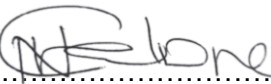






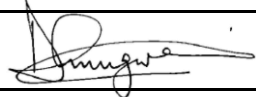



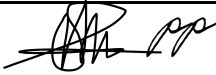



	Scope Of Work	Research, Testing and Development
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1. INTRODUCTION

Eskom is currently developing wind farms for Four (4) sites (Hendrina, Camden, Grootvlei & Tutuka). The Four sites are situated in the Mpumalanga Province in South Africa. Eskom is planning to install Meteorological (Met) Masts on each site and one lidar unit for wind resource assessment campaign.

1.1 Site Locations

Site 1: Hendrina PS

Hendrina PS is situated about 40km south of Middleburg and 28 km north of the town Hendrina in the Mpumalanga Province of South Africa next to the N11 national road in Mpumalanga. The GPS coordinates for the power plant is: 26° 01' 55.35 S, 29° 36' 01.82 E. The elevation is 1645m above mean sea level.



Figure 1: Hendrina PS Proposed Met Mast Area Location Based on Identified Suitable Spots for Wind Turbines

Site 2: Camden PS

Camden PS is situated about 18km from Ermelo and 106km from eMkhondo (Piet Retief) in the Mpumalanga Province of South Africa next to the N2 national road between Mpumalanga and KwaZulu Natal. The GPS coordinates for the power plant is: 26° 37' 15.18 S, 30° 05' 24.53 S E. The elevation is 1667m above mean sea level.

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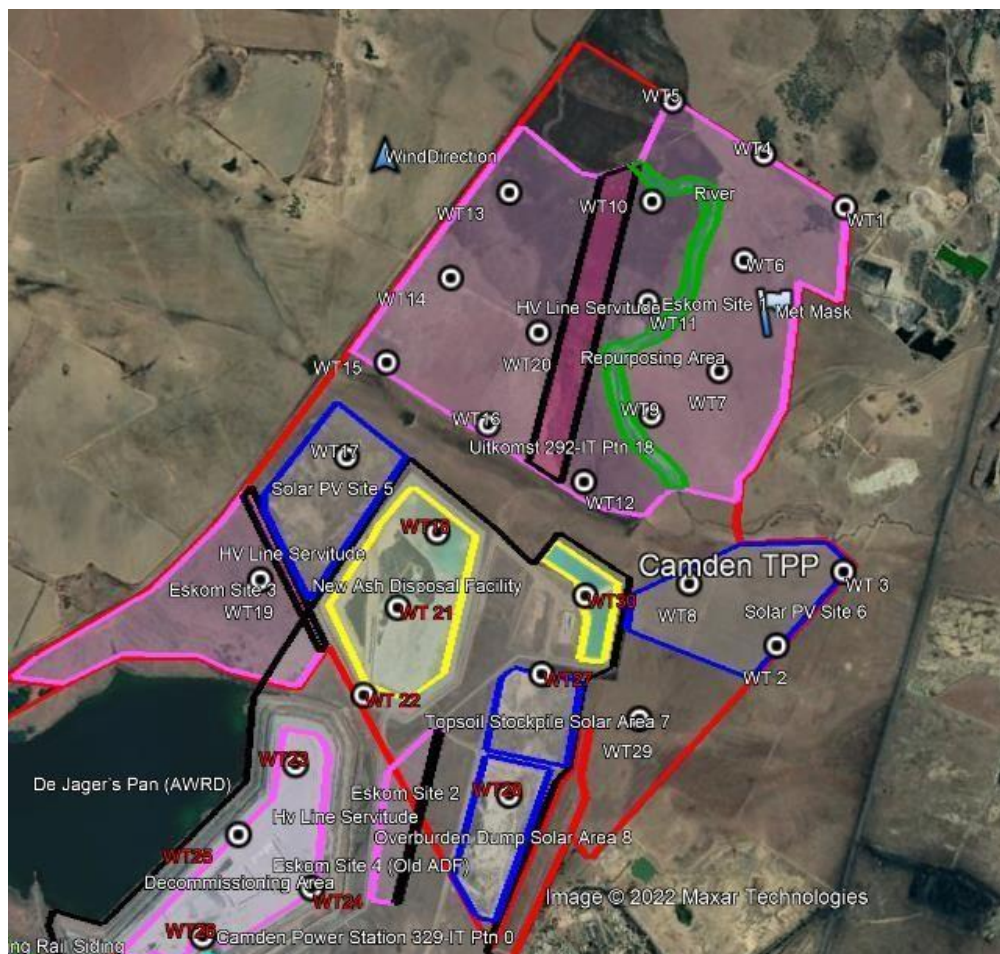


Figure 2: Camden PS Proposed Met Mast Area Location Based on Identified Suitable Spots for Wind Turbines

Site 3: Grootvlei PS

Grootvlei PS is situated about 48km from Heidelberg, 21km from Balfour and 42km from Villiers in the Gauteng Province of South Africa next to the N3 national road between Gauteng and KwaZulu Natal. The GPS coordinates for the power plant is: 26° 46' 0" S, 28° 30' 0" E.

