Eskom	Technical Specification	Generations

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Auxiliary Engineering	Auxiliary Engineering	
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1. INTRODUCTION

The compressed air plant provides control air and service air to the power station. The compressors at Camden Power Station are housed in two houses, namely: the East compressor house and the West compressor house. The control air components are housed in both the east compressor house and the west compressor house. Three electrical oil flooded screw compressors, and an oil flooded screw diesel compressor are housed in the east compressor house and two electrical compressors are housed in the west compressor house. The service air compressor is housed in the west compressor house. The currently installed electrical compressors are obsolete and needs to be upgrade. The upgrade includes the following:

Design: The detailed mechanical, electrical, and civil design and engineering of the new control air compressors, service air compressor, all other related equipment, and auxiliaries, called a compressor train. The design and engineering of the Control and Instrumentation (C&I) interfacing the compressor to DCS will be carried out by a third party working in collaboration with the Contractor. The design consists of a detailed design report and all related drawings and specifications. The detailed design report is done using 240-49910707 - Detail Design Report Template.

Manufacturing: ONLY after detailed design acceptance by the Project Manager, the procurement, manufacturing, fabrication, quality control and assurance, supply of the compressors, and all related equipment, material and equipment supply, testing and delivery to and offloading at Camden Power Station.

Decommissioning and Removal: The Contractor is responsible for the decommissioning and removal of the existing compressors, instrumentation, electrical board internals, fuses/breakers, and all associated cabling from the plant. The work shall be carried out in a phased approach and in accordance with applicable Eskom standards. The decommissioning of all the related equipment, which will be replaced with the new compressors as part of the contract.

Installation: The Contractor is responsible for the installation of five new control air compressors, one service air compressor, and all associated equipment and auxiliaries in their designated positions within the Plant.

Main drive motors and soft starters: The detailed design, manufacturing, testing, supplying, delivering, offloading, installation and commissioning of each control air compressor's main drive motor, which is supplied in tandem with the compressor as a complete assembly which includes a human machine interface (HMI) or a controller that features navigation buttons and an intuitive, high resolution colour, display for easy, compressor control, an emergency stop button, a soft starter and all required cabling.

Integration: All work related to integrate and interface with existing systems.

Testing and commissioning: All required testing and cold and hot commissioning of the compressor trains.

Hand-over: Handing over, and correcting defects during the guarantee period.

The removal and installation of each compressor is conducted in a phased approach i.e. one compressor train at a time, to ensure continuous production of control air by the remaining compressors. The works listed below are not necessarily in a sequence or preference, which the Contractor must adhere to hence, the Contractor considers all requirements in preparing and submitting his own plan/method statement for review and acceptance by the Project Manager. It

is also possible, that planning may change during the works should the Employer deem it necessary and the Contractor re-aligns the programme accordingly.

2. SUPPORTING CLAUSES

2.1 SCOPE

The scope is for the design, procurement, supply, installation and commissioning of the entire engineering works to ensure fully functional replaced electrical compressors, herein after referred to as the works.

2.1.1 Purpose

The purpose of this specification is to provide the necessary requirements for the replacement of the Camden power Station electrical compressors.

2.1.2 Applicability

This document shall apply throughout Eskom Group Technology and Camden Power station.

2.2 NORMATIVE / INFORMATIVE REFERENCES

2.2.1 Normative

[1]	32-727	Eskom Safety, Health, Environment and Quality (SHEQ) Policy
[2]	240-53114186	Document and Record Management Procedure
[3]	240-54179170	Technical Documentation Classification and Designation Standard
[4]	240-56227443 Standard.	Generation requirements for control and power cables for power stations
[5]	240-56227927	Electrical load list template
[6]	240-56536505	Hazardous Locations Standard
[7]	240-56355754	Field Instrument Installation Standard
[8]	240-56356376	On-Site Commissioning for Low Pressure Systems Standard
[9]	240-56356396	Earthing and Lightning Protection Standard
[10]	240-56360387	Storage of Power Station Electric Motors.
[11]	240-56361435	Transport of Power Station Electric Motors.
[12]	240-56364545	Structures and Engineering standards
[13]	240-65459834	Documentation Management Review and Handover Procedure
[14]	240-86973501	Engineering Drawing Standards
[15]	240-93576498	KKS Coding Standard
[16]	240-105929225	Compressed Air System Standard
[17]	240-123801640	Specification for Low Pressure Pipelines
[18]	SANS 347 equipment	Categorization and conformity assessment criteria for all pressure
[19]	ISO 9001	Quality Management Systems.

[20] ISO 14001 Environmental Management Systems

[21] Occupational Health and Safety Act, 1993 (Act No. 85 of 1993)

[22] Plant layout drawings - See drawing list in appendix A.

2.2.2 Informative

[23] 32-245 Eskom Waste Management Standard

[24] 240-49230046 Failure Mode and Effects Analysis Guideline

[25] 240-49230111 Hazard and Operability Analysis Guideline

[26] 240-53113685 Design Review Procedure

[27] 240-53114026 Project Engineering Change Management

[28] 240-56355843 Pressure Measurement Systems Installation Standard

[29] 240-56355782 Human Machine interface Design requirements Standard

[30] 240-65459834 Documentation Management Review and Handover Procedure

[31] 240-56355843 Pressure Measurement Systems Installation Standard

[32] 240-56355888 Temperature Measurement Systems Installation Standard

[33] 240-56364545 Structural Design and Engineering Standard

[34] 240-57127955 Geotechnical and Foundation Engineering Standard

[35] 240-105658000 Eskom Supplier Quality Management Specification

[36] 240-107981296 Constructability Assessment Guideline

[37] 240-71432150- Plant Labelling Standard

[38] 240-109607332 Eskom Plant Labelling Abbreviation Standard

[39] 240-8673501 Engineering Drawing Standard.

[40] 240-109607332 Eskom Plant Labelling Abbreviation Standard

[41] 240-124341168 Instruction Project Plant Specific Technical Documents - Handover Works

[42] 240-144332407 - Guideline for Eskom Power Stations Concrete Remedial Work

[43] SANS 62 - Steel pipes and fittings 150mmm and below

[44] ISO 10007: Guidelines for Configuration Management

2.3 DEFINITIONS

Definition	Description
Air Quality	Quality of compressed air is guided by the degree of dryness and filtration needed and acceptable contaminant level for the end users. Classes for particles, liquid water and total oil are defined
Compressed Air	Compressed air in this case is air at a pressure of greater than 1.5Bar
Compressor Capacity	Capacity is m^3/min at a particular inlet reference condition, including temperature, pressure, and relative humidity. **Note that the different manufacturers are using various reference conditions (inlet temperature, pressure, and relative humidity) when quoting compressed air equipment should specifically be confirmed and not assumed*
Compressor train	Includes an inlet filter, compressor with electrical/diesel motor, switchgear, and control system, pre filter, air dryer, post filter and all necessary isolating, control, blow off and non- return valves, up to but excluding the air receiver inlet manifold
Dewpoint	The temperature of a given pressure at which a relative humidity of 100% will be reached. At this point, the water vapour and partial pressures are equal, and condensation will take place if the temperature is further reduced or if the pressure increases
Free air delivery	It is the volume of uncompressed air at inlet conditions that is delivered by the compressor.
Kraftwerk Kennzeichen System	A type of Identification System for Power Stations which serves to identify plants, systems, sub-systems, sub-systems of plants and items of equipment in any type of power station according to task, type, and location. Used by Engineering disciplines for planning, licensing, construction, operation, and maintenance.
Labelling	Identification of process, structure, point of installation, equipment, or component by means of approved fixing methods, material, and ergonomic requirements.
Maintenance	A combination of all technical, administrative, and managerial actions during the lifecycle of an item intended to retain it in, or restore it to, a condition in which it can perform its required function.
Maintenance Philosophy	The principal approach decided upon for performing maintenance, such as pro-active or re-active maintenance.
Maintenance Strategy	The type of maintenance selected for specific asset / plant and equipment, such as time or condition-based maintenance, corrective, or preventative maintenance.
Maintenance Schedule	The timing of the Maintenance Plan information stipulating when in the calendar year, work needs to be done.
Normal cubic meter	It is the volume of air at 0ºC, 1.01325bar (101.325kPa) (atmospheric pressure at sea level) and 0% Relative Humidity (completely dry air). **Note that the different manufacturers are using various reference conditions (inlet temperature, pressure, and relative humidity) when quoting compressed air equipment should specifically be confirmed and not assumed* Normal conditions for Matimba to be used as: 85 kPa (abs), 25°C and 60% RH

Obsolescence	Compressors and dryers are declared obsolete by the OEM when the compressor and dryers are no longer in production. The result is that although most parts are still available, the large castings for the casings will not be available as the moulds have been destroyed.
Pressure dew point temperature	Measured at the last point in the air treatment process, typically downstream of the after filter after the air dryer.
Redundancy	Use of more than one independent means to accomplish a given function
Relative Humidity	The ratio of the partial pressure of a vapour to the vapour saturation pressure at the dry bulb temperature of a mixture.
Standard cubic meters	Which refers to the conditions of the flow measurement…i.e.: 100 kPa and 20ºC. **Note that the different manufacturers are using various reference conditions (inlet temperature, pressure, and relative humidity) when quoting compressed air equipment should specifically be confirmed and not assumed*
Surge	The reversal of flow within a dynamic compressor that takes place when the capacity being handled is reduced to a point where insufficient pressure is being generated to maintain flow
System Pressure	The air pressure of a particular class of compressed air as measured at the air receiver directly after the dyers. Where multiple receivers are in service, the system pressure is average pressure of the receivers in service
Testing	All activities required determining the actual performance or condition of an item.
Vapour	A gas that is at a temperature below its critical temperature and that, therefore, can be liquefied by isothermal compression

2.3.1 Classification

Controlled Disclosure: Controlled Disclosure to external parties (either enforced by law, or discretionary).

