 Parts of the Cable Tunnel Ventilation Works which the Contractor is to Design**

The plant and material are 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 are 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 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
- b) Operating, control and maintenance philosophies

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c) As Built drawings & Commissioning Results

The Contractor is to execute the following:

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

The Contractor is responsible for the detailed design of the Works below and that such designs are submitted to the Employer for approval prior to procurement and manufacture of any plant and material.

### **2.1.3.1 Tunnel Ventilation System Design**

The envisaged process flow diagram for supply and extraction of air through the cable tunnels is as dissipated by accompanying airflow schematics drawings which forms part of this scope of works. These schematic drawings are issued for information purposes, it remains the responsibility of the contractor to design a tunnel ventilation system which is fit for purpose as per SoW, including all civil, structural, and building works required to supports the tunnel. The airflow schematics are found in Appendix A6

The airflow schematics drawings provided 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 airflow schematics 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.

#### **2.1.3.1.1 Unit 1-6 Auxiliary Bay Tunnels**

Each ACC is equipped with 2-off ducted type fresh supply air fans (each fan has a capacity of 15m<sup>3</sup>/s) which are arranged on a running & standby configuration, and supply air to the respective auxiliary bay tunnel. The ACC supply fans are existing and have been installed as part of package 08 scope of works and do not form part of this works.

The ACC fans are to be complemented by 2-off roof mounted type fans with each fan having a capacity of 3.5m<sup>3</sup>/s and both fans are running to supply additional 7m<sup>3</sup>/s to the auxiliary bay tunnel.

2-off smoke extraction fans of equal capacity at 10m<sup>3</sup>/s each are to be installed as indicated by the accompanying air flow schematics various auxiliary bays.

#### **2.1.3.1.2 Station Services Building Tunnel**

The tunnel that links station services building and auxiliary bay 6 is supplied will fresh air by 2 -off ducted type fans and the fire wall separating the two areas is equipped with 2-off fire dampers which are normal opened during normal conditions to allow air to be extracted from auxiliary bay 6 side. The supply fans and fire dampers are existing and do not form part of this works.

#### **2.1.3.1.3 Tunnel 23**

Tunnel 23 is located between Auxiliary Bay 1 and Substation North. Fresh air to tunnel 23 is to be supplied through 2-off weather louvres as detailed by attached air flow schematics with each louver providing 0.65m<sup>3</sup>/s.

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1-off smoke extraction fan with a capacity of  $1.3\text{m}^3/\text{s}$  is to be installed between Auxiliary Bay 1 and Substation North as detailed by attached air flow schematics.

#### **2.1.3.1.4 Tunnel 39 and 39B**

Tunnel 39 and 39B are located between Compressor House Substation North and Auxiliary Bay 2/3. Fresh air supply to each tunnel is to be supplied through 1-off roof type mounted fans as detailed by attached air flow schematics with each fan having a capacity  $1.3\text{m}^3/\text{s}$ .

2-off smoke extraction fans with each having a capacity of  $1.3\text{m}^3/\text{s}$  are to be installed between Compressor House Substation North and Auxiliary Bay 2/3 as detailed by attached air flow schematics.

#### **2.1.3.1.5 Tunnel 44A**

Tunnel 44A is located between Substation West and Diesel Generator Building. Fresh air supply to the tunnel is to be supplied through 1-off roof type mounted fans as detailed by attached air flow schematics with capacity  $1.3\text{m}^3/\text{s}$ .

1-off smoke extraction fan with a capacity of  $1.3\text{m}^3/\text{s}$  is to be installed between Substation West and Diesel Generator Building as detailed by attached air flow schematics.

#### **2.1.3.1.6 Tunnel 44 and 46A**

Tunnel 44 and 46A are located between Substation West/Diesel Generator Building and Auxiliary Bay 5. Fresh air supply to the tunnels is to be supplied through 1-off roof type mounted fans as detailed by attached air flow schematics with capacity  $1.3\text{m}^3/\text{s}$ .

1-off smoke extraction fan with a capacity of  $1.3\text{m}^3/\text{s}$  is to be installed between Substation West/Diesel Generator Building and Auxiliary Bay 5 as detailed by attached air flow schematics.

#### **2.1.3.1.7 Tunnel 30 and 31A**

Tunnel 30 and 31A are located at the Coal Stockyard Substation South. Fresh air supply to tunnel 30 and 31A is to be supplied through a weather louvre at a rate of  $0.3\text{m}^3/\text{s}$  and roof mounted supply air fan at a rate of  $1.3\text{m}^3/\text{s}$  as detailed by attached air flow schematics.

1-off smoke extraction fan a capacity of  $1.6\text{m}^3/\text{s}$  is to be installed at tunnel 30 and 31A as detailed by attached air flow schematics.

#### **2.1.3.1.8 Tunnel 34A**

Tunnel 34A is located at the Ash Conditioning Plant Substation. Fresh air supply to tunnel 34A is to be supplied from substation basement at a rate of  $0.3\text{m}^3/\text{s}$  as detailed by attached air flow schematics.

1-off smoke extraction fan a capacity of  $0.3\text{m}^3/\text{s}$  is to be installed at Tunnel 34A as detailed by attached air flow schematics.

#### **2.1.3.2 Fire Dampers and Pressure Relief Dampers**

The southern access opening in all ACC substation basements that leads to Auxiliary Bay tunnels is to be equipped with fire dampers in the wider section of the tunnel that will be kept open during normal operation.

The required fire damper physical sizes are estimated 800x800mm and 600mm long (for tendering purposes only). The Contractor is required to take the actual measurements onsite before proceeding with design & manufacture of the works as accuracy remains the responsibility of the Contractor.

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The fire dampers specified are motorized 24V AC fire dampers that are equipped with spring return actuators, combined with thermoelectric tripping device at 72°C with integral limit switches and thermal release; these will be wired by means of 2.5mm<sup>2</sup>, heat resistant conductor wiring in galvanized conduit from the fire damper to the HVAC panel. The fire dampers are to be fitted with 2-off auxiliary micro switches, closed position to be monitored on the blade and open position to be monitored on the actuator. The fire dampers are powered and controlled from the HVAC panel. The fire dampers are permanently driven open in a failsafe configuration. In the event of a fire the power to all the dampers will be switched off, which will close the dampers. The fire signal will be normally closed.

The fire damper to have a 2-hour fire rating and fire sealing to be provided all around the fire damper to ensure that the 2-hour fire rating of the barrier is maintained.

An allowance is to be made for gravity type dampers that are to be installed on ACC substation which will open so that pressure can be released to the outside when closing all ACC substation tunnel fire dampers have been closed.