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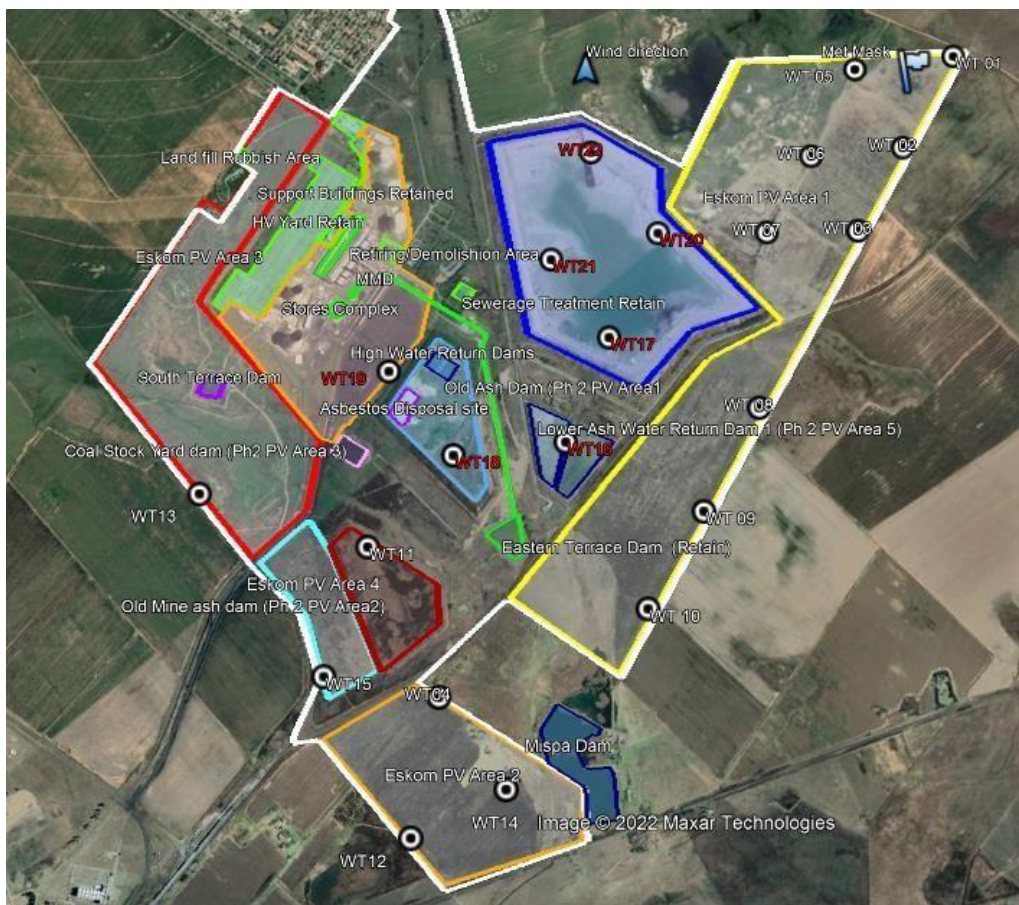


Figure 3: Grootvlei Proposed Met Mast Area Location Based on Identified Suitable Spots for Wind Turbines

Site 4: Tutuka PS

Tutuka PS is situated approximately 26km outside the Standerton, within the Lekwa municipal jurisdiction, between the R38 and R39 road in Mpumalanga. The GPS coordinates for the power plant is: 26° 46' 43" S, 29° 21' 7" E.

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Figure 4: Tutuka Proposed Met Mast Area Location Based on Identified Suitable Spots for Wind Turbines

2. SUPPORTING CLAUSES

SCOPE

This document covers the scope of work (SoW) for the detailed design, installation, commissioning, operation, and maintenance of wind meteorological (met) mast tower systems for four power stations and one Lidar unit.

PURPOSE

The purpose of the document is to document the scope of work detailing the engineering requirements for the Engineering, Procurement, Construction, Commission, operating and maintenance of the wind Met Masts and Lidar unit.

APPLICABILITY

This document applies to the Risk and Sustainability Division, Hendrina, Camden, Tutuka and Grootvlei Power Stations.

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NORMATIVE/INFORMATIVE REFERENCES

NORMATIVE

- [1] ISO 9000: Quality Management Systems.
- [2] Occupational Health and Safety Act (Osh Act; Act 85 of 93)
- [3] World Bank Report Rev Hendrina Thermal Power Plant Technical Analysis on retiring and repurposing four coal plants, South Africa (30. November 2022)
- [4] World Bank Report Rev Camden Thermal Power Plant Technical Analysis on retiring and repurposing four coal plants, South Africa (30. November 2022)
- [5] World Bank Report Rev 02 Grootvlei Thermal Power Plant Technical Analysis on retiring and repurposing four coal plants, South Africa (11. November 2022)
- [6] Genesis Analytics, Support for South Africa's Just Energy Transition Tutuka Deep-dive (18 November 2022)

INFORMATIVE

- [7] 240-53113953 Manage Engineering Accountability Procedure
- [8] 240-53114026 Project Engineering Change Management Procedure
- [9] 240-53114002 Engineering Change Management Procedure
- [10] 240-50317699 Manage Technical Queries Procedure
- [11] 240-53114194 Control of Non-conforming Product
- [12] 240-53113685 Design Review Procedure
- [13] 240-48929482 Tender Technical Evaluation Procedure
- [14] 240-49910527 Procedure for Plan and Select Technologies
- [15] 240-76992014 Project/Plant Specific Technical Documents and Records Management Work Instruction.
- [16] Department of Environmental Affairs, National Environmental Management Act, 1998, (Act 107 of 1998), Amendment of the Environmental Impact Assessment Regulations Listing Notice 1 of 2014

DEFINITIONS

DISCLOSURE CLASSIFICATION

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

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INTERPRETATION AND TERMINOLOGY

Term	Definition
LIDAR	LIDAR (Light Detection and Ranging) is a remote sensing device that measures wind speed and direction in the atmosphere using laser beams. It <i>Works</i> by emitting short pulses of laser light into the atmosphere and measuring the time it takes for the light to bounce off aerosols or molecules in the air. By analysing the Doppler shift of the returned signals, the instrument can determine the speed and direction of the wind at various altitudes.

ABBREVIATIONS

Abbreviations	Description
ATNS	Air Traffic Navigation Services
CAA	Civil Aviation Authority
C&I	Control and Instrumentation
CAD	Computer Aided Design
COC	Certificate Of Compliance
IEC	International Electronical Commision
OHSA	Occupational Health and Safety Act
PS	Power Station
ECSA	Engineering Council of South Africa
NEMA	National Environmental Management Act
LV	Low Voltage
LED	Light Emitting Diode
SANS	South African National Standards
SoW	Scope of Work
OHSA	Occupational Health and Safety Act
P&ID's	Piping and Instrumentation Diagrams
PFD	Process Flow Diagram
PPE	Personal Protective Equipment
PTW	Permit To Work
QA	Quality Assurance
QC	Quality Control
QCP	Quality control program/plan/procedure

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OEM	Original Equipment Manufacturer
SHE	Safety, Health & Environmental
SHEQ	Occupational Safety, Health, Environmental, and Quality
SOW	Scope Of Work
LIDAR	Light Detection and Ranging
WGS	World Geodetic System
TMH	Technical Methods for Highways

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3. SCOPE OF WORK

The scope of *work* describes the major activities and plant and material that falls within the scope of the *Contractor*. It is the responsibility of the *Contractor* to ensure that all the activities are carried out and all equipment, plant and material is supplied to complete the *works* in every respect.