2.4 ABBREVIATIONS

Abbreviation & Acronyms	Description
AIA	Approved Inspection Authority
Aux	Auxiliary
ASTM	American Society for Testing and Materials
BS	British Standard
C&I	Control & Instrumentation
CM	Configuration Management
dBA	A-weighted decibels,
DCS	Distributed Control System
ECM	Engineering Change Management
ECSA	Engineering Council of South Africa
EN	European Standard
FAD	Free Air Delivery *For Matimba: FAD conditions: 85kPa(abs), 25°C and 60% RH, with flow expressed as dry air*
FAT	Factory Acceptance Test

HMI	Human Machine Interface
ISO	International Standards Organisation
ITP	Inspection and Test Plan
KKS	Kraftwerk Kennzeichen System (Plant Codification System)
LDE	Lead Design Engineer
LPS	Low Pressure Services
MM	Millimetre
MV	Medium Voltage
N/A	Not Applicable
NB	Nominal Bore
NDT	Non-Destructive Testing
Nm3/min	Normal cubic meter per minute
NRV	Non-Return valve
OEM	Original Equipment Manufacturer
OHSA	Occupational Health and Safety Act
OPCR	Outside Plant Control Room
PDP	Pressure Dew Point
PER	Pressure Equipment Regulations
PFD	Process Flow Diagram
PLC	Programmable Logic Controller
PLCM	Project Life Cycle Model
P&ID	Piping and Instrumentation Diagram
PLND	Pneumatic no-loss drain
PPE (Personal Protective Equipment)	Personal Protective Equipment
ppm	Parts per million, a way of quantifying small concentrations, usually mass.
Q	Flow rate in [kg/s] or [kg/hr]
QA	Quality Assurance
QC	Quality Control
QCP	Quality Control Plan
RH	Relative Humidity
SANS	South African National Standard
SAT (SITE ACCEPTANCE TEST)	Site Acceptance Test
SI	International System of Units
SSB	Station Services Building
SOW	Scope of Work
T	Temperature in [ºC] or [K]
TDS	Technical Data Sheet
VDSS	Vendor Document Submittal Schedule
VSD	Variable speed drive

2.5 ROLES AND RESPONSIBILITIES

Compiler: The document compiler is responsible for ensuring that this document is up-to-date and that this document is not a duplication of an existing documentation, regarding the document's objectives and content.

Functional Responsibility: The Functional Responsible Person shall determine if the document is fit for purpose before the document is submitted for authorisation.

Authoriser: The document authoriser is a duly delegated person with the responsibility to review the document for alignment to business strategy, policy, objectives, and requirements. He/she shall authorise the release and application of the document.

The following roles and responsibilities will be applicable to this project:

Auxiliary Engineering Department:
- Provide technical specifications and SOW for compressor replacement and installation.
- Monitor and approve any activities related to the project.
- Update all related Mechanical drawings and documents related to the modification.
- Ensure the maintenance strategy is kept up to date and incorporate the project changes.
- Function as compiler of the document and ensure that this document is up to date.

Environmental Management Department
- Provision of environmental legal requirements to be part of the replacement scope,
- Review the scope and facilitate processes for environmental approvals,
- Specify the requirements for the recovery or disposal of scraped compressors.

Electrical Engineering department:
- Provide technical specifications and requirements on the SOW for electrical supply and installation.
- Monitor and approve any electrical activities related to the project.
- Update all related Electrical drawings and documents related to the modification.
- Ensure the electrical maintenance strategy is kept up to date.

C&I Engineering:
- Provide technical specifications and requirements for the C&I SOW interface to the DCS
- Provide guidance on control equipment and installations.
- Review and approve any C&I system activities related to the project.
- Update all related C&I drawings and documents related to the modification.
- Incorporate the new installation into the HMI at OPCR
- Ensure the C&I maintenance strategy is kept up to date.

Civil Engineering:
- Provide technical specifications and requirements on the SOW for civil aspects of the installations.
- Provide guidance on civil equipment and installations.
- Monitor and approve any civil activities related to the project.
- Update all related Civil drawings and documents related to the modification.
- Ensure the Civil maintenance strategy is kept up to date.

Outside Plant Mechanical Maintenance Department:
- Assist with the installation of the mechanical related aspects of the modification.
- Assist with information on maintenance needed on the equipment.
- Provide training requirements for maintenance.
- Hiring compressors for redundancy during installation or project execution
- Attend training and learning the maintenance aspects of the plant.

Electrical Maintenance Department:
- Assist with the installation and connection of electrical related aspects of the modification.
- Assist with information on maintenance needed on the equipment.
- Provide training requirements for electrical maintenance.

C&I Maintenance Department:
- Assist with the installation and control related aspects of the modification, including PTW as may be required by the works.
- Assist with information on maintenance needed on the equipment.
- Assist on the project as may be required.

Civil Maintenance Department:
- Assist with civil maintenance related aspects of the modification and support where necessary.

Project Management Department:
- Orchestrate non-technical project aspects, contractor access and requirements, relevant contract documentation.
- Ensure project is kept on time and within budget.

Finance Department:
- Ensure that the financial aspects of the project are in place.

Commercial/Procurement Department:
- Ensure that all procurement aspects are in place.

Operating Department
- Provide operations information to include in the philosophies and strategies.
- Provide training requirements for the operational department.

Production department
- Orchestrate plant production and running during project installation.
- Mediate between the distinct functions and keep all working towards the project goals.

Stores
- Procure and maintain stock levels of spares for the compressors.
- Manage refurbish able stock items to have spares and stock available as always specified.
- Safekeeping of stock

Quality Department
- Verify documentation and regulations.

Documentation Management
- Keep documents and register drawings.

2.6 PROCESS FOR MONITORING

This document will be reviewed as per the Design Review Procedure 240-53113685.

The Engineering Change Management (ECM) procedure will be used for the duration of this project.

- The specified engineering activities and effort will be reviewed and either approved or revised.
- Correct and adequate engineering processes, systems, tools, packages, and disciplines are selected and specified.

2.7 UNITS FOR MEASUREMENT

The units of measurement are the SI system.

3. DESCRIPTION OF THE WORKS

3.1 EMPLOYER'S OBJECTIVES AND PURPOSE OF THE WORKS

Upon the start date, the Contractor studies the Employer's Works Information, prepares, and submits a detailed work methodology and draft Quality Control Plan (QCP) to the Project Manager, for each section of works, to obtain acceptance before each activity is started.

The Contractor liaises with all the Employer's project team such as engineers, quality controller/s, plant specialist/s etc. and requests clarification from the Project Manager immediately if any discrepancy or vagueness is discovered in the Works Information, which was not clarified during the tender period. The Contractor identifies all such discrepancies and vague areas of scope within the first twelve (12) weeks of the contract and submits them for further clarification to the Employer who reviews and provides decisions on those issues.

3.1.1 The Purpose of the Works

Address the issue of obsolescence of the control air and service compressors at Camden Power Station.

Ensure that Camden Power Station has reliable compressors with OEM support for the equipment for the remainder of the power station life span.

3.1.2 Camden Power Station Compressor design

The Contractor designs the new control air and service air system as documented in Section 4, Engineering and the Contractor's Design. The Contractor shall commence with procurement, manufacturing, and fabrication activities only after the Project Manager has formally accepted the Contractor's design.

3.1.3 Manufacturing and Fabrication of the New Control Air Compressor System

The Contractor submits the manufacturing and fabrication Quality Control Plans (QCP's) detailing activities listed as per the activities in the works for approval by the Project Manager before any manufacturing and fabrication work starts.

3.1.4 Transportation, storage and Preservation of Compressors and Related Equipment

The Contractor submits a storage and preservation procedure for review and acceptance by the Project Manager. This procedure ensures that the compressors are kept in good condition from the time of manufacture until they are put into service.

The equipment is stored inside a building or container or in ventilated covers. The storage area is clean, dry and dust-free.

The Contractor transports all electrical motors complying with the standard 240-56361435 - Transport of Power Station Electric Motors and stores and preserves all electrical motors complying with section 10.1 of MAINT/EMD 101 44 – Storage of Power Station Electrical Motors.

3.1.5 Decommissioning and Removal of Existing Plant

The Contractor studies, understands and documents all the hazards of working on the compressor plant and compiles a risk assessment and puts all necessary precautions and mitigations in place.

Before the removal of any Plant and Materials, the Contractor compiles a comprehensive list containing all Plant and Materials to be removed. As a minimum, this list includes the serial numbers, model

numbers and the location at which the Plant and Materials were installed. This list is submitted to the Project Manager for acceptance.

The Contractor submits a proposal outlining the planned method for use to remove the existing and installation of the new compressor's trains for the Project Manager's review and acceptance. Only after acceptance is given in writing, may the removal and installation begin.

Apply for a permit to enable the approval and the commencement of work on the related plant.

The removal and re-installation of the plant affected is the responsibility of the Contractor. The Contractor securely and safely protects the pipework remaining in service to ensure that they are not damaged during installation. Any damages to the plant may result in serious safety and production-related incidents and must be avoided.

All plant removed for access is included in the respective activities in the QCP/ITP to ensure that all plant/apparatus is properly re-installed.

3.1.6 Installation of New Compressors

The Contractor supplies and fits new fixtures, fittings and hold-down bolts and secures the new compressors into position. Rigging of compressors or any other equipment is done by the Contractor.

The adjacent plant and equipment may not be modified without written permission from the Project Manager.

The compressors are tested under normal operating conditions, which include vibrations.

The Contractor provides all tools, software and licenses required for installation, maintenance, configuration and calibration of the compressors and associated.

The Contractor provides calibration certificates for all instrumentation provided as part of the works. The calibration is performed by either a SANAS or any other internationally accredited certification/calibration laboratory, capable of certifying temperature measurement instruments. The calibration certificates are accompanied by a SANAS accretion certificate.

The Contractor provides Certificates of Compliance for electrical work completed.

3.2 EXISTING SYSTEM

3.2.1 Process/Mechanical description

The compressed air plant provides control air and service air to the power station. The compressors at Camden Power Station are housed in two houses, namely: the East compressor house and the West compressor house.

The control air components are housed in both the East and West compressor houses. The East compressor house contains three electrical oil-flooded screw compressors and one oil-flooded screw diesel compressor, while the West compressor house houses two electrical compressors.

The service air compressor is housed in the west compressor house.

The compressors intake atmospheric air and compress it using a single-stage oil-flooded screw mechanism. Following compression, the air temperature is reduced, and moisture is removed via intercoolers. The condensed water is discharged through automatic water traps. Compressor output is regulated by modulating the inlet and blow-off valves in accordance with the operating philosophy.