### **2.1.3.3 Fire Sealing**

Openings and penetration through fire walls are to be fire sealed as indicated by accompanying drawings. Fire Seal must be 2-hour rated (have a 2-hour fire resistance) in accordance with SANS 10177-2 (stability, integrity, and insulation) or equivalent standard. Test certificate no older than 5 years to be provided for the product to be used. Product to be installed in accordance with manufacturers recommendations. Waterproofing is required for cable penetration seals.

### **2.1.3.4 Tunnel Ventilation Controls**

The smoke ventilation fans are to be used as extraction system during normal operation/conditions and is to serve as smoke exhaust fans during fire conditions. The smoke ventilation fans are to be 2-hour fire rated and be equipped with black mild steel ducting for smoke exhaust (where required). The smoke ventilation fan starter panels, electrical and control cables are to be 2-hour fire rated as well.

The fire dampers are to be provided on the respective fire zones as detailed by the damper section above. The tunnels are divided into fire zones. The system operation is that when fire is detected in a zone, the relevant fire dampers on the supply side of the tunnel ventilation of that zone are closed.

### **2.1.3.5 Fire Detection Interfaces**

The complete cable tunnel ventilation 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 ventilation system starters/controllers to indicate that there is a fire in a specific zone; the ventilation system starters/controllers are to automatically stop the fresh supply air fans serving the respective areas; however, the smoke extraction fans are to continue running to exhaust the smoke out. The HVAC system is to automatically return to normal operation once the fire alarm signal to the ventilation system switchboard is cleared.

The fire detection installation is to be installed as follows:

- a) The Fire Detection System (FDS) is existing and is excluded from the works
- b) The Fire Detection System (FDS) interfaces to the field controllers through a local hardwired failsafe interface in accordance with section 8 of 240-56737448 Fire Detection and Life Safety Design Standard.
- c) The Contractor performs a fire risk assessment which informs the tunnel ventilation response to an activation of a fire signal.
- d) The Contractor provides interface points (controller inputs) for each fire zone at the field controller to accommodate the FDS hardwired interface requirements. The smoke ventilation fan starter panels, electrical and control cables are to be 2-hour fire rated as well.

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- e) The Contractor provides sufficient DIN rails to support a FDS line relay for each interface point. FDS line relays are excluded from the Works.
- f) The interfaces are localised per fire zone.
- g) In the event of a fire being detected the field controllers associated with the activated zone close all dampers and shut down supply air fans to choke the fire.
- h) The field controller's response to FDS alarms take priority over other HVAC commands.
- i) An initiated fire signal remains activate until manually reset by the fire responder.
- j) The Contractor programs and configures the HVAC System and field controllers for the above requirements. The CBMS will be configured and programmed by Eskom, however the contractor should provide information for the CBMS configuration.
- k) The Contractor tests and commissions the FDS interface according to SANS 10139 to confirm the above requirements

#### **2.1.3.6 Electrical System Design**

The interfacing electrical scope of work is as follows:

- a) The Contractor shall provide details of the loads requiring power supply, information shall be provided on the provided load list template. 240-56227927 Electrical Load List Template.
- b) Eskom will allocate a point of connection or source supply from the current LV Switchgear.
- c) The Contractor shall be responsible for the supply, termination and pulling of cables from these allocated points of power supply to the load.
- a) The Contractor shall be responsible for sizing all cables, this includes cables from the source of supply and outgoing cables to the extraction fans. A cable schedule developed as per provided template. 240-56176097- Electrical Cable Schedule template.
- d) All power and control Cable installations, laying, identification, type, routing, racking and termination to be done as per standard 240-56227443-Requirements for control and power cables for Power station standard.
- e) Installation of durable cable numbering for all cables connected to the equipment, the cable labelling is to be installed such that it is visible for ease of identification during maintenance and is to comply with 240-56227443 Requirements for Control and Power Cables for Power stations Standard.
- f) The MCC for the extraction fans shall be designed, manufactured, installed, and commissioned in accordance with 240-55714363-Coal Fired Power Station Lighting and Small Power Installation standards.
- g) The Contractor is to carry out the necessary bonding, earthing and, earth testing requirements on all new installed equipment, according to the requirements of the 240-56356396 – Earthing and Lightning Protection Standard.
- h) The Contractor shall be responsible for design, manufacturing, installation, and commissioning for Hazardous location areas as per SANS 10108 - The Classification of Hazardous Locations and Selection of Equipment for Use in Such Locations and 240-56536505 - Hazardous Location Standard.
- i) The Contractor to produce drawings and ITP's (Manufacturing and construction) for MCC boards and all the associated electrical works (i.e., cabling) prior to construction phase.

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- j) Handover of the plant is to be done, and to include all relevant documentation including but not limited to the following:
- Cable test certificates,
  - Cable routing and cable block diagrams,
  - 400V MCC panels should include as built single line diagrams, General Arrangements; load schedules, cable and termination schedules, A&B schedules (240-115583001), all factory test certificates, operation and maintenance manuals etc.
  - Earth continuity certificates
- k) The Contractor is to provide all the Works to the Employer as per the templated listed below, for review:
- 240-56176097: Electrical Cable Schedule Template
  - 240-56227927: Electrical Load List Template
  - 240-56356421: Electrical LV Switchgear Schedule Template
  - 240-56356465: Electrical LV List of Switchboards Template
  - 240-77302094: Electrical Termination Schedule Template
  - 240-115583001: LV switchgear Schedules A and B template
- l) Verification of the allocated circuits for serviceability and operability shall be conducted; any defects on the circuits are to be reported to the Employer before any rectification is conducted.
- m) The Contractor is to verify the components ratings (i.e., fuse switches, fuses, and terminals) of the allocated circuits, before completion of designs. Provision is to be made to supply the correctly rated components to achieve adequate protection grading, on acceptance of the designs and recommendations by the Employer

#### **2.1.3.7 Civil, Structural and Building Works Design**

The Contractor is responsible for the design, procurement, construction, and construction monitoring of all Civil and Structural Works. All designs will be submitted to the Employer for review and acceptance, as per the design review procedure (240-53113685). The Contractor's structural/civil designer shall ensure that design intent is achieved during construction. Once the construction work is completed, the Contractor's designer will issue the necessary certificates (inclusive of geotechnical and structural Professional Engineering Certificates) and as-built documentation (drawings, native files as well as structural and foundation design reports that includes all calculations).

The civil, structural and buildings works including the following however not limited to:

- a) Tunnel link boxes
- b) Fan, fire damper, pressure relief damper and louvres openings
- c) PJFF side tunnel escape cat ladders leading out to the top
- d) Cat ladders for operation and maintenance access to tunnel ventilation fans
- e) Any other civil, structural, and building works required to supports the tunnel ventilation system including fire sealing of openings where required.
- f) Escape hatches and cat ladders for the ACC side cable tunnels. The positions of the escape hatches and cat ladders to be based off the fire escape route design of the tunnels.