1) The *works* comprises the following:

- a. Detail Design
- b. Manufacture and procurement
- c. Delivery to and offloading at site
- d. Installation
- e. Commissioning, testing and optimisation
- f. Monitoring and analysis of data
- g. Initial training of Employer's personnel in the operation and maintenance of the system
- h. Documentation as specified in works
- i. Compliance to Safety, Health, Environmental and Quality Specifications
- j. Storage and security of equipment on site

2) All plant, material and equipment is required to be designed for operation in a power plant environment with a minimum requirement for maintenance and operator intervention.

3) It is not the intention of this scope of work to describe in detail all the activities the Contractor is required to carry out, nor to describe in detail everything to be supplied by the Contractor.

4) The Contractor incorporates all the requirements of the Employer's design stated on section 3.

5) The Contractor's design is required to be accepted before any procurement and construction begins.

The purpose of the *Works* is to provide wind met masts for the four Eskom Sites that complies with the IEC 61400-50 series of standards.

The scope of supply shall include the design, manufacture, inspection and testing, transportation, storage, installation, commissioning and handover of four complete, climbable, guyed, three-face lattice towers for wind resource monitoring for each of four sites (four towers in total). The lattice towers shall be supplied and installed with meteorological sensors and data loggers configured with the lidar unit.

All installations of the meteorological towers, booms and sensors shall comply with IEC 61400-12-1. The Contractor must demonstrate that the previous installations done has been done in accordance with IEC 61400-12-1 by providing details of such installations of lattice towers or meteorological masts.

Met Lattice Tower supplied shall be designed in accordance with British Standard 8100 & British Standard 5950 or relevant South African standard. Type test certificates of the Met Lattice Tower shall be submitted for review and acceptance by Eskom. The site design life for the Met Lattice Tower shall be a minimum of twenty (20) years.

The Contractor shall perform Wind data measuring monitoring services and analysis for the period of the contract. The resource performing this function must have a minimum of 3yrs relevant experience in Wind Data Monitoring, Evaluating and Reporting.

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The Inspection Test Plans shall cover all stages of inspections like raw materials, in-process, final inspections and tests at factory, preservation, transportation, storage, erection and commissioning the field quality checks.

All sensors shall be calibrated and calibration certificates be provided. All enclosures for electrical/instruments shall be IP65 for better ingress protection.

Both Lidar unit and the Meteorological Lattice Tower shall be provided with power using solar panels and battery backups.

The Contractor shall also provide a detailed method statement how they plan to execute all the activities listed in this document.

After contract award the contractor shall complete the scope of supply for lattice tower and its instrument within 90 days and shall provide a schedule with the bid demonstrating how he shall meet this target date

Eskom shall be granted access to download, monitor and analyse the meteorological masts and lidar unit data during and after contract expiry date.

The Works is inclusive of all activities necessary for the provision of a fully functional system that meets the Employer's requirements. The Contractor shall ensure that the complete design shall be performed by, an ECSA registered professional engineer/technologist as required by the scope of the design. In instances where the design is performed under the direction, control and supervision of a professional engineer, the professional engineer will be responsible for signing off the design as applicable to his field of registration.

The geotechnical investigation work shall be performed by a person registered with the South African Geomatics Council. In instances where the work is performed under the direction, control and supervision of a professional practitioner or technologist, the professional practitioner will be responsible for signing off the geotechnical report.

The Employer approves the designs as per conditions of NEC3 Engineering and Construction Contract.

3.1 METEOROLOGICAL MASTS LOCATIONS

The Contractor shall confirm the location provided by Eskom. The mast location selection shall comply to the IEC 61400-12 standard.

The location shall take into consideration but not limited to the following:

- The mast shall be located in areas with non-complex terrain and minimal obstacles.
- The mast shall be placed in the main wind direction with no obstructions ahead of the mast as per the IEC 61400-12 standard.
- The mast shall be placed away from obstacles that could create turbulence.
- The placement of the mast shall be in the wind turbine placement area or as close as possible to it at the highest point.

The mast shall be placed away from power lines (outside servitude areas) and environmental sensitive areas as defined in NEMA.

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3.2 SITE CONDITIONS

The *Contractor* ensures that the structures are designed to accommodate the site-specific ambient conditions.

3.3 GUYED LATTICE METEOROLOGICAL TOWERS

The scope of the tower is described below but not limited to the following:

- Design, fabricate, inspect/test, supply and installation of a climbable guyed three-face lattice tower of 160m total height. Lattice tower climbing steps shall be incorporated for ease of maintenance, repairs, and upgrades and not applicable where the tower is designed to be climbable.
- Design, fabricate, inspect/test, supply and installation of a Remote Sensing system (lidar units)
- The design of the structure shall also comply to Eskom Structural Design and Engineering Standard 240-56364545
- Geotechnical investigation for tower foundation design
- Tower foundation design and installation.
- Tower grounding with lightning protection.
- All guy wires, anchors, and other equipment with adequate climatic protection required for installation.
- Aviation lighting system conforming to South African CAA requirements in Technical Standard CAR 139.01.33 including LED lights, solar panels, battery backup, and lighting controller.
- Aviation painting conforming to South African CAA requirements in Technical Standard CAR 139.01.33
- Climbing safety system.
- Fabrication of booms and risers for meteorological equipment per site.
- To stabilise the met masts, each mast will have ground anchors. The guy wires attach the met mast tower to the ground at different heights.
- All required tower erection and boom mounting hardware with adequate climatic protection suitable to both sites.
- Provide all required instrumentation, cables, and instrument enclosures and detailed specifications.
- Data logger and enclosure and detailed specifications.
- Communications equipment and detailed specifications.
- Boom mounting, sensor installation, cable installation, data-logger installation, programming, and commissioning.
- Met Lattice Tower shall be galvanised to applicable ISO 1461 for all the four (4) sites
- All the Meteorological Lattice Tower and Lidar unit shall be provided with power using solar panels and battery backups.

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- Met Lattice Tower supplied shall be designed in accordance with British Standard 8100 & British Standard 5950 or relevant South African standard. Type test certificates of the Met Lattice Tower shall be submitted for review and acceptance by Eskom. The site design life for the Met Lattice Tower shall be at least twenty (20) years.
- Six monthly routine inspection and maintenance of the tower and its instrument for a two year period which include but not limited to structural and guy wires inspection and maintenance.

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3.4 SPECIFICATIONS OF LATTICE METEOROLOGICAL TOWERS

Tower

Towers will be standard guyed three face lattice type with total height of 160 meters. The contractor to provide tower engineering, design, and certification. Scope includes tower and guy anchor foundation design and geotechnical investigation. Tower scope includes finish painting and solar powered lighting system. Marking and lighting shall conform to CAA requirements in Technical Standard 139.01.33. Tower will include an integral climbing safety system.