3.2.1.1 East compressor House

The east compressor house, housed the following control air components:

- Three electric rotary screw compressors
- One Diesel Driven Screw Compressor
- Four Horizontal Air Receivers
- One Heatless Regenerating air dryers' systems
- Three Microfilter

3.2.1.2 West compressor house

The west compressor house, housed the following control air components:

Control Air system

- Two electric rotary screw compressors
- Two Horizontal Air Receivers
- One Heatless Regenerating air dryers
- Three Microfilter

Service Air system

- One electric rotary screw compressor
- One Vertical Air Receivers
- One Heated Regenerating air dryers
- Two Microfilter

3.2.2 Control system description

The current control system, implemented in the localised PLC, maintains constant air pressure in the air receiver's by means of starting and stopping the compressors.

3.3 SCOPE OF WORK

- Replacement of five electric rotary screw compressors dedicated to control air system.
- Replacement of one electric rotary screw compressors dedicated to service air system.
- Developing of a new control and protection philosophy which will be used to design the C&I control into the DCS. (To be done by a third party).
- Civil limited to the assessment, modification, or reconstruction of compressor foundations and ducting exiting the building.

3.3.1 Mechanical

Compressors train:

The mechanical limit starts at the compressor to the discharge pipe that connects to the air receivers.

3.3.2 C&I

The compressor must come with an onboard controller. Provide for the interface of each compressor to the DCS including ,Inlet and outlet pressure of compressors, Oil temperature, discharge flow rate, discharge temperature.

3.3.3 Electrical

The electrical limit is from the supply switchgear to the respective loads.

3.3.4 Civil

The civil limits for this project:

- All modification done on plinths and ducting.

4. ENGINEERING AND THE *CONTRACTOR'S* DESIGN

The *Contractor* submits the documents specified in the VDSS to the *Project Manager* for acceptance.

4.1 *EMPLOYER'S* REQUIREMENTS/DESIGN

The following plant performance are required:

4.1.1 Plant Requirement/Design

The plant will comprise five electric rotary screw compressors dedicated to delivering control air and one additional electric rotary screw compressor for supplying service air. Each control air compressor will have a free air delivery (FAD) of at least 23.5 m^3/min, operating within a working pressure range of 560 kPa to 730 kPa. The service air compressor will have a free air delivery of at least 35 m^3/min, also operating within the same pressure range of 560 kPa to 730 kPa. All compressors will be installed at the existing compressor house locations in line with the current plant configuration. The electrical compressors will receive power from various 380 V substation boards as detailed below:

380V AC SUBSTATION BOARD 1:

- East Electrical Compressor 1

380V AC SUBSTATION BOARD 2:

- East Electrical Compressor 2
- East Electrical Compressor 3

380V AC SUBSTATION BOARD 3:

- West Electrical Compressor 4

380V AC SUBSTATION BOARD 4:

- West Electrical Compressor 5
- West Electrical Compressor 6

No additional air receivers will be required, as the running capacity will remain the same.

The compressor houses are naturally ventilated by means of louvres and open areas. Fire Protection is provided by permanent fire protection, extinguishers and hydrants located inside and close to the compressor's houses. The design is to include exhaust extraction duct for the six electrical compressors (5 electric rotary screw compressors for control air and one electric rotary screw compressors for service air).

The operation of the plant shall be fully automatic with system start/stop initiated from the Control room as well as the onboard control panel (cooperation with others for the interfacing of the compressors to the DCS will be crucial). In normal operation the supply of compressed air will be from three electrical

compressors on duty with two on standby dedicated to supply control air and one (1) service air dedicated to service operations. The diesel compressors remain as standby in the event of low system air pressure or on failure of any of the running electrical compressors. If the system pressure drops below 600 kPa an additional compressor has to start to stabilize the system pressure at 600 - 660 kPa. If the system pressure drops to 580 kPa the diesel compressor automatically start. At 680 kPa, the safety relief valves on the receivers will lift, thus the plant should not be operated above 660 kPa. The duty cycle and setting for the cutting in of compressor to be incorporated in the final detail design and agreed by all parties. The compressors and drier pair shall interface with the DCS for monitoring, control, and alarming. The interfacing to DCS be done by a third party.

The following signals of the new electric compressors to be interfaced to the DCS:

- Compressor Online indication
- Compressor Pressure Discharge per compressor
- Compressor Temperature Discharge
- Compressor Inlet Valve Position
- Compressor Discharge Flow per compressor
- Mode of Operation
- Oil temperature indication per compressor
- Suction differential pressure per compressor

The following signal to be interfaced to the DCS:

- System Pressure discharge pressure (already interfaced)
- System discharge flow rate (one off)
- Dryer Pressure Discharge (three off)
- Dryer Dew point (three off)

4.1.1.1 Operating Philosophy

The contractor to provide the operating philosophy for each compressor and assist the Client in updating Operating and maintenance philosophies for the complete compressor plant.

4.1.1.2 Alarm Levels

The Contractor will assist the employer in the design and configuration of indications and alarms by others (third party) in the DCS as well as alarm response procedures, as required by the Employer for the following as a minimum requirement:

- System Pressure discharge pressure
- Compressors Online indication
- Compressor Discharge Pressure
- Compressor Discharge Temperature

- Dryer Discharge Pressure
- Dew point Temperature
- Compressor Discharge Flow rate
- System discharge flow rate
- Mode of Operation
- Oil temperature indication per compressor
- Suction differential pressure per compressor

4.2 PARTS OF THE WORKS WHICH THE CONTRACTOR IS TO DESIGN

4.2.1 General

The Contractor's design and the works complies with the standards listed in section 5 – Plant and Materials Standards and Workmanship, with all national and international standards required to Provide the Works and with good professional engineering practice and industry best standards for Fossil Fuel Fired power plants.

Drawings, data, or information submitted by the Employer to the Contractor does not relieve the Contractor from responsible duty of care in the design and execution of the works.

The Contractor designs the works for the environmental conditions prevailing at Camden Power Station Site.

The compressors are designed and provided as part of the works, have local Engineering and Maintenance support including repair and maintenance facilities in South Africa. The Contractor submits proof of local Engineering and Maintenance support with the design.

The compressors and all related equipment provided as part of the works are standardised across the Camden Power Station control air system. This is to ensure simplified spares holding, maintenance, and engineering requirements.

Should the Contractor require any additional information from the Employer for his design, the Contractor submits a formal request through correspondence with the Project Manager. Mechanical Design

The new electrical compressors for control air plant and service air plant provides clean cool, dry, oil-free compressed air to the users at Camden Power Station, which meets the following requirements in Table 1 below.

Table 1: Data Sheet for control air and service air compressors

Descriptions	Value
Control Air System Compressors	
Compressor Discharge Pressure (kPa)	750
Rated Capacity (m^3/min FAD)	25
Power (kW)	132
Moisture dew point -40°C better than class 2 according to ISO 8573-1	
Oil-free (oil contamination better than class 1 according to ISO 8573-1)	
Dust Contamination better than class 1 according to ISO 8573-1	
Relative Humidity of 20% to 80%	
Spares and services available in the country.	

Automatic condensate traps	
Air Cool	
Real time monitor	
Service Air System Compressors	
Compressor Discharge Pressure (kPa)	750
Rated Capacity (m^3/min FAD)	35
Power (kW)	132
Moisture dew point of minus (-) 20°C better than class 2 according to ISO 8573-1 Oil-free (oil contamination better than class 1 according to ISO 8573-1) Dust Contamination better than class 1 according to ISO 8573-1	

4.2.1.1 The Compressors

The Contractor supplies five (5), electrical driven screw compressors dedicated for control air supply meeting the requirement of table 1. The contractor supplies one electrical driven screw compressor dedicated to service air operation. The contractor includes the ducting requirements for cooling as part of the design. The machines are designed, complete with the instruments and transducers.

All new compressors are supplied with permanent lifting lugs and adequate provisions are made by the Contractor for safely lifting and handling the total weight of the compressor assembly including the electrical motor. The compressors are designed to operate efficiently under all possible site environmental conditions as specified in Appendix C:

All compressors have a permanently fixed stainless steel/trifoliate data plate in a conspicuous place with the following minimum particulars:

- Name of the manufacturer;
- Country of Origin;
- Compressor model;
- Year of manufacture;
- Manufacturer's serial number;
- Design pressure in units of KiloPascal (kPa);
- Design temperature for both minimum and maximum in degrees Celsius;
- Capacity in cubic meters;
- Input voltage and frequency in units of volts and hertz;
- Rated power and current in units of watts and ampere respectively;
- Unique mark of an approved inspection authority as applicable;
- The hazard category complies with the requirements of SANS 347;
- Compressor KKS identification number.

4.2.1.2 Piping System Requirements

The air piping meets the following requirements:

- Pipes of diameters smaller than 150NB meet the requirements of SANS 62.
- Contractor confirms current pipe sizes.
- Compressor come with its own isolation and NRV to connect on the existing pipes.

The contractor shall provide tap-offs for third-party instrumentation as required in Section 4.1 of this specification. Prior to any work, the contractor must assess the integrity of the pipe.

4.2.1.3 Corrosion Protection

All compressor components are externally coated, and internal components are adequately protected against corrosion, taking into account the environmental conditions outlined in Table 2: Site Environmental Characteristics Parameters. The contractor shall submit the corrosion protection specification to the Employer for approval prior to execution.

4.2.2 Control and Instrumentation Design

The onboard controller should be able to communicate with third party SCADA/DCS systems via open standard communication interface protocols such as Profibus DP or fibre communication protocols.

The C&I works will be executed by third party. The compressor designs will give input to C&I integrations. The Contractor provides the necessary input for the C&I works in the DCS as stated on the works before implementation for C&I to finalise their Integration scope of works. The contractor cooperates with the third party for a successful integration of the works in the DCS.

4.2.3 Electrical Design

4.2.3.1 General

The air compressors must be equipped with a suitably sized 380V main motor capable of driving the compressors to achieve maximum load conditions. The compressor must be equipped with premium efficiency motors that are IP66 rated and have Class H insulation. The main electrical motor must be supplied via an inbuilt 380V soft starter. The compressors and motors must be supplied as one complete compressor assembly.