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Some tunnel link boxes, fan and louvres openings have been constructed on site, however some works are outstanding. The list of constructed and outstanding items is detailed in the table below:

**Table 1: List of constructed and outstanding tunnel boxes and openings per area**

Area	Tunnel Link Box for Supply Fan Openings	Tunnel Link Box for smoke extraction fan Openings	Escape Hatches	Louvre Openings
1. Unit 1	Not constructed and is required	Not constructed. 2 link boxes/openings required	N/A	N/A
2. Unit 2	Existing	Not constructed. 2 link boxes/openings required	N/A	N/A
3. Unit 3	Existing	Not constructed. 2 link boxes/openings required	N/A	N/A
4. Unit 4	Required	Not constructed. 2 link boxes/openings required	N/A	N/A
5. Unit 5	Existing	Not constructed. 2 link boxes/openings required	N/A	N/A
6. Unit 6	Existing	Not constructed. 2 link boxes/openings required	N/A	N/A
7. Tunnel 23 to Unit 1 tunnel entrance	Existing	N/A	N/A	Existing
8. Tunnel 44A	One opening already constructed, however one more opening is required	N/A	N/A	Existing
9. Tunnel 34A	One opening already constructed, however one more opening is required	N/A	N/A	N/A
10. Tunnel 30 and 31A	Required	N/A	N/A	N/A
11. Tunnel 44 and 46A	Required	N/A	N/A	N/A
12. Tunnel 39 and 39B	Required	N/A	N/A	Existing
13. Unit 6 ACC Tunnel	N/A	N/A	3 Required	N/A
14. Unit 5 ACC Tunnel	N/A	N/A	3 Required	N/A
15. Unit 4 ACC Tunnel	N/A	N/A	3 Required	N/A
16. Unit 3 ACC Tunnel	N/A	N/A	3 Required	N/A
17. Unit 2 ACC Tunnel	N/A	N/A	3 Required	N/A
18. Unit 1 ACC Tunnel	N/A	N/A	3 Required	N/A

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#### **2.1.3.7.1 Detail of Civil Related Works**

##### **i. Inspection**

It is required that the Contractor verifies and inspects all existing works to confirm quality and/or any possible required modifications to the existing infrastructure. The contractor will be responsible for any required testing that the contractor's designer might require for designs.

##### **ii. Geotechnical Design and Construction criteria**

The Contractor shall carry out any/all geotechnical investigations for the required works (where necessary); whereafter the Contractor shall design, construct, monitor and certify all geotechnical works. The Contractor furnishes all necessary equipment and resources required to execute the works. All geotechnical investigation and reporting works to be carried out in accordance with the SAICE Site Investigation Code of Practice, 2010 and Revised Guide to Soil Profiling for Civil Engineering purposes in Southern Africa" Trans. S.A.I.C.E, Vol. 15.

Medupi Specification for the preparation of engineered fills and backfill to all structures except backfill in turbine hall (200-6166)[40] and SANS 1200 series should be adhered to in relation of earthworks, backfill and requirements for testing. All design and construction works shall be built in accordance to approved drawings and geotechnical recommendations supplied by the Contractor. A geotechnical PE certificate\professional declaration shall be produced by the Contractor's geotechnical specialist and shall include compilation and submission of geotechnical data books that shall be issued to the Employer for review once all works are completed.

##### **iii. Concrete Works**

The Contractor shall submit to the Engineer concrete mix designs, concrete-mix trial test cube results and all other required test results as indicated in the Medupi Power Station Specification for Structural Concrete (84CIVL053) prior to the placement of any concrete. Concrete mix designs with the required acceptance tests as indicated in the specification (84CIVL053) shall be submitted once reviewed and accepted by the Contractor's structural designer. Where tests results are not within specified limits the Contractor's structural designer shall submit a report with recommendations to the Engineer for acceptance. Where the requirements of the specification (84CIVL053) appear to be unclear or ambiguous the Contractor and its designer shall discuss these with the Engineer and make the necessary recommendations in accordance with their specific project conditions.

The Contractor shall also submit to the Engineer for review detailed construction method statements and a quality and test plan prior to the casting of concrete. The Contractor shall submit to the Engineer its inspection and test plans (ITP's) for acceptance. The Engineer will indicate his/her hold and witness points on the ITP. All specified tests and required interventions to be itemized on the ITPs and should be easily linked/referenced to all other technical documents.

Due to the aggressive environment that the reinforced concrete works are exposed to, the exposure condition of all the reinforced concrete is classified as severe in accordance with SANS 10100-2, hence the quality of concrete works is of paramount importance. To ensure durability of the reinforced concrete works the design and construction of reinforced concrete shall be done in such a way to limit the total concrete crack widths as specified by relevant specifications.

In addition to the tests specified in the specification (84CIVL053), durability index tests shall be performed, if required by the Engineer or the Contractor, to confirm the durability of concrete placed. The durability index tests are developed to assess the transport properties of the concrete cover zone. There are three durability tests, namely Oxygen Permeability Index, Chloride Conductivity test and the Water Sorptivity test.

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#### **iv. Structural Steelwork**

The Contractor shall ensure that all conceptual, detailed, and final construction drawings are approved as per Eskom's review processes prior to beginning construction and that compliance is maintained to all specifications for material grades that are fabricated and erected. This includes fabrication and erection tolerances, testing parameters and corrosion protection required for steel structures and their supporting elements. The Contractor is also required to submit to the Engineer, steel grade certificates, fabrication drawings, welder's certificates and quality and test plans for review prior to fabrication (refer to Section 3.5 for details).

All structural steel work must be designed, manufactured, and erected in accordance with relevant national specifications and relevant Eskom specifications.

Structural steel used shall be manufactured/fabricated to SABS 1431 or EN 10025.

#### **v. Integration of Civil Design and Construction**

The Contractor is responsible for the integration of the design, procurement, construction, commissioning, and certification of all systems, including any modified/alterd existing infrastructure. During the concept design phase for the various disciplines and their respective designs, the Contractor shall discuss, agree, and integrate with the Employer's Engineers as per the change management processes on Medupi Site.

##### Design and Construction criteria:

1. The Contractor shall design and construct the Works in accordance with this technical specification/SOW, all final reviewed and approved construction drawings, Construction Regulations, Medupi Quality control specifications and the SANS 2001 specifications, as well as all other relevant design and construction SANS and Eskom specifications.
2. The Contractor shall ensure alignment with respect to degree of accuracy for every interface and where the Employer standards are limited on information shall make use of the relevant SANS and design standards.
3. The Works to be provided by the Contractor shall include, but is not limited to all scaffolding, site cranes, lifting equipment and construction vehicles. All excavations, earthworks and terracing as required; all signage required; any modifications required for the use of existing infrastructure (including analysis and certification); and all materials, facilities and samples required to perform inspections, tests, and commissioning as per the relevant statutory and regulatory standards and as per this Technical Specification.