Booms

The Contractor shall determine the number of instrument mounting booms required per tower that will be supplied per site. Final boom design is the responsibility of Contractor. Boom and riser design should be per recommendations of IEC 61400-12, 2017. Adapters may be required for instrument mounting. Boom design should minimize boom deflection during normal operation. Boom designs should be submitted for review and accepted by Eskom before fabrication.

Instrumentation and Mounting Heights

The Contractor shall determine the suitable type, quantity and placement height of all meteorological sensors and data loggers. Not limited to, the Contractor should cater for six (6) wind vanes, six (6) Anemometers, three (3) Temperature/ Relative Humidity, three (3) Barometric Pressure Instruments and one (1) Leaf Wetness sensor. The instrumentation required must be adequate for the required height (160m) of the meteorological mast.

At each met mast site, the instruments should be oriented facing the predominant wind direction. "Predominant Wind Direction" describes the direction in which the wind blows from most of the time. To position the measuring instruments, the Contractor must use weather station wind data (Wind rose) to determine which wind direction is predominant.

The data from the met masts will be automatically routed to the datalogger which transfers the data to a server and then to a receiving base for monitoring and analyses.

In addition to the instruments, the following will be installed on the mast:

- Solar panel and battery to provide power to the mast, enabling it to transmit the daily data file.
- Lightning rod at the tip of the mast to conduct lightning down the mast through a copper cable, which is earthed at the foundation
- Aviation (obstacle) lighting and visibility markers will be provided in compliance with the CAA regulations.
- Adapters may be required for instrument mounting. The Contractor shall provide all adapters for sensor installation with the data sheets (It shall form part of the design package submitted to Eskom for approval).

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3.5 CIVIL AND STRUCTURAL DESIGN REQUIREMENTS

3.5.1 Design Requirements

All structures shall be designed in accordance with the following code of practice:

- The design of the structure shall also comply to Eskom Structural Design and Engineering Standard 240-56364545
- Vertical, wind and seismic loading: SANS 10160: 2011. Basis of structural design and actions for building and industrial structures.
- Concrete work: SANS 10100:2000. The structural use of concrete.
- Steel work: SANS 10162: 2011. The structural use of steel.

Other acceptable international codes of practice and/or standards may be used in cases where the above codes do not cover the design requirements.

3.5.2 Construction Requirements

Construction shall be carried out in accordance with the relevant sections of SANS 1200, standardized specification for civil engineering construction. Where feasible, the contractor shall minimise the construction footprint to within the final guy wire spread, including laydown area.

3.6 METEOROLOGICAL SENSORS AND DATA LOGGER

- Design, procurement of anemometers, wind vanes, and other sensors as described in the attached summary of instrumentation and mounting heights.
- All required adapters and sensor cabling for the sensors, including sufficient cable slack
- Procurement and installation of a micro-logger including solar panels, battery, and terminal block, and weather tight enclosure.
- Mounting brackets for enclosure.
- Compact Flash module and Compact Flash card for local data storage.; and should be capable of storing data for a minimum period 30 days without overwriting the stored data.
- GPRS modem and antenna compatible with South African GSM cellular service
- Data logger maybe setup to continuously transmit to a central gateway device which can then upload the data to a local network or cloud using ethernet or cellular.
- Micro-logger programming
- Sensor installation and commissioning
- The Contractor shall provide all datasheets (It shall form part of the design package submitted to Eskom for approval).

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3.7 LIDAR UNIT SOFTWARE SERVICE WARRANTY AND SUPPORT

A remote sensor will be located within the identified area per site. The remote sensor is mobile and will be moved from one site to another to further reduce wind resource uncertainty.

The Lidar unit shall be delivered at a site provided by Eskom after the installation of the meteorological mast.

The Lidar units shall be supplied with appropriate software service warranty and support for two-year period. The two-year term commences upon commissioning of the Lidar Units at its first measurement site or test location. The appropriate software shall allow the team to monitor the Lidar on a daily basis and report any issues to Employer within 24 hours of business for rapid repair or other remedial action if required. It shall also allow to carry out remote diagnostics to ensure that problems are rectified as efficiently as possible in the field. The contractor shall also provide after sale service and support. The Contractor or the Original Equipment Manufacturer (OEM) will provide any software upgrades supportable by the Employer's software system at no charge to the Employer. All warranty repairs shall cover all events arising from normal operation of the appropriate software system at no cost to the Employer. If a warranty repair trip is needed, the OEM will schedule the trip to occur as fast as practicable at no charge to the Employer. Labour, transport and spare parts for warranty repairs will be for OEM's expense.

The contractor shall provide an option to Eskom to enable to view live data performance, analysis features; fast data export and secure data storage from software. The contractor must also provide to Eskom a second option for File Transfer Protocol (FTP). This shall enable quick download of data on a monthly period from an FTP site rather than accessing live software.

The software online system shall provide access to a web-based wind data service with functionality for:

- Data uploading from wind data measurement devices
- Data archiving of wind data
- Data review of current and historical data
- Data export and downloading
- Analytics, such as custom reporting and charting

3.8 CONTRACTORS WORKS EXPERIENCE

- 1) The *Contractor* must demonstrate a minimum of three years' experience in supplying, installing and commissioning of meteorological towers of heights $\geq 100\text{m}$ and sensors successfully.
- 2) The Contractor must have traceable references adequately proving that at least One (1) or more contracts of similar scope (Erecting of a Met Mast Towers of height $\geq 100\text{m}$) were successfully completed with added experience in the Towers maintenance and wind data monitoring, evaluating, and reporting.
- 3) All installations of the meteorological towers, booms and sensors shall comply with IEC 61400-12-1. The Contractor must also demonstrate that the previous installations done have been done in accordance with IEC 61400-12-1 by providing details of such installations of lattice towers or meteorological masts. Met Lattice Tower supplied shall be designed in accordance with British Standard 8100 & British Standard 5950 or relevant South African standard.