The current switchgear from which the compressors are supplied from caters for a maximum load of 150 kW and 400A. The current supply cables for the different compressors are as follows:

- East Electrical Compressor 1: 600/1000V, General PVC, Steel Wire Armoured, 3 core, 185 mm^2, Stranded Copper, General PVC Sheathed.
- East Electrical Compressor 2: 600/1000V, General PVC, Steel Wire Armoured, 3 core, 185 mm^2, Stranded Copper, General PVC Sheathed.
- East Electrical Compressor 3: 600/1000V, General PVC, Steel Wire Armoured, 3 core, 185 mm^2, Stranded Copper, General PVC Sheathed.
- West Electrical Compressor 4: 600/1000V, General PVC, Steel Wire Armoured, 4 core, 240 mm^2, Stranded Copper, General PVC Sheathed.
- West Electrical Compressor 5: 600/1000V, General PVC, Steel Wire Armoured, 4 core, 240 mm^2, Stranded Copper, General PVC Sheathed.
- West Electrical Compressor 6: 600/1000V, General PVC, Steel Wire Armoured, 4 core, 185 mm^2, Stranded Copper, General PVC Sheathed.

The Contractor must review the current LV switchgear circuit and test the supply cables to establish if the current switchgear circuit and existing cables will be able to supply the new installation without risks of tripping.

If the Contractor proposes modifications to the current electrical circuitry or cables, such proposal will be reviewed by the Employer's relevant System Engineer. If the proposed option is agreed upon, the Project Manager will issue formal instruction to the Contractor to proceed with the modification.

4.2.3.2 Electrical Motors

The Contractor designs, manufactures, tests, supplies, delivers, installs and commissions each control air compressor's main drive motor.

The Contractor correctly sizes the electrical motors, which operate at a nominal voltage of 380V and is capable of being installed in the area designated for the control air compressors.

The LV electrical motors comply with 36-472 - Procurement of Power Station Low Voltage Electric Motors.

The LV motors are supplied with permanent lifting lugs and adequate provisions are made by the Contractor for safely lifting and handling the total weight of the motor.

The Contractor must note that the design of the motor and compressor train does not require the extension or re-routing of the current cable infrastructure. The Contractor must visit the site to obtain and confirm measurements and design information concerning the current electrical system layout.

4.2.3.3 Cabling Requirements

The *Contractor* performs the scope detailed here-in pertaining to cabling *Works*:

- Cable installation and termination complies with zone classifications of each location, where applicable also complies with 240-56536505: Hazardous Locations Standard and 240-56227443: Generation requirements for control and power cables for power stations Standard.
- 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. The *Contractor* is to apply to the *Employer* for cable numbers using developed cable schedules.
- Power cabling for all the various compressors
    - Design
    - Supply
    - Pulling
    - Termination
    - Testing
    - Commissioning
- Cable route identification
    - Should any of the existing cables be tested and found to failing, the Contractor is to make use of the existing cable routes and cable racks as far as possible for running of the replacement cables. Provision for additional cable racks is to be made after assessments and accepted by the Project team.
    - The *Contractor* is to clearly specify the power requirements for the compressor equipment to be provided and installed.
- Cable schedules are to be developed to include the new circuit descriptions, cable sizes and lengths, cable numbers, cable types etc. as per 240-56176097.
- The *Contractor* is to carry out the necessary bonding and earthing connections on all new installed equipment, according to the requirements of the 240-56356396 -Earthing and Lighting Protection.
- A test certificate of compliance prior to commissioning is to be issued.
    - The *Contractor* is to clearly specify the power requirements for the Compressors equipment to be provided and installed. The load schedule template provided by the Employer is to be utilized to specify the power requirement 240-56227927.

- Supply and install all cable accessories such as terminating and jointing kits, cable glands, lugs, bolts, washers and nuts for terminations, sleeves, and other ancillary material for fitting the cables into position.
    - The complete power and control cabling is to be designed, installed, and commissioned in accordance with the requirements of Eskom Standard 240-56227443 – Requirements for Control and Power Cables for Power Stations Standard.
    - Contractor to ensure that power and C&I cables are not installed in the same cable racks to mitigate effects of electromagnetic interference (EMI) from heavy current electrical cables.
    - The Contractor to be responsible for all the connections to the earth mat.
- Verification of the allocated circuits for serviceability and operability shall be conducted; any defects on the circuits are to be reported to the Project team before any rectification is conducted.
- Verify the components ratings (i.e., fuse switches, fuses, terminals, etc.) of the allocated circuits, before completion of designs. Provision is to be made to supply the correctly rated components to achieve adequate protection grading.
- Supply all consumable materials associated with the electrical works, therefore all the cabling, earthing material.
    - The *Contractor* will be responsible for any modification and circuit components associated with supply buckets on the 380V LV Switchgear Substation boards. All steel structures shall be bonded to this common earthing electrode installation.
    - All terminations shall be made with the tool recommended by the manufacturer of the lugs.
    - Crimping tools shall be of the type which will not release the crimping during normal operation until the crimp has been correctly formed.
    - If new cable racks are required, the *Contractor* ensures electrical continuity of the new and existing cable racks. All cable racks (new and existing) shall be connected to the earth mat.
    - The *Contractor* uses test equipment with valid calibration certificates. All calibration certificates are handed over to the Project Manager before testing on site starts.

4.2.3.3.1 Qualification and experience

For the installation, testing, jointing and termination of both LV and MV cables, a formally qualified Installation Electrician is a requirement to manage the quality and safety of cable jointing and termination.

The work must be conducted by someone with the experience of having successfully completed projects involving cable jointing and termination in the past.

4.2.3.3.2 Testing and commissioning of cables

Type tests and sample tests

- Type tests and sample tests shall be in accordance with SANS 97, 1507, 1574, 1339.

Routine tests

240-56227443: Generation requirements for control and power cables for Power Stations Standard the specific tests performed on the different type of cables and shall provide test certificates at the delivery of the cables.

Site tests

All tests shall be according to SANS 97, 1507, 1574, 1339, 10198-13 and other relevant standards.

Insulation resistance

- The insulation resistance of each core to sheath or conduit and between cores of all cables shall be measured and recorded after the cable has been installed and made off.
- For each cable termination the person conducting the job shall print and sign his name, enter the date on which the work is conducted and records the insulation readings in the appropriate place on the cable pull card.
- Cables having 110 V grade insulation or higher shall be tested by applying a voltage of 500Vdc for 1 min, as set out in SANS 5526. When performing insulation resistance testing, cable length and temperature (inclusive of temperature correction factor from OEM) shall be taken into consideration. Insulation resistance values shall be in line with Table 9 of SANS 1507-3 (2020).

High voltage tests (voltage withstand)

- Voltage withstand testing cables shall be as follows:

Table 2: Test voltages for voltage withstand tests.

Cable type	Reference to SANS
UVG cables (300/500V)	Table C.2 of SANS 1507-1 (2020)
LV PVC	Table 7 of SANS 1507-3 (2020)
LV rubber-insulated	Table 6 of SANS 1574-5 (2013)
MV XLPE	Table 4 of SANS 1339 (2020)

Commissioning procedure

- The provisions of the power station project commissioning procedure shall be strictly adhered to, as well as the requirements described here below.
- The plant to be wired in accordance with the schematic wiring and termination diagrams, updated where necessary, to represent a true record of cabling and terminations as installed.

- For control interface cables the process control supplier shall certify that the cable terminations are in accordance with standard or special termination information.

- For commissioning suitably qualified personnel must be available to conduct changes in cables and terminations to reverse the direction of rotation of drives or complete or change control and protection cable functions.

4.2.3.4 Electrical Drawing Requirements

Drawings for the required equipment as per the standards referenced within this technical specification. The supply of reproducible drawings according to the Vendor Document Submittal Schedule (VDSS). The following minimum requirements for the drawings to be developed:

- Schematic Drawings showing the following:
    - All protection and control devices and their contacts, each of which are labelled.
    - Device terminal numbers, terminal block numbers and terminal numbers.
    - All internal interconnections, bus wiring, inter-panel wiring and connections to external equipment.
    - All control and protection switches.
    - Power supply connections.
- Wiring Drawings showing the following:
    - Approximate physical locations of all items in each control panel.
    - All interconnecting wiring between control panels.
    - Identification of all terminals, terminal blocks, and wires by numbers.
    - Clear identification, by some distinguishing method, of all wiring which will be installed. This will include, but not be limited to, leads from external current transformers, trip circuits from remote devices, auxiliary contacts to remote devices, incoming dc control power, and separate incoming ac power. This also includes spare auxiliary contacts and relay contacts which are wired to terminal blocks for future use.
- Single-Line Functional Diagrams
    - Illustrate the functionality and interfaces between protection, control, and metering systems.
    - All power circuit equipment and their descriptions including type and specifications.
    - Electrical connections of instrument transformers (i.e., VTs and CTs) with relation to the cabling of protected Plant.
    - Details of the instrument transformers
    - Protection scheme
    - Tripping and control (including interlocking logic)

4.2.3.5 Earthing

- The contractor shall connect all non-current carrying conductive parts (metal) including the entire panel frame, doors, all removable covers, relays, meters, gland plates, etc., are effectively connected to the earthing conductor by means of their mounting arrangement on the panel or by a separate earthing.

Earthing concepts shall follow the OEM best practices and 240-56356396 Earthing and Lightning Protection Standard to ensure safe and reliable operation.

4.2.4 Civil Design

The Contractor executes all civil work according to SANS 1200, SANS 10100 and 240- 56364545 - Structural Design and Engineering. Where products are not catered for within these standards, the Contractor adheres to material datasheets.

The Contractor performs an on-site investigation and geometrical measurements, i.e., rebar scanning, concrete strength tests or any other non-destructive testing methods to ascertain the reinforcement within the concrete slab, produces as-built drawings for the concrete slab and determines the load capacity by the back-calculation process.

The new static and dynamic loading of the compressors do not exceed the existing compressor loads. The maximum weight of the new control air and service air do not exceed the current weight. The dimensions of the new compressors do not exceed the space availability of the existing plinths. The contractor to evaluate the current weight and dimensions (length, width and height) of the current compressors.

Existing civil and structural plant components are analysed complying with SANS 10100-1 to verify their load capabilities before design commences. The Contractor utilises SANS 10160-1 for all loading requirements and all design values should be the maximum permissible loads on the structural components.