#### **vi. Construction Monitoring by Contractor's designer and Professional Engineering Certification by Contractor's designer**

Construction monitoring includes but not limited to:

- a. Review a sample of each important work procedure and construction material and other technical submissions such as construction method statements, inspection and test plans and quality control and quality assurance plans.
- b. Attending site meetings and maintain adequate presence on the construction site to review samples of works and important completed work prior to enclosure or on completion as appropriate.
- c. Provide the construction team and the Engineer with technical interpretation of the plans and specification when required and checks the construction team's civil works and structures for conformity with design requirements and ensures that design intent is achieved during construction.

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- d. General inspection of materials and equipment for compliance with the design documentation for adherence to National and International standards.
- e. Provides the construction team with updated design documentation (drawings and specifications) where changes are required to ensure integration with existing works and where design changes are required due to unforeseen site conditions.
- f. Prepares and, on completion of the works, provides the Employer with As-Built drawings and a final (updated) design report signed by the Contractor's ECSA registered professional person.
- g. Certifies the works as complete and that design intent is achieved during construction by issuing a completion certificate (Professional Engineering Certificate (PEC)), signed by an ECSA registered professional, in terms of the Construction Regulations, 2014, Occupational Health and Safety Act, 1993 when the works is deemed safe for commissioning.
- h. The Contractor's Designer shall provide services in accordance with ECSA's Guideline Scope of Services and Tariff of Fees for Persons Registered in terms of the Engineering Profession Act, 2000, (Act No. 46 of 2000) and the Construction Regulations, 2014, Occupational Health and Safety Act, 1993.

#### **vii. Codes & Standards to be used in the works**

The Contractor is required to adhere to the latest editions of the normative and informative references within this document, all applicable SANS standards and Eskom specifications/standards mentioned throughout this document.

### **2.2 PACKAGE 35A&C SERVICE AND REPAIRS OF THE COMPLETE HVAC WORKS**

Critical repairs and service are required to ensure the HVAC plant is available for commissioning & handover as detailed by Appendix A3.

Maintenance and manual operation of the plant will be supported by Medupi Generation during the completion of works, however the contractor will be responsible for one visit(per area) during the 12 month period for service and maintenance of each of the the Chillers, NCP's, MCC's and water treatment.

All buildings have reached cold air (uncontrolled cold air), which means that the mechanical and electrical installations are complete and operational; however, the controls installations are incomplete and not operational. Uncontrolled air (cold air) means the supply of air by running chillers and air handling units through the Motor Control Centre (MCC) panel without the NCP.

The Employer has taken beneficial occupation and the HVAC plants are operated on manual mode 24 hours per day, 7 days a week.

The Contractor is to make allowance for the following service and repair scope:

- i. Critical repairs
- ii. Routine service & repair (one visit during the 12-month period)

The Contractor is to further allow for the following:

- i. Annual chiller services
- ii. Water treatment
- iii. MCC services
- iv. NCP service
- v. Spares and equipment for repairs and breakdowns are excluded. These are to be paid on a cost-plus basis. Refer to the Rate Card in Appendix A3.2. The Contractor are to price both the Activity Schedule and the Rate Card

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### **2.2.1 Critical Repairs**

Critical repairs and service are required to ensure the plant is performing to design base and is ready for final commissioning and handover. The Contractor is to audit the plant and ensure these repairs are completed timeously so commissioning and handover is not delayed. A Provisional Sum are included in the Activity Schedule for this purpose as detailed by Appendix A1.

### **2.2.2 Routine Service & Repairs**

Routine service and repairs are the responsibility of the Contractor. Routine service and repairs are to be carried out in accordance with the approved Operational & Maintenance manuals. A summary of all equipment is in Appendix A4. The routine service and repair schedules in Appendix A3.1. If any further technical information is required refer to the equipment submissions and drawings in Appendix A5 & A6.

The Contractor will as minimum have to use the services of the original equipment suppliers for the following services, as the HVAC systems have not been handed over:

- i. Chillers
- ii. Motor Control Centres (MCC)
- iii. Network Control Panel (NCP)
- iv. Water Treatment

## **2.3 ENGINEERING OF THE COMPLETE HVAC WORKS**

To complete the works, it is a requirement by the Quality Assurance (QA) system that all construction documents and drawings must reach a final approved status. Currently all these documents have either one of the following statuses:

- i. AWC - Authorized with Comments
- ii. A - Authorized
- iii. NA – Rejected

The contractor is to refer to Appendix A5 and A6 for detailed Equipment Submittal Schedule and Drawing Submittal Schedule

All construction documents and drawings are to be updated, revised, and submitted to the Employer for approval until it reaches Authorized/Approved status. Thereafter, the as-built drawing process can begin.

It must be noted that equipment submittals do not have to be issued as As-built except for MCC and NCP documents. The MCC and NCP documentation must be updated to reflect as-built status.

MCC documentation consists of the following documents:

- i. Material equipment submittal – MAT-document
- ii. Drawing equipment submittal – DWG format
- iii. MCC Cable Schedule
- iv. Equipment label list
- v. Load schedule

NCP documentation consists of the following documents:

- i. Material equipment submittal – MAT-document
- ii. Drawing equipment submittal – DWG format
- iii. NCP Cable Schedule
- iv. Equipment label list
- v. Points list

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### 2.3.1 As-built Drawings

As-built drawings are to be conducted as follows:

- i. A site walk must be conducted, and the as-built drawings must be updated accordingly. The as-built stamp must be signed by the person who conducted the walk down and the person who prepared the drawing.
- ii. Drawings must be issued officially to Employer.
- iii. The Employer team will conduct their own walk down inspection to check the drawings and provide review comments.
- iv. The Contractor is to update the drawings.

### 2.3.2 Ad Hoc Design Changes

Due to site integration and field conditions; design changes may be required on an ad-hoc basis. The Contractor is to provide design support on all changes that impact their designs. All design changes are to be accepted by TM Engineers (Mechanical, Electrical, C&I and Civil).

The Contractor ensures that HVAC systems are integrated with the existing structures. Where structural changes are unavoidably required the Contractor is to follow the Employer's change management process (ECN process). Structural changes including, but not limited to, coring through structural elements, additional required supports, design load changes and equipment layout changes are to be discussed with the structural designer and optimised by the Contractor where required. Any structural changes are to be approved by the assigned building designer prior to implementation by the Contractor.