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3.9 RESPONSIBILITY FOR DESIGN

- 1) The Contractor takes full professional accountability and liability for all Works performed.
- 2) All designs, design reports, Construction drawings, as built drawings and other deliverables as indicated in 10.2 prepared by the Contractor are signed off by an ECSA Professionally registered Technologist or Engineer who takes full professional accountability for the designs.
- 3) The Contractor's design and execution of the Works is required to be in accordance with all National Standards and Specifications referenced in this Scope as well as the Employer's Standards referenced in Annexure 17. Specifications referenced within referenced documents are also adhered to.
- 4) All the designs are subjected to the Employer's acceptance prior to the Execution of the Works as per the conditions of NEC3 Engineering Construction Contract
- 5) Prior to the execution of the Works, the Contractors detailed design of the Works shall be executed only and once review & approval of the designs has occurred. The review & approval shall be submitted to the employer.
- 6) The Contractor is solely responsible for providing the protection of the equipment from damage or loss due to weather, fire, theft, unexplained disappearance or similar during the execution of the Works
- 7) The liability of the use of such equipment in the execution of the Works shall remain that of the Contractor.
- 8) The Contractor's Professional Engineer conducts the necessary inspection during execution to the sign-off and certify the Works

4. COSTRUCTION OF WORKS

4.1 SITE ACCESS

As main access roads, the use of existing roads at the sites will be prioritised. However, some minor access roads might be added to reach the met masts with the necessary heavy-duty vehicles and cranes.

4.1.1 Contractor's scope for the operating, control and maintenance philosophy

The *Contractor* shall provide a detailed operating and maintenance philosophy for the installed equipment. The *Contractor* shall also provide the necessary periodic maintenance inspections required for the plant together with the maintenance philosophy. The *Contractor* shall provide a critical spares list for the *works*.

4.1.2 General Design and Manufacturing Process Constraints

In providing the *works*, the *Contractor* is fully responsible for the delivery to, offloading and storage of all plant, equipment and materials required for the *works* on site. The *Project Manager* reserves the right to carry out any checks of his/her own on any plant, equipment and materials that have been delivered to site for the *works*.

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The *Contractor* is fully responsible for the installation of all mechanical, civil, electrical, process control and instrumentation components, equipment and material as well as the interfacing and tie-ins with existing plant and equipment as required for the *works*.

The *Contractor* is responsible for the complete optimisation of the *works* to meet or exceed the guaranteed performance levels.

4.1.3 Engineering Design

The Contractor shall be responsible for the detailed design & manufacture of the new 160m 1000/484 guyed lattice mast.

- All design drawings must be done in Computer Aided Drawing (CAD) format and provided to Eskom electronically. Drawings must be Microstation/Bentley view compatible.
- The contractor must specify the necessary corrosion control measures to be applied on the tower structure.
- The contractor must comply with the Civil Aviation Organisation Authority) stipulations on obstruction painting and obstruction lighting. Lighting must be supplied in 24Vdc if possible.
- The contractor must clearly specify the tower structure base foundation requirements and the appropriate concrete design thereof.
- The contractor must ensure that the design includes adequate information concerning the structure and any materials and substances.
- The contractor shall consider the risks involved with the different methods of construction when selecting appropriate design features and materials.
- The contractor shall make clear the principles of the design and describe any special requirements or assumptions made for the purposes of construction, maintenance, and eventual removal.
- The contractor must take cognisance of the geo-technical investigation findings on soil and wind conditions at the installation site for purposes of determining bearing pressures (vertical and horizontal), other sub-surface conditions, the suitable foundation type (reinforced concrete blocks, standard pad and column, raft, preset rock anchors or piles), construction materials and installation method.

4.1.3.1 Civil & Structural Design

General

1. The *Contractor* is responsible for the detailed design of the entire *Works*.
2. The *Contractor* is required to submit detailed drawings for construction signed by a Professional Engineer/Technologist. These drawings are in accordance with the Constructability Assessment Guideline (240-107981296)
3. The *Contractor* is required to submit a comprehensive design report signed by a Professional Engineer/Technologist.
4. Design reports include all information related to the design including but not limited to the following:
 - Project name
 - *Contractor's* name
 - Contract No.
 - Date of calculation
 - Revision No.
 - Name of the item

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- Page No.
 - Assumptions used for design purposes.
 - Codes and standards used.
 - Computer programmes used.
 - Loading imposed by structures, plant and equipment during the erection, commissioning, operation and maintenance.
 - Safety factors and combinations of loads used.
 - Detailed calculations of all components
 - Settlement of plant and equipment foundations
 - Reference sources (including textbooks and design manuals used)
 - Reference to the appropriate drawings
 - Selected materials and finishes.
 - Manufacturer's technical specifications
 - Survey drawings
 - Design criteria/parameters
 - Design models
 - Software input information
 - Software outputs
 - Sources of information and any record of other information associated with the completed *Works*.
5. The *Contractor* also adheres to the requirements for design reports indicated in 240-56364545 - Structural Design and Engineering Standard.
6. The detailed design report in conjunction with the drawings contains sufficient information at a level of detail allowing a complete re-analysis and redesign of the infrastructure.
7. The *Contractor* submits all calculations files, software models, stage curves and drawings in native electronic format to the *Employer*. The *Contractor* considers the *Employers* Design Review Procedure (240-53113685) as stipulated in Section 3 of the NEC Document.

4.1.3.1.1 Geotechnical and Geophysical Survey Investigation

- The Contractor is required to conduct geotechnical investigations for all areas required for the Contractor's design. The geotechnical investigation *Works* will also include geophysical surveying to ensure that no underground services are impacted during the geotechnical investigation.
- The Geomatics practitioner/Technologist has a minimum of 3yrs relevant experience in geotechnical studies.
- Letter of intent signed by both parties is required where subcontractor/s will be used.
- The geotechnical investigation is required to be in accordance with the following:
- SAICE Site Investigation Code: 2010
- All drilling is conducted in accordance with CSRA: Standard Specification for Sub-surface Investigations, 2010

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- All laboratory testing is conducted in accordance with the latest standard methods and procedures as outlined by the appropriate authorities (B.S/ Eurocode equivalent, A.S.T.M, A.A.S.H.T.O, I.S.R.M, S.A.B.S / S.A.N.S)
- All Soil profiling is conducted in accordance with guidelines outlined in: Jennings, J.E, Brink, A.B.A, & Williams, A.A.B, (1973) "Revised Guide to Soil Profiling for Civil Engineering purposes in Southern Africa" Trans. S.A.I.C.E, Vol. 15, No. 1, pp 3 – 12.
- All rock core logging is conducted in accordance with guidelines outlined in: Brink, A.B.A, & Bruin, R.M.H, (2002) Second Impression: "Guidelines for Soil and Rock Logging in South Africa, Proceedings of Geoterminology Workshop 1990" S.A.I.E.G. – A.E.G. – S.A.I.C.E.