The Contractor assesses the capacity of the compressor plinths, supporting ground slab and the dryer plinths. If the supports do not have sufficient capacity, the Contractor designs a modification for the supports or replace the supports with new structures that meet the load requirements. The design is submitted to the Project Manager for acceptance before work starts.

The design process follows 240-56364545 - Structural Design and Engineering Standard.

The steps below outlines the deliverables specified:

- The Contractor performs adequate calculations and design checks to show that the existing compressor plinths have the load-bearing capacity for the new compressors with adequate factor of safety. The Contractor takes vibrations or dynamic loading into account.
- The Contractor checks the concrete strength of the plinths if deemed necessary.

4.3 PROCEDURE FOR SUBMISSION AND ACCEPTANCE OF *CONTRACTOR*'S DESIGN

The *Contractor* submits design packages for acceptance as following:

- Assessment of existing plant
- Arrangement design
- Mechanical detail design
- Electrical detail design
- Control and Instrumentation detail design
- Integrated design (whole of the works)
- Commissioning Procedure and Check Sheets (including test procedures)
- Performance Test Procedures
- O&M Manuals (whole of the works)
- Cataloguing
- Input to SAP plant maintenance

The Contractor submits a request to the Project Manager to provide KKS coding for the works, refer to section 4.4.2.1, Plant Codification. The Contractor updates all design documents with the KKS codes before submitting the document packages to the Project Manager for acceptance.

The Contractor provides the detailed design freeze documentation packages indicated in the VDSS, to the Project Manager for review and acceptance.

The 240-53113685 - Design Review Procedure is followed for the review of the Contractor's design at the end of the detailed design phase. The Contractor ensures that at least thirty (30) working days' notice is provided before the design freeze and any acceptance is required. All documentation required for the detailed design review is submitted before the start of the thirty (30) working day notice period. The Contractor provides an allowance for this design review in the project programme.

Interim reviews are recommended to ensure that major issues are rectified during the design phase and to prevent delays that could result from an End-of-Phase review being rejected.

The Contractor provides a detailed design package comprising of documents and drawings as shown in the VDSS. The Contractor ensures that the detailed design is reviewed, approved and signed off by technologist/ professionally registered with ECSA in their respective fields namely: mechanical, electrical and electronics, and civil engineer.

The detailed design package is presented to the Employer in an End-of-Phase review meeting. The review meeting will either accept or reject the design package, where after the design will be frozen. The End-of-Phase review is a milestone and hold point in the project and is approved before moving onto the next phase.

The Contractor keeps records of any Engineering changes after the design freeze and documents and motivates changes in a report. This report is submitted to the Project Manager for acceptance.

The Contractor notes that incomplete design submissions are rejected for re-work and resubmission by the Contractor. The Contractor allows for time in the schedule to address comments from the review and for rework if required.

The Contactor only starts with procurement, fabrication or manufacturing, supply and installation once the design is accepted and written approval to implement the solution is provided by the Project Manager.

The final handover package, including all As-built drawings and datasheets for the new control air compressor system, is signed off by the Employer's Engineering staff and Contractor representative before contract completion.

The Contractor is the Design Authority that can approve the design documentation. The Employers design reviewers can only accept/not accept documentation issued by the Design Authority.

4.4 OTHER REQUIREMENTS OF THE CONTRACTOR'S DESIGN

4.4.1 Engineering Documents

For consistency it is important that all documents used within a specific domain follow the same layout, style, and formatting standard. The creation, issuing and control of all Engineering Drawings are in accordance with the latest revision of the Employer's standard: 240-86973501 (Engineering Drawing Standards – Common Requirements). MicroStation is the Eskom standard CAD software. All documentation is in English.

The *Contractor* follows the existing Camden PS plant codification and labelling philosophy as per 240-64550692 -Camden PS Labelling Specification and Plant Coding Procedure.

4.4.2 Plant Labelling and Codification

4.4.2.1 Plant Codification

KKS coding is applied during the design stage and cross-referenced to all arrangement drawings, schematics, instructions and manuals and where practical to spare parts list/manuals. The Employer is responsible to provide the KKS coding, according to 240-93576498 - KKS Coding Standard. The Contractor provides an electronic list with the descriptions of all items, components, equipment, etc. that has to be coded, in table format (MS Word or preferably MS Excel). As a minimum the Contractor covers the following documents' equipment into the list:

Mechanical

i. Piping and Instrumentation Diagrams (P&IDs)
ii. Interface list
iii. Process flow diagrams (PFDs)

Electrical

i. Single line diagrams
ii. Electrical board general arrangements (GA)
iii. Electrical board summary sheets
iv. Cable schedule
v. Updating of the cable route drawings

C&I

i. C&I architecture drawings
ii. C&I Cubicle GA
iii. Cable block diagrams
iv. Remote control signal lists
v. Cable schedules

Civil

i. Site layouts
ii. Building layouts
iii. Building sectional layouts
iv. Building floor plans per level
v. Underground services layouts
vi. Cable rack & support

The Project Manager arranges the coding of the plant and submits the coded lists back to the Contractor. The Contractor allows five (5) days for issuing of KKS coding in the project programme.

The specific KKS code of each item of works, equipment, component, measuring point, junction box, cable etc., appears on all documents, instruction manuals, schedules (i.e. load schedules, drive and actuator schedules, instrument schedules, etc.), lists (i.e. board parts lists, alarm lists, signal lists, etc.), drawings (i.e. flow diagrams, loop diagrams, termination diagrams, functional logic diagrams, general arrangement, schematic diagrams, cable block diagrams, etc.) and labels for works, equipment and components.

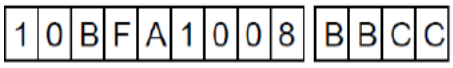
The Contractor codes all documentation above, before submission to the Project Manager for review and acceptance.

4.4.2.2 Labelling

All new equipment installed by the Contractor is labelled appropriately as per the Eskom Plant Labelling Standard, 240-71432150. The Contractor is responsible for ensuring familiarity with the standards, specifications and concepts of the coding system as applied by the Employer.
The Contractor manufactures, supplies and securely fits all new labels onto the plant with the correct backing plates and strapping. The Contractor submits a sample of the labels for acceptance by the Project Manager before manufacturing and supplying the batch/es of labels for installation on the plant.
The Contractor may request assistance from the Employer via the Plant Codification Section for further clarity.
No replacement or changes are made to plant labelling or codification outside the battery limits of the works unless damaged by the Contractor or if stated otherwise by the Employer.
All KKS labels are installed in a similar location for each similar item of the plant across all six (6) Units and at the Common Plant at Camden Power Station. The Contractor labels all electrical cables complying with the following:

- All internal cables are tagged and labelled with KKS numbers provided by the Contractor. Internal cables are labelled with standard PVC K-Type flexible cable markers and more than 13 digit carrier strips and attached on both ends with suitable cable ties (T18R or T30R, depending on cable thickness).

Figure 1: An example of a PVC K-Type flexible cable marker with a 13 digit carrier strip.



- Electrical cable number tags are fixed to the cables as follows:

i. One tag inside a floor-mounted cubicle, switchboard etc. visible through an open door.

ii. One tag below the cubicle, switchboard etc. to permit the identification of the cable from below the fire barrier or other seal of the floor opening above which the board is mounted.

iii. One tag at the cable entry into the field mounted equipment (for cubicles with top or side entry or where a cable enters an enclosure from an open run only one tag just below the cable gland is required).

4.4.2.3 Technical Risk Assessment

The Contractor highlights any foreseen risks, documents and implements mitigating measures. These risks are captured in a risk assessment report and submitted to the Project Manager.

4.4.2.4 FMEA (Failure Mode and Effect Analysis)

The Contractor carries out formal Failure Mode and Effect Analysis (FMEA) on the complete compressor system. The analysis complies with the 240-49230046 – Failure Mode and Effect Analysis (FMEA) Guideline. The Contractor submits the FMEA to the Project Manager for review and acceptance.

4.4.2.5 System Interfaces

The Contractor's design includes all system interfaces, which are required to provide the Works. The Employer provides the relevant information defining the system interfaces. The Contractor caters for all the identified interfaces in the design.

4.5 USE OF *CONTRACTOR*'S DESIGN

There are no restrictions on the Employer's use of the Contractor's design. The Employer may use, copy and distribute the Contractor's design for any purpose including use for procurement, construction, modification, alteration and demolition of the works.

The Contractor grants the Employer full rights and ownership of the Contractor's design, drawings, datasheets, specifications and other documentation obtained as part of the works.

4.6 AS-BUILT DRAWINGS, OPERATING MANUALS, AND MAINTENANCE SCHEDULES

4.6.1.1 As-built drawings

The Contractor provides both construction and distinctly marked As-built drawings in Micro Station (DGN) format as well as Tiff and/or PDF formats. Three (3) A1 size, hard copies and an electronic copy of each drawing is submitted to the Project Manager.

The documentation indicated in the VDSS must be available before installation and are necessary to conduct commissioning activities. The creation, issuing and control of all drawings are complying with the latest revision of the Engineering Drawing Standard 240- 86973501.

The Contractor includes the Employer's drawing number in the drawing title block. Drawing numbers are assigned by the Employer as documents/drawings are developed.

4.6.1.2 Submission and Acceptance of Manuals

The Contractor submits one set of the manuals in draft for final review and acceptance by the Project Manager. The Contractor allows for time in the schedule to address comments from the review and for rework if required.

Hand over cannot be done unless the manuals are accepted.

After acceptance by the Project Manager, the Contractor submits three (3) sets of the final version of the manuals in hardcopy and three electronic copies (on discs).

Relevant payments may be withheld by the Project Manager until the data pack is submitted by the Contractor.