### 2.3.3 Certification

The Contractor's Designer is required to issue Professional Engineering Certificates (PEC) for the HVAC systems as well as any structures and/or modifications to structures of, for the Balance of Plant Buildings. The Contractor will undertake full design liability for the works. The designer scope of work and division of responsibility is detailed in Appendix A7.

## 2.4 COMPLETION OF CONSTRUCTION

The HVAC Works are to be completed in accordance with the approved equipment submissions and drawings as detailed by Appendix A5 & A6.

### 2.4.1 Medupi Package 35A (P35A)

**Table 2: Medupi Package 35A (P35A) Buildings**

Full Building Name	Building Description
1. Coal Silo Substation	C/Silo
2. Coal Plant Substation	C/Plant
3. Coal Stockyard North Substation	CSYN
4. Coal Stockyard Office	CSYO
5. Coal Stockyard South Substation	CSYS
6. Ash Conveyor Substation	-
7. Ash Conditioning Substation	-
8. Compressor House South Substation	CHS

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Full Building Name	Building Description
9. Compressor House South Building	CHSB
10. Substation West	Sub West
11. Compressor House North Substation	CHN
12. Substation North	Sub North
13. Workshop and Stores Substation	W&S S/S
14. IT and Comms Buildings	IT
15. Access Control Building	ACB

#### **2.4.1.1 Required Works for P35A Buildings**

##### **2.4.1.1.1 Construction**

Construction in this package is mainly complete except for the items below.

- a) The Contractor is to install primary filters on all emergency cooling louvers. The size of the openings is indicated on the drawings.
- b) The Contractor is to cut and install access panels next to all motorized dampers (motorized supply air and motorized fresh air dampers).
- c) The Contractor is to connect all make-up water system to the chilled water system directly from the fire or potable water line instead of going via the open expansion tanks. The contractor is to tie-in into the existing water connection points which are located within the various chilled water plants. This is not applicable to Workshop and Stores Substation, Access Control Building, Compressor House South Building and Coal Stockyard Office.
- d) All HVAC equipment installed in existing barriers or walls to comply with the fire rating of the wall or barrier. All penetrations to be fire sealed. Fire Seal must be 2-hour rated (have a 2-hour fire resistance) in accordance with SANS 10177-2 (stability, integrity, and insulation) or equivalent standard. Test certificate no older than 5 years to be provided for the product to be used. Product to be installed in accordance with manufacturers recommendations.

The Contractor is to complete all outstanding snags that might exist in any building. The list of snags is included in Appendix A8.

##### **2.4.1.1.2 Repair and Service**

The Contractor is to service and repair all P35A HVAC installations. The repair and service required is complete or full repair from replacing broken equipment to performing major service of Chillers, AHUs, Fans, MCC, NCP, Actuators and Instruments as required by OEM as well as doing water treatment of the system. All records of service and repairs done are to be kept safe and handed to the Employer at handover stage.

##### **2.4.1.1.3 Commissioning**

The Contractor is to fully commission all P35A HVAC installations after the service and repair has been done. Full commissioning includes but is not limited to commissioning of the water system, commissioning of the air system, commissioning of the MCC and NCP. It also includes commissioning of the monitoring interface between the HVAC system and Honeywell system as well as fire detection system interface between Honeywell system and HVAC system. Once commissioning has been

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concluded by the Contractor, witnessing of the commissioned systems needs to take place with Team Medupi. Upon successful witnessing of the commissioned system, the Contractor must issue Professional Engineer certificates for the HVAC works

#### **2.4.1.1.4 Documentation**

Upon completion of the above i.e., construction, service & repair and commissioning of the systems, the Contractor is to submit the documentation below. This documentation includes but is not limited to:

- a) HVAC O&M manual and as-built drawings
- b) HVAC Spares List
- c) HVAC commissioning data
- d) HVAC as built documentation including drawings.
- e) Permanent KKS Certificates (HVAC Mechanical, Electrical and C&I)
- f) HVAC data books (H1, H2, and H3) for HVAC Mechanical, Electrical and C&I
- g) HVAC CBMS schedules (Alarm List, Virtual Signal List, Cable Schedule, Instrument Schedule, Drive and Actuator list).

#### **2.4.1.2 IT and Comms Building Modifications**

Currently there is a project to add Nicad batteries in the HVAC plant room and increase the size of the existing battery cabinets. The Existing IT & Comms building HVAC system must be assessed to determine the best solution to meet the new configuration. It is envisaged that ductwork and possibly additional split units may be required for the modification. The contractor is required to assess the system and carry out the HVAC modifications according to Eskom Standard listed in Section 1.2

#### **2.4.2 Medupi Package 35B (P35B)**

**Table 3. Medupi Package 35B (P35B) Buildings**

<b>Full Building Name</b>	<b>Building Description</b>
1. Fire & Medical	Fire & Medical
2. Facilities Substation	Facilities Substation
3. Canteen	Canteen
4. Chiller Yard	Chiller Yard
5. Administration Building	Administration Building
6. Compressor House North Building	Compressor House North
7. Ash Dump Workshop	Ash Dump Workshop
8. Office Block Building	Office Block Building

##### **2.4.2.1 Required Works for P35B Buildings**

The outstanding works for these buildings includes completion of data books, KKS certificates, snags and outstanding documentation as listed in Appendix A19.

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### 2.4.3 Medupi Package 35C (P35C)

**Table 4: Medupi Package 35C (P35C) Buildings**

Full Building Name	Building Description
1. Ash Dump Substation	-
2. Workshop and Stores Building	W&S Building

#### 2.4.3.1 Required Works for P35C Buildings

##### 2.4.3.1.1 Construction

Construction on this package is mainly complete except for the items below.

- The Contractor is to install primary filters on all emergency cooling louvers. The sizes of the openings are indicated on the drawings. This is applicable to Ash Dump Substation only.
- The Contractor is to cut and install access panels next to all motorized dampers (motorized supply air and motorized fresh air dampers). This is applicable to Ash Dump Substation only.
- The Contractor is to connect all make-up water system to the chilled water system directly from the fire or potable water line instead of going via the open expansion tanks. The contractor is to tie-in into the existing water connection points which are located within the various chilled water plants. This is applicable to Ash Dump Substation only.

The Contractor is to complete all outstanding snags that might exist in any building. The list of snags is included in Appendix A8.

##### 2.4.3.1.2 Service and Repair

The Contractor is to service and repair all P35C HVAC installations. The service and repair required is complete or full repairs from replacing broken equipment to performing major service of Chillers, AHUs, Fans, MCC, NCP, Actuators and Instruments as required by OEM as well as doing water treatment of the system. All records of service and repairs done are to be kept safe and handed to the Employer at handover stage.