All services are conducted in accordance with the requirements of the Occupational Health and Safety Act (Act 85 of 1993) as amended.

4.1.3.1.2 Surveying

- The *Contractor* is responsible for conducting all additional surveys required for the detailed design of the *Works*. The level of detail of the survey conducted is as required for the detailed design.
- It is the *Contractor's* responsibility for the detection and protection of underground and above ground services.
- Geophysical scanning is done by the *Contractor* to locate sub-surface utilities both metallic and non-metallic prior to any excavations.
- The type of Geophysical scanning employed is at the discretion of the *Contractor*, taking note of the required output. The *Contractor* therefore considers the working environment prior to selection of test methodology and equipment.
- The *Contractor* considers possible signal interferences which may be experienced by the geophysical scanning equipment caused by equipment, and services stray current in and around the areas.
- The *Contractor* submits the results of the scanning to the *Employer* and indicates any possible services which may interfere with the geotechnical investigations or construction of the designs
- All surveys are done using the WGS 84 LO29 coordinate system and are in accordance with TMH 11

4.1.3.1.3 Geotechnical Investigation Report

After completion of field *Works* and laboratory testing, the *Contractor's* professional engineering practitioner or technologist engineer is required to prepare and submit a consolidated geotechnical report based on the field *Works* conducted. Information and interpretive results are to be clearly distinguished in the report.

The geotechnical report is to include but not limited to the following:

- Site Location.

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- Site Description (this shall include observed relief, vegetation, drainage, manmade features).
- Geological Setting;
 - o Regional Geology,
 - o Local Geology and Geo-hydrology.
 - All geo-hydrological information is to be sourced from the local municipality, adjacent mines and mining areas and through accepted published literary *Works*,
 - o Regional Geological Hazards,
- Surface and sub-surface conditions as determined by intrusive ground testing. This shall include:
 - o classification and description of all pertinent geotechnical properties
 - o discussions of loads, settlements, settlement versus time,
 - o all groundwater and process water intersection, quantification, and source thereof,
- Detailed results and discussions of all in situ and laboratory tests, classifications, and stability of the existing structure
- All field data and laboratory results are to be included in the appendices.

4.1.3.1.4 Corrosion Protection

- All steel work is required to be hot dipped galvanised including grating.
- All galvanising is required be done in accordance with SANS 121. Preparation of steel prior to galvanising and coating thickness is also required to be in accordance with SANS 121

4.1.3.2 Electrical Detailed Design

4.1.3.2.1 General Requirements

1. All electrical designs shall be submitted to the Employer for acceptance.
2. Layout drawings that indicate the coordinate location of electrical equipment, every junction box, cable connection points and termination requirements, including lighting and small power in auxiliary bay if applicable.
3. Arrangement and wiring diagrams are required for each skid, junction box, cubicle, and lighting and small power device.
4. Schematics and details required for design of the electrical circuits that will ensure the correct functionality of the equipment.
5. Single Line Diagram depicting source of power supply for the major equipment.
6. Recommended spares list is required.
7. *Contractor* shall hold a design review for conducting an in-depth contract compliance review of the plant, allowing the Employer to gain a clear understanding of the overall design.

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8. The review shall be after the completion of the design, the preliminary outline drawings, and the rating plate drawings.
9. The *Contractor* shall demonstrate how the system functions reliably within the operating requirements and meet the performance guarantees. There shall be sufficient information for each major element available to review the design for functionality and for future reference such as maintenance. The *Contractor* will make available documentation for on-site review.
10. The *Contractor* shall make available the calculations and information for the detailed design verification. This part of the design review will take place in the *Contractor's* design offices.

The *Contractor* as a minimum shall consider the following:

1. Site Assessment
 - Conduct a thorough site assessment to determine the solar radiation, shading, and other environmental factors that may affect the solar PV system performance.
 - Determine the optimal location for the solar PV system installation to maximize energy production and minimize the potential for shading and other adverse factors.
2. Load Assessment
 - Determine the power requirements for the wind mast tower instruments, including data loggers, anemometers, wind vanes, temperature and humidity sensors, and any other equipment requiring power supply.
3. System Design
 - Size the solar PV system based on the power requirements of the wind mast tower and RS system instruments in conjunction with the site's solar radiation data.
 - Ensure that the design adheres to relevant local, regional, and national codes, local & international standards and regulations.
 - Design the system to operate reliably, minimizing downtime and ensuring continuous data collection from the wind mast tower instruments.
 - The Employer proposes that the solar PV be mounted on the wind met mast tower and the remote sensing system structure.

4.1.3.2.2 Battery Tripping Units (BTUs) and DC to AC Inverter Functional Requirements

1. Should there be a requirement of BTUs for DC supply, the *Contractor* shall design the BTUs and comply with 240-56176852 – Essential Power Supplies for Power Stations Standard.
2. An essential service single line diagram detailing the distribution of the DC supplies shall be submitted to the Employer.

4.1.3.2.3 Cabling

1. The *Contractor* shall design all cables with clamps, lugs and fittings.

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2. The *Contractor* shall design the cable routing and racking or supports, cleat in position with approved straps.
3. The *Contractor* shall submit cable schedules, cable routing, cable connection and termination block diagrams for review and acceptance by the Employer showing items interconnected and the cables provided. Each cable shall be numbered and coded, including the applicable general arrangement, wiring, circuit, and cabling drawing numbers.
4. Power and control cables shall comply with Eskom standard 240-56227443 Requirements for Control and Power Cables for Power stations Standard.
5. The *Contractor* shall submit cable design calculations to the Employer for review and approval before installation.

4.1.3.2.4 Cable Terminating Facilities

1. The *Contractor* shall design cabling to allow cable approaches accommodating cable-bending radii as per the cable manufacturer's requirements or SANS 10142-1, whichever is greater.
2. The *Contractor* shall make provision for terminals to accommodate cable cores with cross-sectional areas two sizes larger than that required for the current rating of the device.

4.1.3.2.5 Earthing and Lightning

1. The *Contractor* shall perform a design of the earthing system in accordance with the Wind met mast best practice for the area around the System.
2. The *Contractor* shall provide details of its specific earthing system requirements, philosophy, and details of earthing systems to Employer.
3. The *Contractor* shall design earthing and lightning protection in accordance with Eskom standard 240-56356396 Earthing and Lightning Protection.
4. The *Contractor* shall furnish details of the earth and lightning protection design to the Employer for acceptance for implementation.
5. The Contractor installs lighting that is suitable for the area of application, readily accessible for maintenance, and standardized as much as possible, to keep the luminaires and lamp spares to a minimum.