4.6.1.3 Operating Manuals

The operating manuals are fully comprehensive and cover all plants and plant equipment installed. The manuals contain at least the following:

- High-level plant design philosophy
- Plant general description
- Plant operating principles
- Normal plant operating conditions
- Abnormal Plant Operations and recovery
- Plant Operating limits and set points and performance specifications
- Routine plant inspection requirements

- Operating procedures:
    a. Plant inspections including pre-start and running checks
    b. Operating of plant
    c. Alarm responses
    d. Mechanical and electrical isolations and de-isolations
    e. Hazards and precautions

4.6.1.4 Maintenance Instruction Manuals and Schedules

The maintenance instruction manuals are fully comprehensive and cover all plants and plant equipment installed. The manuals are used by the Employer's technical staff to evaluate performance, trace faults, adjust, maintain and fully understand the plant and plant equipment. The manuals contain at least the following:

- Detailed plant design philosophy
- Plant general and functional descriptions
- Plant limits and set points and performance specifications
- Plant control configuration
- Fully detailed maintenance and inspection schedules for plant services at daily, monthly, three-monthly, six-monthly, yearly and any other necessary intervals
- Manufacturer's and supplier's detailed maintenance and lubrication instructions
- Diagrams and sectional drawings giving part numbers, descriptions, etc.
- General maintenance procedures, covering removal, dismantling, inspection, replacement of parts, re-erection, checking, reassembly, re-commissioning and test-running for all equipment.
- Hardware manuals and wiring diagrams.
- Fault-finding and troubleshooting procedures including the FMECA.
- List of recommended spares and materials and related transport and storage instructions
- Hazards and precautions

The Contractor to support Maintenance Strategy Manage Work (MSMW) project by updating the maintenance strategy templates.

4.7 PLANT AND MATERIAL

4.7.1 Quality

The Contractor ensures that all equipment, tools and material that the Contractor or Subcontractor uses to execute the works, complies with the SABS and other stated standards.

All plant and materials sourced and supplied for the installation are new and are free from defects. Reconditioned or refurbished plant and/or materials are NOT regarded as new under any circumstances and may NOT be utilised.

The Contractor does not use plant and materials, which are generally recognised as being unsuitable or otherwise unsuitable for the purpose for which they are intended.

Only components of high reliability are utilised, with a proven operating history, to enable the plant to achieve the required reliability and availability. Plant and material design, engineering and manufacture

comply with the best practice applicable to high-grade products of the type to be furnished, to ensure the efficiency and reliability of the works and the strength and suitability of the various parts for the works.

Plant and materials withstand 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 to facilitate replacement and repairs. Like parts are interchangeable.

No repair of defective plant and materials may be permitted without the Project Manager's acceptance and any such repair, if accepted, is carried out to the satisfaction of the Project Manager.

4.7.2 Plant & Materials provided "free issue" by the *Employer.*

The Project Manager supplies and installs scaffolding and solid barricading (signage excluded).

4.7.3 *Contractor*'s procurement of Plant and Materials

Absolutely no changes to the current plant configuration are allowed unless authorised by the Employer.

Plant, equipment and materials are procured complying with the specifications listed in the Works Information. Compliance with providing items from the relevant OEM's is essential.

The Contractor only procures plant, equipment and materials as specified in the Works Information. Any accepted change of specifications is notified in writing by the Project Manager through the issue of instruction.

Should any plant, equipment or material specified in the Works Information not be available on the market due to obsolescence or other reason, the Contractor recommends a suitable alternative. All alternative items are accepted by the Project Manager and an instruction issued by the Project Manager before procurement by the Contractor.

The procurement schedule is clearly shown and integrated into the Contractor's accepted project programme ensuring delivery of equipment to site in advance of the installation activity.

All items procured and stored at the Contractor's premises or the Employer's premises are stored complying with the manufacturer's requirements or material specifications. The Contractor ensures that plant and materials procured carry a minimum of fifty-two (52) weeks warranty or guarantee period.

Plant and materials used for the works are to bear no labelling other than the plant coding specified by the Project Manager

4.7.4 Delivery to Site

Delivery, loading, unloading, transporting, rigging, setting out and storage remain the Contractor's responsibility to perform safely and timeously by competent personnel.

The Contractor advises the Project Manager in advance of all shipments and coordinates with the Project Manager the arrival, off-loading and release of such. The Contractor promptly unloads shipments and promptly releases carrier equipment from Site.

All material deliveries are to be performed via the Camden Stores Department. Delivery notes are to be delivered with the materials to the Camden Stores Department.

Arrangements are made with the Project Manager at least 24 hours in advance to arrange for quality inspections of all materials. A copy of the signed delivery note is provided to the Project Manager upon delivery.

The Contractor safely and correctly protects, handles, secures, transports and delivers all plant and materials.

The Contractor marks or tags containers, crates, boxes containing plant and materials for the project, using the contract number and project description. Packaging materials remain the Employer's property and cannot be removed from site.

The Contractor submits the relevant data sheets and material certificates before the equipment delivery to Site for acceptance by the Project Manager or by no later than the date of delivery. Items that have not been accepted, will not be included in the Contractor's assessment for payment.

4.7.5 Spares and consumables.

Replacement components are readily available. The *Contractor* guarantees that all components and consumables are available in South Africa for at least 20 years with a lead time of 6 weeks or less. The *Contractor* provides confirmation in writing from the OEM or authorised dealer.

The Contractor provides his consumables as required by him to complete the works. The cabling that is left over after the project, will be handed to the Project Manager after all the unit cable has been installed and terminated.

4.8 TESTS AND INSPECTIONS BEFORE DELIVERY

4.8.1 General

All off-site inspections and testing (tests before delivery) conforms to all requirements as stated in Pressure Equipment Regulations The Project Manager reserves the right to appoint a representative or representatives to inspect all parts during manufacturing and testing and to be present at any of the tests specified in this works.

The Employer's representative(s) and/or third-party/independent inspection authority have unhindered access to witnessing all manufacturing and testing processes at the manufacturing facility.

All off-site tests performed during and after manufacturing and before delivery to the Site must conform to the requirements of this document and all relevant standards as listed in Section 2.2 normative / informative references and section 5, Plant and Materials Standards and Workmanship.

All off-site tests are conducted and hosted by the Contractor and witnessed by the Employer's representative(s) and/or third-party/independent inspection authority.

Where holding points exist on the manufacturing QCP's, no manufacturing activity proceeds if the preceding activity on the manufacturing QCP was not approved by both the Contractor and Employer's representatives.

The Project Manager carries out quality inspections at his discretion and as per the preapproved Quality Control Plan (QCP).

Such tests as may be required by the Project Manager are carried out by the Contractor during or after manufacturing to prove compliance with the specification independently of any test, which may have been carried out at the manufacturer's facility.

The Contractor provides a test certificate for each test required by the code. Specimen tests used by the Contractor are also submitted.

The Contractor provides current calibration certificates for all equipment used during manufacturing and testing as part of the data pack.

The Contractor is responsible for quality assurance and control during manufacturing and testing. Any acceptance, check, certificate, consent, examination, inspection, instruction, notice, proposal, request, test, or similar act by the Employer (including the absence of acceptance) does not relieve the

Contractor from any responsibility, including responsibility for errors, omissions, discrepancies and non-compliance.

The Contractor takes note of and responds to any comments made by the Employer on the Contractor's manufacturing documents. However, the Project Manager is not bound to check the Contractor's manufacturing documents for any errors, omissions, ambiguities or discrepancies or compliance with the requirements of the Contract. The Project Manager's receipt of, or review of, or comment on, the Contractor's manufacturing documents does not relieve the Contractor from responsibility for the Contractor's errors or omissions or departure from the requirements of the standard.

The Contractor provides a testing plan and procedure and submits the plan and procedure to the Project Manager for acceptance.

The Contractor's test procedure contains testing criteria as defined in Section 4.8, Tests and Inspections before Delivery as a minimum.

The Contractor is available for testing after normal working hours. The Employer reserves the right to waive any test/s without consulting the Contractor. The Contractor provides all Equipment, tools and software required for testing and commissioning.

In the event of incorrect functioning, the Contractor determines the cause of the fault and he corrects the fault if the trouble is within the equipment of his supply, or notifies the Employer.

The Contractor carries out any required routine maintenance on machinery until a Completion certificate has been issued. The Contractor supplies all the required spares during this period.

The Contractor presents the completed Works to the Project Manager for a complete inspection, after being successfully commissioned. The Contractor carries out repairs on all Defects, in those portions of the Works that the scope of work covered, detected during that inspection.

4.8.2 Inspection and Testing Plans (ITP)

The Contractor develops all relevant inspection and testing plans (ITP) and detailed, specific procedures and submits them to the Project Manager for acceptance. The ITP includes all tests and inspections required to ensure that the compressor trains provided under the works, inclusive of all interfaces, allow for safe operation.

The Contractor provides timely notification and allows for witnesses to be present at inspections and tests. The Contractor carries out the inspection and testing complying with the ITP and the specific procedures for safety and quality assurance.

The Contractor strictly controls any modification of accepted designs or plant and material or wiring after it has been inspected. The Contractor re-inspects and re-tests any plant and material or wiring, which has or could have been affected by a modification.

4.8.3 Factory Acceptance and Testing

The Contractor submits a detailed test plan and procedure, which will be used for the Factory Acceptance Testing (FAT) to the Project Manager for acceptance, at least thirty (30) calendar days before starting date of the first FAT The FAT procedure includes the following:

a. Major test activities
b. A comprehensive list and description of the individual tests to be performed
c. How the tests are to be prepared and conducted
d. Test dates and durations
e. Checklists on how the test results will be documented
f. Acceptance Criteria

g. How the identified discrepancies will be managed

Where FAT activities are not conducted in South Africa, the Contractor submits upfront a list and an example from a previous project, for the Employer to review and accept before manufacturing will start.

A FAT is conducted on all the compressor trains supplied to ensure compliance and operability of the equipment supplied. The Employer's representatives will inspect and test some parts of the Plant at the Contractor's premises before dispatch, where required.

The Contractor advises on the period required for the inspection and testing activities of part of the Plant. The Project Manager advises on the parts of the Plant he needs to inspect and/or test and the Contractor makes allowance in the delivery time to cater for this requirement.

The Contractor gives the Project Manager at least 72 hours (3 calendar days) notice of the date on which any compressor train is ready for inspection and testing. The Contractor submits the relevant technical datasheets, material certificates, conformance certificates, manufacturer inspection, and test reports of all equipment in electronic copy to the Project Manager for acceptance before dispatch to site.

The Contractor ensures that all equipment undergoes detailed quality inspections before dispatch to the site. The detailed quality inspections ensure that the equipment corresponds with both the manufacturer's technical datasheets and contractual requirements.