##### 2.4.3.1.3 Commissioning

The Contractor is to fully commission all P35C HVAC installations as per table 4 after the service and repair has been done. Full commissioning includes but is not limited to commissioning of the water system, commissioning of the air system, commissioning of the MCC and NCP. It also includes commissioning of the monitoring interface between the HVAC system and Honeywell system as well as fire detection system interface between Honeywell system and HVAC system. Once commissioning has been concluded by the Contractor, witnessing of the commissioned systems needs to take place with TM. Upon successful witnessing of the commissioned system, the Contractor must issue Professional Engineer certificates for the HVAC works

##### 2.4.3.1.4 Documentation

Upon completion of the above i.e., construction, service & repair and commissioning of the systems, the Contractor is to submit the documentation below. This documentation includes but is not limited to:

- HVAC O&M manual and as-built drawings
- HVAC Spares List
- HVAC commissioning data

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- d) HVAC as built documentation including drawings.
- e) Permanent KKS Certificates (HVAC Mechanical, Electrical and C&I)
- f) HVAC data books (H1, H2, and H3) for HVAC Mechanical, Electrical and C&I
- g) HVAC CBMS schedules (Alarm List, Virtual Signal List, Cable Schedule, Instrument Schedule, Drive and Actuator list).

## **2.5 KKS CODING (CONFIGURATION MANAGEMENT)**

The Contractor is to code the plant structures, systems, and components according to the KKS (Kraftwerk-Kenzeichnungen System) as developed by the VGB.

The contractor is responsible for ensuring that he is fully familiar with the standard and concepts of KKS system. The contractor is responsible for codification of plant, equipment and components which is under his supply.

The specific code for each item of the plant, equipment, measuring point, junction box, cable etc. is to appear on all documents, drawings, maintenance schedules etc.

A list of all KKS codes used by the Contractor is to be provided according to Employer standard documentation. The allocation of the codes is to be approved by Employer.

All designs, testing, commissioning, operating maintenance and training documentation and databases are to be suitably and comprehensively marked, cross-referenced, and indexed with the allocated KKS codes.

### **2.5.1 Functional location of components**

The list of functional locations is to be arranged in Alfa-numeric order from 1st level KKS to 3rd level KKS number to show Hardware breakdown structure in specific plant area. The list as a minimum is to include all the maintenance significant items. It is assumed that items excluded, will automatically have a run-to-failure maintenance strategy and the impact of such failure would be insignificant. Where required, breakdown can be down to 4th level of KKS.

All equipment requires 3rd level KKS coding to comply with Eskom's specifications as detailed by Appendix A4 as follows:

- i. KKS Plant Labelling & Equipment Description Standard
- ii. Medupi Power Station User Requirement Specification
- iii. The Application of KKS Plant Coding

The Contractor is responsible for the following:

- i. Generating coding and obtaining Employer approval prior to installation.
- ii. Updating drawings (MCC & NCP – GA & SLD, AFS & P&ID)) to reflect approved codes and obtaining approval. (Note that QC inspections cannot proceed without these approved drawings)
- iii. Verifying current coding and applying missing labels.
- iv. Supplying and installing labels/mimic to specification (Aluminium, stainless steel, laminated PVC, or cable labels depending on application)
- v. Applying for inspection by Employer.
- vi. Rectifying any incorrect labels.
- vii. Obtaining individual KKS certificates for mechanical, electrical and C&I.

The Contractor is to employ the services of an experienced KKS engineer for this purpose.

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## **2.5.2 KKS Coding Current Status**

The status of the KKS coding is as follows:

### **2.5.2.1 Mechanical Plant**

For the mechanical equipment 3rd level coding has been implemented. For example, for an Air Handling Unit (AHU):

- i. Level 1 – Equipment (AHU, etc.) coded
- ii. Level 2 – Components (Fan, etc.) coded
- iii. Level 3 – Subcomponents (Fan belts, pulley, motor, etc.) coded

All equipment has been labelled as per the current Equipment Label Lists (ELL) as detailed by Appendix A5 & A6. These codes are to be verified and amended as may be required.

### **2.5.2.2 Electrical Plant**

The Motor Control Centres (MCC) and cabling have been coded to 2nd level as detailed by A5 & A6. The Contractor is to (MCC and cabling) bring this up to 3rd level:

- a) MCC
  - i. Level 1 – Main board – single code
  - ii. Level 2 – Tiers & individual buckets – coded on outside of panel
  - iii. Level 3 – Components inside MCC to be coded for example, (MCB's, contactors, terminals etc.)
- b) Cables
  - i. No additional
  - ii. Cables are all coded
  - iii. Cable cores are not coded (Cable schedules contains connection details)

### **2.5.2.3 NCP (C&I) installation**

The Network Control Panels (NCP) and cabling have been coded to 2nd level as detailed by A5 & A6. The Contractor is to bring this up to 3rd level:

- c) NCP
  - i. Level 1 – Main board – single code
  - ii. Level 2 – Tiers – coded on outside of panel
  - iii. Level 3 – Components inside NCP to be coded for example, (Controllers, relays, terminals etc.) A mimic table must be installed in panel door
- d) Cables
  - i. Coding done – partially installed
  - ii. Cable cores are not coded (Cable schedules contains connection details)

## **2.6 DEFECTS TO BE FIXED**

The Contractor is to rectify all defects and obtain sign off by Employer or their representative, thus enabling the completion of H2 Data Books. It must be noted that several Quality Verification Records (QVR) are outstanding, and these inspections will have to be completed.

### **2.6.1 Known Defects**

The Contractor is to rectify all known defects and obtain sign off by Employer or their representative as follows:

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- i. P35A&C TM Snag list, Appendix A8

### **2.6.2 Quality Verification Records**

The Quality Verification Records (QVR) to be completed are detailed Appendix A9

### **2.6.3 Contractor's responsibility**

In terms of the contract the Contractor will take on design responsibility with the appointed Designer. The inspection of the works by the Designer must be allowed for. Any repairs/rectifications will be the responsibility of the Contractor.

### **2.6.4 Cladded ducting (Insulation and capping of flanged joints)**

All exposed flange joints on cladded ducting and joints that could be damaged accidentally to be insulated and capped as detailed by Appendix A10.

## **2.7 COMPLETE DATA BOOKS TO EMPLOYER'S REQUIREMENTS**

All the existing data books are to be completed as part of quality control and assurance in accordance with Employer's Quality Management Specification as detailed by Appendix A9. The data books are divided into as follows:

- i. H1 Data Books (Factory Acceptance Test). These are complete and no further work is required.
- ii. H2 Data Books (Construction Data Book). Partially complete and the Contractor to complete to Employer's specification.
- iii. H3 Data Books (Testing and Commissioning Data Books for Entire HVAC System in each building). Contractor to complete to Employer's specification.

Document management and control of these data books is the responsibility of the Contractor and allowance is to be made for staff, processes, and site facilities.