4.1.3.2.6 Lighting and Small Power

Should there be a requirement of lighting and small power:

1. The *Contractor* shall provide small power reticulation and architectural lighting design for the solar powered flood lights with daylight sensor surrounding the met mast and the RS system. The Contractor to ensure that the lights are within the security system.
2. The *Contractor* shall design lighting and small power in accordance with Eskom standard 240-55714363 Coal Fired Power Stations Lighting and Small Power Installation Standard and SANS 10389-2 – Exterior Lighting Part 2: Exterior Security Lighting.

4.1.3.3 Control and Instrumentation Design

The Contractor determines the final positioning and orientation of the equipment ensuring compliance to the IEC 61400-12-1

The following general design requirements are applicable to all aspects of the C&I design

1. All field equipment is installed in a suitable location.
2. The *Contractor* shall ensure field equipment operates in an environment within the parameters stipulated by the manufacturer.
3. Where harsh environmental conditions are unavoidable, the field equipment shall be designed for operation in that environment.
4. All IP ratings are as per SANS 60529
5. All supplied field equipment, excluding Junction Boxes (JBs) and their electrical connections are rated IP 65 or better.
6. Field equipment situated outdoors, or in adverse environments, must be provided with additional protection hoods and enclosures.
7. All supplied field equipment operates over an ambient temperature range of: -10°C to 70°C.
8. The equipment layout shall be such that when mechanical work is performed, no C&I equipment shall be damaged.
9. The supplied field equipment provided shall be standardised to the maximum extent possible
10. The *Contractor* as part of the scope of work provides a detailed design report prior to execution of the works during the detail design scope freeze.
11. All the documents required to be submitted by the *Contractor* during the design freeze shall be supplied as part of design data pack.
12. The detail design report shall be in line with Eskom detail design report template (240-49910707)
13. All field equipment installations are required to comply with Field Instrument Installation Standard, 240-56355754.
14. All instrumentation shall be provided with a nametag/plate.
15. All instrumentation must use either 24V for binary feedback or 4-20mA for analogue feedback.

4.1.3.3.1 General Junction Box and Termination Requirements

Junction boxes are rated IP 65. The contractor to comply with this standard 240-563555: Junction box and cable termination.

- The *Contractor* uses spare terminals in the existing junction box for interfacing the C&I plant to the C&I control system.
- The *Contractor* uses compression cable glands for cable entries on junction boxes to maintain the junction box IP rating.
- The *Contractor* provides additional terminals in the junction box if necessary to complete the C&I interface requirements.

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- The *Contractor* uses terminal lugs for C&I cables according to 240-56227443 - Requirements for Control and Power Cables for Power Stations.
- The *Contractor* shall supply and install new junction boxes where required in accordance to Eskom standards.

4.1.3.3.2 Enclosures/ Panels

- The Contractor to design and install panels that will house the battery, inverter, data loggers, modem etc to prevent damage from environmental factors.
- The Contractor to position the housing must be accessible to allow ease of maintenance but must also be kept high enough to the position of the housing must be accessible to allow ease of maintenance but must also be kept high enough to avoid theft and vandalism void theft and vandalism.
- All enclosures for electrical/instruments shall be IP65 for better ingress protection.
- The Contractor to ensure sufficient cooling to avoid damage of electronic equipment due to heat.

4.1.3.3.3 General Cabling & Racking Requirements (Cable Installation and Routing)

- All Cable Installation and instrumentation cables shall be flame retardant low smoke type and comply with 240-56227443: Requirements for Control and Power Cables for Power Stations Standard. Instrument cabling to be installed with due respect for safety, reliability, access, maintenance, environmental conditions and best practices. All cabling must be suitably protected against mechanical damage, chemicals, dust build-up and heat.

4.1.3.3.4 C&I Cabling

- The *Contractor* shall provide the design, supply, installation, termination, labelling, testing and commissioning of all cabling.
- Cables are according to 240-56227443 Requirements for Control and Power Cables for Power Stations.
- New cable routes shall be designed such that equipment can be removed for maintenance without causing damage to the cables.
- Cable conduits shall be provided.
- Durable cable numbering/labelling shall be provided for all installed cables entering junction boxes.
- The cable numbering/labelling shall be such that cable maintenance is easily achieved.
- All cables, as a minimum, shall be insulated with flame-retardant, halogen-free PVC outer sheath.
- All field cabling shall have a minimum of 2 pairs (UVG2ACM).
- Internal cores of all multi-core cables shall be colour coded.
- The management, design expertise, supply and installation for all cables, cabling and routing shall be provided by the *Contractor*.

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- All installed cables are tested and Certificates of Compliance are issued prior to commissioning of any instrument.
- All cables provided are secured with suitable cable glands, straps or clamps on racks, in cubicles, switchgear rooms, control rooms, equipment rooms etc.
- Transducer cabling is required to be installed with due respect for safety, reliability, access, maintenance, environmental conditions and best practice.
- All cabling is required to be suitably protected against mechanical damage, chemicals, dust build-up and heat.
- Cables are required to only be terminated in instruments, junction boxes or other approved equipment.
- No intermediate cable joints are permitted.
- Cables connected to instruments are required to be installed with a loop of cable to provide sufficient slack for re-making the cable connection if the instrument is removed and to allow for removing the instrument without electrical disconnection.
- Cables are required to be routed separately from electrical power cables and crossovers that bring signal and power cables into close proximity shall be made at right angles.

4.1.3.3.5 Cable Glands

- The *Contractor* provides stainless steel cable glands for use with cable installations.
- The *Contractor* uses cable glands for all cable entries.

4.1.3.3.6 Cable Racks

- The *Contractor* provides cable racks where required according to 240-56227443 Requirements for Control and Power Cables for Power Stations.

4.1.3.3.7 Cable Conduit/Trunking

- The *Contractor* provides cable conduit or trunking where cables may be exposed to damage during normal plant operation.
- The *Contractor* provides galvanised cable conduit or trunking where necessary.
- The cable conduit or trunking is according to 240-56227443 Requirements for Control and Power Cables for Power Stations.