The functional tests form part of the factory acceptance test and site integration test and are to include the checking of all measurement loops, interlocks, sequence controls, and analogue controls. Additional to this:

a. Tests that are required to be performed on a test bench are performed on a test bench provided by the Contractor.

b. The Contractor to provide controller, with approved configurations and software to test the Contractor supplied Functional logic diagrams and philosophies during factory acceptance testing.

Inspection and Testing of Electrical Motors:

a) The Contractor gives the Employer not less than seven days' notice of when the inspection may be undertaken. Motors dispatched to site without the required inspection, may be rejected at the Employer's discretion. All cost related to transport, re-testing, inspection, etcetera for a rejected motor will be for the Contractors' account.

b) For motors of 200 kW and larger, an inspection and test plan is submitted to the Project Manager for approval before manufacturing or procurement.

Type Testing of Electrical Motors:

a) The Employer and/or authority, independent of the Contractor, witness type tests.

b) The first motor of each size and type manufactured will be performance tested to prove compliance with the quoted performance. Type test certificates on identical motors may, at the Employer's discretion, be accepted instead of these tests.

c) All performance tests comply with SANS IEC 60034-1 and SANS 1804. The permissible temperature rise motors comply with the limits specified in clause 4.2.3 of 36-472 - Procurement of Power Station Low Voltage Electric Motors

d) The temperature rise of the stator windings is measured by the winding resistance method.

Routine Motor Tests:

a) Each motor is tested at the manufacturer's works for light-run, no-load current, vibration, locked rotor, insulation resistance, high voltage, and winding resistances.

b) All motors larger than 150 kW are subjected to a light-bearing run for long enough to allow the bearing temperatures to reach equilibrium.

c) All routine tests comply with SANS IEC 60034-1 and SANS 1804. For motors of 200 kW and larger, an inspection and test plan is submitted to the Project Manager for approval.

Test Certificates:

a) Before the delivery date of the motors, routine and type test certificates are submitted to the Project Manager for approval.

b) Type test certificates show power factor and efficiency figures calculated from the test results for 100 %, 75 % and 50 % of full load conditions.

c) Motor test results are recorded on the Employer standard form. The Contractor's template is only acceptable if it is comprehensive and covers all the details required by the Employer.

The following checks during inspections are conducted by the Contractor as a minimum:

a) Visual inspections to verify the mechanical and/or physical integrity of the equipment as well as specifications of the major and/or active components.

b) For each valve, the verification of the model name and number, pressure rating, temperature rating, material of construction, flange/thread size, face to face length, bore size, pitch circle diameter, "Open" and "Close" markings and directions, data plate, etc.

c) For all pipes, the verification of the fabrication standard, grade, heat treatment used, non-destructive tests performed (liquid penetrant testing, radiographic testing, corrosion testing), pressure test performed, surface finishes, traceability markings, etc.

d) For all other equipment not mentioned above, the verification of the dimensions, material of construction, performance capabilities, data plates, etc.

A final FAT report is prepared by the Contractor that includes the following as a minimum:

a) Test procedures used during FAT

b) Detailed Test results

c) Discrepancies identified during the tests

d) Resolution of the discrepancies

e) Retests conducted and the result thereof

f) FAT certificate

g) The Contractor submits the Final FAT Report to the Project Manager for acceptance.

h) FAT Completion is achieved upon acceptance of the Final FAT Report by the Project Manager.

The Contractor obtains clearance from the Project Manager before dispatching the equipment. This factory release inspection does not release the Contractor of any of his obligations under the contract.

No Plant will be released for dispatch without the as manufactured documentation and drawings accompanying them.

The Contractor manufactures, fabricates and assembles all relevant equipment complying with the Employer's standards and specifications as listed in section 5 - Plant and Materials Standards and Workmanship.

The Contractor tests all the shop fabricated equipment required for the completion of the works and submits the relevant technical datasheets, material certificates, conformance certificates and

manufacturer inspection and test reports of all equipment as an electronic copy to the Project Manager for acceptance before dispatch to Site.

The Project Manager accepts the Contractor's off-site testing plan. The Employer decides which tests are witnessed by a representative of the Employer and communicates it to the Contractor.

The Project Manager reserves the right to request the manufacturer's detailed drawings relating to the proposed materials, heat treatment, machining and surface roughness tolerances to perform a design check.

4.8.4 Inspection and Testing on Site

Pre-removal inspections are to be conducted in conjunction with the Employer to verify the condition of the existing equipment. Appropriate check sheets are developed for the activity by the Contractor. The Project Manager accepts the format of test certificates and check sheets before construction.

After installation and before commissioning, the Contractor and relevant Employer's representatives carry out final quality inspections and the acceptance tests as listed in the Works Information to ensure the correct function of the equipment, the safety of works and personnel, and to determine compliance with contractual specifications.

Post-inspection check sheets are developed by the Contractor with the Pre-inspection sheets being used as a baseline for the activity.

The Contractor supplies a programme of all tests that are to be carried out in preparation for commissioning and indicates the details of proposed tests he proposes to perform and how the results of tests are documented.

The Contractor provides current calibration certificates for all test equipment, which are used to perform testing, to the Project Manager.

The Contractor provides test certificates for all tests performed (pressure test, NDT, calibration reports, etc.), final inspection reports and safety clearance certificates for all components installed to the Project Manager for acceptance.

Where the results of the performance tests performed don't correlate with expected results (concentration values, flow rates, pressures etc.) and/or the control functions as per the operating philosophy do not meet the specifications guaranteed, the Contractor, at his own expense, carries out all necessary adjustments and modifications to the works required to obtain the stated tolerances required, forming part of this scope of work.

Where inspections indicate that the working of an instrument is likely to be suspect, the instrument is adjusted, repaired or replaced by the Contractor to the Employer's acceptance and a full check to verify the operation and correct calibration is carried out.

4.9 COMPLETION, TESTING, COMMISSIONING, AND CORRECTION OF DEFECTS

4.9.1 Work to be done by the Completion Date

The Contractor ensures that all work is completed on or before the completion date, except for the work listed below which may be done after the completion date but before the date stated in the table.

The Project Manager cannot certify Completion until all the work has been done and is free of Defects, which would have, in his opinion, prevented the Employer from using the works and others from doing their work.

Acceptance of the "As-built" documentation is a pre-requisite for commissioning to be done and to certify completion of the works.

	Item of work	**To be completed by**
	As built drawings of Plant and peripheral equipment installed	Within 90 days after Completion
	Performance testing of the *works* in use as specified in paragraph 49.10 of this Works Information.	See performance testing requirements.

4.9.2 Use of the *works* before Completion has been certified.

Completion is according to the Sectional Completion in the Employer's Data.

4.9.3 Materials facilities and samples for tests and inspections

The Contractor provides all facilities, test equipment and material to perform the Factory Acceptance Testing.

4.9.4 Commissioning

The Contractor is responsible for the drawing up of commissioning and testing plan and schedule for each system, in conjunction with the input of the Employer's engineering, maintenance and operating personnel before the completion of that section of the work and submits it to the Project Manager for review and acceptance.

The Contractor's commissioning plan complies with the requirements of 240-56356376 - On-Site Commissioning for Low-Pressure Systems.

The Contractor submits procedures for the testing and commissioning of installed equipment to the Employer. (See VDSS). The Project Manager accepts these procedures before being used for testing and commissioning purposes.

Commissioning and testing are conducted by the Contractor with support from the Employer's engineering, maintenance, project and operating personnel.

Upon completion of the work done on each system and before de-isolation and commissioning of the plant, the Contractor confirms that the plant is fit for use and verifies that all re-assembled and newly installed components are correctly installed, including the directions checks, directions of flows, alignments, bolt tightness/torqueing etc. and that they match the existing plant configurations with the necessary plant labels installed.

The Contractor's test procedure contains testing criteria as defined in Section 4.4, Tests and Inspections before Delivery as a minimum.

The plant is also cleaned of waste, scrap and debris and equipment removed. Scaffolding that does not affect the operation of the plant may be left until the plant commissioning is completed.

Thereafter, the Contractor submits all completed QCP's, datasheets, material certificates, operating and maintenance manuals, design drawings etc. to the Project Manager to first verify that commissioning may be planned.

In addition, the Contractor submits a complete list of numbered schematic, wiring and cable diagrams, which are a true record of the Plant and Equipment as installed and certifies that the works have been wired complying with these diagrams.

An erection check/plant walk is arranged between all the relevant parties and a snag list generated for immediate rectifications to be done by the Contractor.

The Contractor requests the RP to provide a Sanction for Test (SFT) so that isolations may be removed. All commissioning activities may be performed under the SFT.

The Contractor conducts both cold and hot commissioning together with the Employer's personnel.

The Contractor, at the time of commissioning, has the agreement, or the attendance of the Project Manager involved in a particular phase, before proceeding with commissioning. Consequently, the Contractor must assure himself as to the safety of his Plant and Equipment in respect of any particular commissioning test and in the event of damage, accept responsibility for such Plant and Equipment.

The Contractor co-operates fully with the Project Manager and the Employer's C&I representatives in the commissioning the whole of the works for which he supplies the portion of Plant and Equipment specified in this Works Information. The Contractor assists the Employer's C&I representatives in the optimisation of all controls and notifies the Project Manager when the controls have been completed to the Contractor's satisfaction before offering the works for take over. Actions needed to be performed on the DCS to achieve the commissioning requirements, is performed by the Employer's C&I

representative. These activities include HMI indication verification, alarm verification, HMI range checks etc. This is applicable to the Common Plant DCS.

Calibrations of all instrumentation form part of the works and calibration sheets must be provided and signed by both parties and included as part of the data pack for the works.

As a minimum, the cold commissioning activities conducted by the Contractor consists of:

a) Electrical and instrumentation loop check activities defined in IEC 62382
b) All field equipment checks.
c) Interlocks or Protections checks
d) Sequence controls checks
e) Actuator/Valve stroking
f) 4-20 mA injection - At least three set-points including 0

It is the Contractor's responsibility to check that each measuring loop falls within the specified loop accuracy.

The Contractor complies with all the Employer's safety and site regulations, which all Contractors are to conform to at Camden Power Station.