Data books are to be submitted as follows:

- i. Three (3) Hard Copies all dividers to be cardboard with "Optitab"
- ii. Two (2) CD's or USB memory stick in PDF format, Native File, If Excel spread sheet e.g., ELL also to be included.

Drawings are to be submitted as follows:

- i. Two (2) A1 prints
- ii. Two (2) CD's or USB memory stick in PDF format, Native File, If Excel spread sheet e.g., ELL also to be included.

Method statements, equipment submittals and other correspondences are to be submitted in hard copy and PDF format in CD's or USB memory stick.

## **2.8 NCP AND CBMS INTERFACE**

The Contractor is to be responsible to interface the Network Control Panels (NCP) to the CBMS which is supplied by Honeywell. All NCP's have been installed and are using Distech equipment. For further details, refer to the Equipment Submissions and drawings in Appendix A5 & A6. The Sample schedules Alarm Management Systems Guideline has also been referenced in Appendix A11 and A12 respectively.

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### **2.8.1 Engineering and Planning Phase of NCP and CBMS Interface**

The Contractor is to use the latest approved P&ID and AFS drawings to complete 5 x C&I schedules per building as follows:

- i. Alarm list
- ii. Cable schedules
- iii. Driver and Actuator schedule
- iv. Virtual signal list
- v. Instrument schedule

IP addresses will be supplied by Honeywell for the devices described on the Device Instance List.

ALL MCC and NCP related documents, drawings and schedules are required to be fully KKS coded to Level 3. This 3<sup>rd</sup> level coding of the MCC and NCP is required to complete the 5 x C&I schedules noted above. Engineering (Contractor) to ensure that the SLD's are updated to reflect the as-built panels in accordance with the specification before being sent to Employer's Configuration for KKS coding. Once documents are approved it is the Contractor's responsibility to physically label (KKS code) the MCC or NCP internal components.

The Contractor is to apply for Employer to inspect and sign off all labelling. The completed 5 x C&I schedules per building must be submitted to Employer's Configuration Team for KKS coding of the soft signals and alarms.

#### **2.8.1.1 Alarm Schedule**

Alarm rationalisation will be the combined responsibility of TM Engineering and the Contractor's designer. The Contractor's designer will review the Alarm and Virtual Signal Schedule submissions primarily for completeness of alarms, alarm priorities and rationalisation.

#### **2.8.1.2 Cable Schedule**

The cable schedule already forms part of the NCP pack of documents. This format is acceptable and no further information is required.

#### **2.8.1.3 Driver and Actuator schedule**

Driver and actuator schedules are to include the following, however not limited to:

- i. Pump motors
- ii. Fan motors
- iii. Chiller pumps
- iv. Chiller fans
- v. Actuated Dampers

#### **2.8.1.4 Virtual Signal List**

All monitoring and control signals must be listed.

#### **2.8.1.5 Instrument Schedule**

All instruments on AFS, P&ID's and chiller P&ID's are to be referenced as detailed in Appendix A5 & A6.

### **2.8.2 Implementation of NCP and CBMS Interface**

Once the MCC and NCP 3<sup>rd</sup> level KKS codes are approved, labels or mimics will be produced and physically installed on the MCC or NCP internal components.

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The Contractor is to update the MCC and NCP document pack with the approved KKS signal codes as received on the 5 x C&I schedules.

The KKS signal codes must be implemented in the NCP software and HMI graphics. HMI Graphics (NCP touch screen) is to be configured as follows:

- a) The latest AFS and P&ID drawings will be used to update the HMI homepage graphics.
- b) ALL equipment on the HMI to have KKS codes. The latest approved equipment lists must be used.
- c) The KKS codes on the HMI can be displayed either in the bottom corner of the HMI or to be displayed when hovered over with mouse. Last option is the preference of Eskom Generation.
- d) ALL equipment descriptions as per the latest approved equipment lists. Descriptions can be shortened since the faceplate of the HMI will contain building/location name and system name.
- e) A clear description is required for each alarm state especially for multi-state variables.
- f) Legend to be generated on HMI with the following:
  - i. Green: On or Running
  - ii. Red: Alarm
  - iii. Grey: Off
  - iv. Purple: Override
  - v. Orange: Offline

Interface to CBMS (Honeywell EBI) and the HVAC P35A&C NCP panel controllers will be via BACnet/IP communication protocol. The KKS signal code must be transmitted to the CBMS.

## **2.9 TESTING, COMMISSIONING AND CORRECTION OF FAULTS**

The HVAC systems for all buildings has reached “Cold Air” and are operating without the control system. Each building must be fully commissioned. A commissioning procedure has been developed and approved in the previous contract.

The commissioning process is divided as follows:

- i. Water distribution system
- ii. Air distribution system
- iii. HVAC operation (functionality)

The Commissioning and hand over procedure details the approved process as per Appendix A13. This procedure details the requirements of the Employer and contains the following:

- i. Flow diagram
- ii. System description
- iii. Method statements
- iv. Cold commissioning definition and requirements
- v. Hot commissioning definition and requirements
- vi. Hand over requirements

Appendix A18 comprise of the following documents however not limited to:

- a) Eskom Commissioning (Safety Clearance) Specification
- b) ITP-HVAC-COM1-001 – water
- c) ITP-HVAC-COM2-001 – air
- d) ITP-HVAC-COM3-001 – functionality
- e) COM-HVAC-001-1 Rev H – Commissioning and Hand Over Procedure
- f) ENV-QA-COM-010 Rev 0 – Water Distribution data book index
- g) ENV-QA-COM-011 Rev 0 – Air distribution data book index
- h) ENV-QA-COM-012 Rev 0 – Operation data book index
- i) Building specific drawings:

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- i. Airflow schematics
- ii. Piping and Instrumentation diagrams
- iii. Chiller piping and instrumentation diagrams
- iv. Cause & effect matrix
- v. MCC pack
- vi. NCP pack
- vii. Layout drawings

## **2.10 COMPLETION & HANDOVER**

The contract is deemed to be complete when the following has been completed in accordance with the scope of work:

- i. The Plant is erected and commissioned. The plant and all documentation, drawings are coded and labelled.
- ii. Signed erection and safety clearance certificates.
- iii. The final as built drawings have been submitted.
- iv. All documentation has been submitted including testing reports and the associated certificates received.
- v. All Quality Control Plan (QCP) documentation received.
- vi. Final technical, operating and maintenance manuals delivered.
- vii. Training and transfer of technology received.
- viii. All spare lists and special tools have been supplied.

### **2.10.1 Training and Transfer of Technology**

At 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 training manual has been approved on the previous contract as detailed by Appendix A19; and further referenced in Appendix A3. The training is to comprise of the following:

- i. General HVAC training
- ii. Building Specific Training

The following are the minimum requirements for each session:

- i. Discuss each type of equipment in detail including chilled water generators, chillers with on-board pumps, AHU's, fans, pumps, ducting, attenuators, humidifiers, duct heaters, MCC panel, NCP panel, air terminals. Show PowerPoint slides with photos.
- ii. Supplier literature.
- iii. Service and maintenance requirements.
- iv. Operating and maintenance manuals.
- v. Describe how various maintenance procedures are performed.
- vi. Identify common tools used to safely maintain the equipment.
- vii. Identify instruments used to take measurements.
- viii. OEM Supplier presentation.
- ix. Troubleshooting

The following locations must be covered under the training:

- i. P35A Buildings
- ii. P35C Buildings

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iii. Cable Tunnel Ventilation

The training is to be configured in six modules as follows. These are classroom-based modules however a few performance based tasks will be required. The instructor will expose the trainees to an active job site. Ensure that trainees possess and use the required PPE during any exposure to these types of settings.

**Table 5: HVAC Training Modules**

Module Number	Training Description	Training Completed
1. Module 1	Provides a broad introduction to the world of HVAC. The most basic operating principles of HVAC systems are presented. Introduction to HVAC at Medupi Power Station Package 35A&C with the following objectives: i. Explain the basic principles of heating, ventilation, air conditioning and refrigeration. ii. Discuss the design criteria used. iii. Discuss the sites and locations. iv. Discuss the types of HVAC systems used at Medupi Power Station	Yes
2. Module 2	Different types of equipment used at Medupi, with the objective of Introducing the types of HVAC equipment.	Yes
3. Module 3	MCC panel and electrical distribution to HVAC equipment	No
4. Module 4	NCP panel and interface to HVAC equipment. NCP to CBMS interface	No
5. Module 5	Chiller, service, and interface training (Trane, Carrier, Ciat)	No
6. Module 6	HVAC Equipment which includes AHU's, Fans & Attenuators, Humidifiers, duct heaters, pumps	No

## **2.11 OPERATING AND MAINTENANCE MANUALS**

The Contractor is to prepare and submit a detailed Operating & Maintenance Manual for each building. The format and template for these manuals have been approved in the previous contract as detailed by Appendix A14.

## **2.12 DELIVERABLES**

The Contractor will provide sufficient documentation at Handover to the Employer for safe and sustainable maintenance and operation. This will include but not limited to:

- a) HVAC As built drawings, operating manuals, and maintenance schedules
- b) HVAC O&M Manuals per building
- c) HVAC Spare Lists
- d) Production of CBMS Schedules for each Building
  - i. Cable Schedule
  - ii. Instrument Schedule
  - iii. Drive and Actuator Schedule
  - iv. Virtual Signal List
  - v. Alarm List
- e) Completion of CBMS Interface with CBMS Contractor.
- f) Completion of HVAC and Fire Detection Interface with CBMS Contractor.

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- g) Completion of NCP Installations where applicable as per scope of work.
- h) Commissioning of all HVAC systems where applicable.
- i) Closing out of defects (manufacturing, construction, and commissioning defects).
- j) Completion and handing over of Data Books
  - i. H1 - Manufacturing Data Books (MCC and NCP)
  - ii. H2 – Construction Data Books (HVAC Mechanical, Electrical and C&I)
  - iii. H3 – Commissioning Data Books (Entire HVAC System in each building)
- k) Issuing of HVAC Professional Engineering Certificates for Completed works per building.
- l) Issuing out of Natives drawings (CAD, DGN, DWG format, etc.)
- m) Civil and structural drawings in As-built status
- n) Professional Engineering Certificates for all constructed and/or modified civil structures
- o) All calculation reports for designs and/or modifications signed by the Contractor's registered professional

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### 3. AUTHORISATION

Name & Surname	Designation
Bruce Tyson	Lead Discipline Engineer, Low Pressure Services
Nkosi Ndika	Chief Technologist, Asset Management
Rofhiwa Nemutandani	Project Engineering Manager
Antonie Coetzee	Project Manager
Sibusiso Mthombothi	Configuration Management
Mpho Ramunenyiwa	Electrical Engineering
Zandisiwe Majola	Electrical Engineering
Mhlengi Sithole	C&I Engineering
Marius Van Niekerk	Civil & Structural Engineering
Mufarisi Manyuha	Medupi Auxiliary Engineering
Hanlie Joubert	Fire Engineering, Low Pressure Services

### 4. REVISIONS

Date	Rev.	Compiler	Remarks
November 2020	0	P Gangan	Draft version for review by Engineering Team
November 2020	0.1	P Gangan	Document updated to incorporate various stakeholders' inputs and comments
November 2020	0.2	P Gangan	Document updated to incorporate various stakeholders' inputs and detailed appendices
January 2021	1	P Gangan	Final Document for Authorisation and Publication
July 2021	2	P Gangan	Updated revision after QS team review
August 2021	3	P Gangan	Package 08 scope removed. Tunnel Ventilation added
March 2022	4	P Gangan	P35B documentation, IT & Comms Mod added
May 2022	5	P Gangan	Maintenance scope removed- repairs and service included

### 5. DEVELOPMENT TEAM

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

- Nkosi Ndika
- Antonie Coetzee
- Sibusiso Mthombothi
- Mpho Ramunenyiwa
- Zandisiwe Majola
- Mhlengi Sithole
- Marius Van Niekerk
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## 6. ACKNOWLEDGEMENTS

We would like to acknowledge Site Engineering as well as Power Station operating and maintenance departments for their support during data gathering and plant walk downs.

## 7. APPENDICES

In addition to the scope of work and other related documents applicable to the Contract, the following appendices are issued by the employer, and they show general layout of all equipment and distribution systems, complete with schematic arrangements. These, together with the scope of work give sufficient information to enable the Contractor to estimate the cost and to determine how the system installation is to be completed, tested, balanced, inspected, operated, serviced, and maintained.

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

**Table 6: Appendices issued by Employer**

<b>Appendix</b>	<b>Title</b>
A1	Activity schedule
A2	Recommended Organisational Structure
A3	Service & Repair Activity Schedules
A4	Major HVAC Equipment List
A5	Equipment Submittal Schedule
A6	Drawings
A7	Designer Scope of work & division of Responsibilities
A8	Defects Lists
A9	Quality Requirements
A10	Supply Air Double Skin Duct Capping Detail
A11	CBMS Schedules
A12	Alarm Management System Guideline
A13	Commissioning & Handover Procedure
A14	Operation & Maintenance Manual - Approved Format
A15	KKS Specifications
A16	General HVAC Specification
A17	Limit of Supply and Services (LOSS)
A18	Unit 1-6 Aux to ACC Substation Fire Protection Layouts
A19	P35B HVAC Works Status 25-11-2021

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