The safety clearance certificate is the certificate issued by the Employer to the Contractor, stating that from the time and date stated on the certificate the specified machinery is under the Project Manager's control. Further access to the machinery is only permissible through the Employer's permit system.

The Contractor ensures that proper housekeeping is done again before re-instating the plant through the RP(s) clearing the PTW.

The plant is considered "in operation" once the RP clears the PTW and the Contractor may not perform any more activities on that plant unless a new PTW is applied for and accepted.

The Contractor presents the completed Works to the Project Manager for a complete inspection, after being successfully commissioned. The Contractor carries out repairs on all Defects, in those portions of the Works that the scope of work covered, detected during that inspection.

4.9.5 Acceptance Testing

a) The Contractor provides the following documentation packages indicated in the VDSS, to the Project Manager as part of site acceptance testing:
    - Site Integration Test (SIT) Completion Documents
    - Construction Completion and Design Review (Mechanical inspection)
    - Operation Acceptance Testing (OAT) Completion Documents

4.9.6 Commissioning Completion

a) Conformity of the installation to the design documentation shall be assessed and certified upon completion of the commissioning phase. All hot commissioning and performance tests are completed and captured. All necessary test and calibration certificates to form part of the Operational Acceptance Testing document file.

b) The employer approves the following for all compressor systems, as indicated in the LOSS:

- All commissioning check sheets and tests
- The operational acceptance test report
- Alarm list and response procedures.

4.9.7 Start-up procedures required to put the *works* into operation.

The start-up of the compressors requires the entire train to be available The Contractor provides a new start-up procedure to the Project Manager for acceptance.

A risk assessment is performed by the Employer and Contractor before the activity to ensure all risks are identified and mitigated. The Contractor is available on site during the start-up process of each of the control air compressors The Contractor refers to the OEM manuals provided for details on start-up of the plant during the commissioning of the various plant systems.

4.9.8 Take Over Procedures

When a plant section is commissioned, the Project Manager may accept the plant and arrange for the takeover. Such acceptance affects the transfer of the asset and the control of the plant from the Contractor to the Employer.

During initial testing and commissioning of the plant up to guarantee performance testing, the plant is deemed to be in beneficial occupation.

4.9.9 Access given by the Employer for Correction of Defects

The defect(s) is/are reported to the Contractor as soon as the Project Manager becomes aware thereof.

An opportunity is arranged by the Project Manager for the repair and the Contractor is notified at least 48 hours in advance of the opportunity to repair the defect(s).

It is the Contractor's responsibility to get the Safety Plan checked and approved again, if necessary and to apply for Site access permits before any work can commence on Site.

4.9.10 Performance tests after Completion

During the commissioning of each of the compressors, the performance is measured against the design operating criteria as stated in Section 4, Engineering and the Contractor's Design.

The performance of the compressors are assessed on the following:

a) A flow measurement test is carried out and is compared with the factory tests and deemed acceptable if it meets the required flowrate as per compressor design flowrate.

b) Vibration analysis is done according to BS ISO 14839-3 Mechanical vibration - Vibration of rotating machinery equipped with active magnetic bearings - Part 3: Evaluation of stability margin.

c) A natural surge test is done ensuring that the compressor surges at the design surge pressure as per compressor design.

d) A throttle surge test determining the throttle range of the compressor at an operating pressure of. The Contractor verifies that the inlet valve controls between the design point and near the surge point. An inlet valve throttle range modulation curve is developed from this test.

e) Performance testing of the interstage coolers to verify adequate heat transfer as per OEM specification.

f) Vary inlet valve position between 35%-100% and check the kW of the motor to verify that the power of the motor is as per design for a certain load.

g) Perform an integrated system functional test for the compressor train.

h) The following tests are applicable for the compressors before accepting the compressors:

- ISO 1217: Displacement compressors – Acceptance tests
- ISO 5389: Turbo-compressors - Performance test code
- ISO 7183: Compressed air dryer assemblies - Specifications and testing
- ISO 12500 -Part 1 to 3, Filters for Compressed Air – Test Methods
- ISO 8573-Part 1 to 9, Compressed Air - Contaminants and purity classes – Test Methods

i) The interface to existing equipment does not compromise the functionality or life of any plant equipment.

During the proving/defects period, the Contractor optimises all aspects of the operation of the plants and is responsible for any defect resulting from faulty design, material and workmanship and remedy such defects at his own expense and as soon as possible when called upon to do so by the Employer.

Any outage of sections of the plants required by the Contractor during this period is, as far as practicable, arranged to suit the convenience of the Employer.

After completion, during the defects period, the Contractor continues to monitor all installed compressors for compliance to performance and design criteria.

4.9.11 Training and technology transfer

The Contractor provides training to the Employer's staff on the newly installed control and service air system with all its components at a training venue on site, supplied by the Employer. Separate training packages are developed to suit the Operating, Maintenance, and Engineering departments' specific needs. The Contractor arranges separate training sessions for each department. The training packages contain at least the following:

a) Operator training

- Operation, maintenance and troubleshooting

b) Maintenance training

- Covers all different disciplines, i.e. Mechanical, Electrical and Control and Instrumentation.
- Hardware and software configuration
- Engineering, operation, maintenance and troubleshooting.
- Software and tools required for installation, configuration, maintenance and troubleshooting.
- Covers day-to-day maintenance which will be done during the first 52 weeks by the Employer's appointed staff or contractor.

c) Engineering training

- Covers all different disciplines, i.e. Mechanical, Electrical and Control and Instrumentation.

- Design philosophy, system architecture, configuration specifications and plant layout
- Hardware and software configuration
- Engineering, operation and troubleshooting
- Software and tools required for configuration, maintenance and troubleshooting.

d) The Contractor provides the training before the final assessment is done for completion.

e) As proof of training provided to the Employer's staff, the Contractor submits signed attendance registers to the Project Manager, for retention release.

4.9.11.1 Training Documentation

The Contractor provides all course material including manuals in both hard copy and an electronic copy (Microsoft Word document) to the Project Manager for review and acceptance before training is arranged and commences. The Contractor allows for time in the schedule to address comments from the review and for rework if required.

The course material is in English and includes any third party documentation required to install, operate and maintain the system.

Printed and electronic copies of the training documentation are supplied for each trainee plus three (3) additional hardcopy master sets and three (3) electronic copies on disks, for storage in the Camden Documentation Centre. The Contractor makes provision for the following numbers of trainees per department:

Department	Estimated no of trainees
Operating	5
Maintenance	5
Engineering	5

All training documentation provided by the Contractor is customised for Camden Power Station's installed system.

Training manuals are updated electronically by the Contractor for each set point change or approved modification to the design, up to the date of issue of the Defects Certificate for the whole of the works. The Contractor provides three (3) updated electronic copies on disks before the issuing of the Defects Certificate.

5. PLANT AND MATERIAL STANDARDS AND WORKMANSHIP

The Contractor complies with all relevant regulations, procedures, and specifications, as and when revised.

6. SITE INFORMATION

The Site is situated within the Eskom, Camden Power Station (MPS) premises, situated Piet Retief Street, Nucam, 2355 ; Location, Ermelo, Msukaligwa Local Municipality, Mpumalanga, South Africa.

7. AUTHORISATION

This document has been seen and accepted by:

Name & Surname	Designation
[redacted]	Snr Technologist Engineer
[redacted]	C&I Engineer
[redacted]	Electrical Engineer
[redacted]	Snr Technologist Electrical Engineer
[redacted]	Design & Spec Manager
[redacted]	Auxiliary Engineering Manager
[redacted]	C&I Engineer
[redacted]	Project Coordinator Tech
[redacted]	Civil Engineer
[redacted]	Snr Technician Configuration
[redacted]	

8. REVISIONS

Date	Rev.	Compiler	Remarks
November 2024	1	[redacted]	Revision 1
April 2025	2	[redacted]	Updated all sections of the specification. Scope related to Control and Instrumentation (C&I) has been removed.

9. DEVELOPMENT TEAM

The following people took part in the development of this document:

[redacted]

10. APPENDIX A DRAWING LIST

This is the list of drawings issued by the Employer at or before the Contract Date and which apply to this contract.

Note: Some drawings may contain both Works Information and Site Information.

Drawing number	Revision	Title
15306	20	Compressor house east and west Control air Piping P&ID
13945	5	Station Air System P&ID
3495	4	Station and Boiler Control Air Compressor Plant East layout
5353	12	Layout of Station & Boiler Control Air Compressor Plant East
4689	5	Arrangement of foundation for boiler control air compressor plant (East)
5419	2	Air Compressor plant house-West
6290	1	Boiler Control Air Compressor Plant West Layout
21145	5	Service air West compressor room piping dimensions
21146	5	Service air West compressor room general arrangement
14061	5	380V AC Sub Starion Board 2 Single line Diagram
14066	4	380V AC Sub Starion Board 3 Single line Diagram
14067	4	380V AC Sub Starion Board 4 Single line Diagram
14063	4	380V AC Sub Starion Board 1 Single line Diagram

11. APPENDIX B KKS NUMBERS FOR THE EXISTING SYSTEM

FLOCNUMBER	FLOC DESC
14-01SCA10AN001	EAST ELECTRICAL COMPRESSOR 1
14-01SCA51AN001	EAST ELECTRICAL COMPRESSOR 2
14-01SCA52AN001	EAST ELECTRICAL COMPRESSOR 2
14-02SCA51AN001	WEST ELECTRICAL COMPRESSOR 5
14-02SCA52AN001	WEST ELECTRICAL COMPRESSOR 5
14-02SCA10AN001	SERVICE AIR SCRW TYPE COMPR
14-01SCA20AN001	EAST DIESEL COMPRESSOR

12. APPENDIX C AMBIENT REFERENCE CONDITIONS FOR CAMDEN POWER STATION

Elevation	Atmospheric pressure			Dry-Bulb temperature			Relative Humidity		
MASL	Minimum	Expected	Maximum	Minimum	Expected	Maximum	Minimum	Expected	Maximum
	kPa(abs)	kPa(abs)	kPa(abs)	ºC	ºC	ºC	%	%	%
1662	78.2	83.203	88.20	-10	25	35	20%	60%	80%

13. APPENDIX D VENDOR DOCUMENT SUBMITTAL SCHEDULE

See attach Spreadsheet.