4.1.3.4 Mechanical Design

The Mechanical scope of work for this Package entails the following:

- (1) The Contractor as part of the scope of work provides a detailed design report prior to execution of the works during the detail design scope freeze. All the documents required to be submitted by the Contractor during the design freeze shall be supplied as part of design data pack.

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4.1.3.4.1 Welding

- Welding is in accordance with 240-56241933, "Control of welding during construction, repair and maintenance activities standard"
- Welding is in accordance with 240-83539994, "Eskom NDT personnel approval for quality related special processes on Eskom plant standard"
- Welding is in accordance with 240-56246601, "Qualification, certification and accreditation requirements for personnel and entities performing welding related work on Eskom plant standard"
- Welding is in accordance with 240-83540088, "Requirements for non-destructive testing on Eskom plant standard"
- Welding is in accordance with 240-106628253, "Standard for Welding Requirements on Eskom Plant"

4.2 PROCEDURE FOR SUBMISSION AND ACCEPTANCE OF CONTRACTOR'S DESIGN

- The Contractor submits all designs to the Employer for record purposes. The designs submitted are complete packages with all elements (drawings, calculations) included.
- The Employer conducts a high-level review of the drawings. The Employer reserves the right to review any design in the detail that is deemed necessary. The Employer accepts no accountability and liability due to the review of any designs or if any acceptance is given.
- The Contractor is the Design Authority as defined in the Design Review Procedure 240-53113685 for the *Works*. In terms of the Construction Regulations, the Employer's review of the Contractor's design does not influence the design as only the Contractor can amend, update and revise the design. The Contractor remains the "Designer" as per the Construction Regulations, the Employer is not the "Designer". The Contractor is responsible for following this design procedure and submits all the necessary information to the Employer to allow the following reviews to be conducted:
 - Design Freeze Review
 - System Integrated Design Review
 - The Contractor considers this review process in the schedule
- The following process will be followed during submission of documents:
 - The *Contractor* submits the documents/drawings to the Employer's Document Controller.
 - The Employer's Document Controller registers the documents.
 - The Employer's Document Controller will supply the documents/drawings to all relevant parties within the Employer's project team.
 - The Employer's project team reviews the documents/drawings and will submit all comments or inputs to the Contract Manager who submits to the Contractor for consideration.

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- If the Employer finds major deficiencies in the submitted documents/drawings, the Contractor revises the documents/drawings and resubmits to the Employer.
- The Employer reviews the documents/drawings and if no major deficiencies are found, the *Contractor* organises a review session.
- The Employer and the Contractor conduct a review.
- If any fundamental errors were found in the review or further actions are required, the *Contractor* record all concerns raised and revises the documents/drawings.
- The *Contractor* organises a review session once all documents/drawings have been revised according to the concerns raised by the Employer.
- If no fundamental errors were found in the documents/drawings during the review session, the *Contractor* compiles the review minutes/report and submits it to the Employer.
- The Employer's Document Controller registers the report.
- The Employer's project team reviews the Contractor's report/minutes. If the report/minutes are not acceptable, the Contractor revises the report/minutes and resubmits to the Employer.
- The Employer will accept the Contractor's documents/drawings once the report/minutes are accepted by the Employer's project team.
- The Contractor is to implement the following activities for acceptance:
 - The *Contractor* reviews, stamps, dates and signs to signify his approval and submit in the manner required by the Employer in an orderly sequence so as to cause no delay in the work, all *Contractor's* drawings, equipment selections and/or samples required by the *Works* or subsequently by the Employer. Contractor's drawings, equipment selections and samples are to be properly identified as specified or as the Employer may require.
 - At the time of submission, the Contractor informs the Employer in writing of any deviation in the *Contractor's* drawings, equipment selection or samples from the requirements of the *Works*.
 - Each individual plant & material selection submission is to be accompanied by a copy of the applicable detailed technical specification. Each clause of this specification to be marked "Complies" or "Does not comply", complete with reason stated, alternative offered and countersigned by the Contractor.
 - Plant & material selection submissions are to be indexed like the index for plant & material part of the "Operating Instructions and Maintenance Manual".
 - The *Contractor* is required to submit two copies of drawings and plant & material selections along the channels agreed.
 - By submitting drawings, plant & material selections and/or samples, the Contractor represents that he has determined and verified all site measurements, site instruction criteria, materials, catalogue numbers and similar data, and that he has checked and co-ordinated each services drawing and sample with the requirements of the *Works*.
 - The Employer reviews *Contractor's* drawings, plant & material selections and samples so as to cause no delay, but only for conformance with the design of the *Works*. The Employer's approval of a separate item does not indicate approval of an assembly in which the item functions.
 - The *Contractor* makes any corrections required by the Supervisor and re-submits the required number of corrected copies of the *Contractor's* drawings, plant & material selections or new samples until approved. The *Contractor* directs specific attention in writing on resubmitted drawings to revisions other than the corrections required by the Supervisor on previous submissions.

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- A design report will be compiled on the Eskom Template 240-59083262 by the *Contractor* for submission to the *Employer*
- In addition to the internal design review and change management system of the *Contractor* the Eskom Design Review Procedure 240-53113685 and Project Engineering Change Procedure (240-53114026) must be implemented
- During the design process, if tools are required which have intellectual property, the *Contractor* will provide the details in terms of acquiring the intellectual property or offer an alternative tool or design calculations that will yield the same results to assist with the reviewing process by the *Employer*.

4.3 USE OF CONTRACTOR'S DESIGN

All documentation, as specified in this Scope, forms part of the *services*, and is supplied to the *Employer* by the *Contractor*. The *Contractor* to implement the approved design or drawings for construction, maintenance, design reviews, construction monitoring, and technical support during construction, spares, verifications, modifications in future or any other purposes required by the *Employer*. The *Contractor* notes that all drawings and other documentation supplied to the *Employer* become the property of the *Employer*.

4.4 OTHER REQUIREMENTS OF THE CONTRACTOR'S DESIGN

4.5.1 Operating and Maintenance Manual

The *Contractor* provides operating and maintenance manuals, as well as an Operating Technical Specification for the new Plant. The *Contractor* provides 4 hard copies and an electronic copy.

The procedures are provided by the original equipment manufacturer detailing descriptions of operating and the maintenance work. The procedure covers the requirements for maintenance of the equipment over the design life.

4.5.2 Maintenance Schedule

The *Contractor* provides a maintenance strategy for the life expectancy of the meteorological masts and lidar unit with a summary schedule. The *Contractor* provides the life expectancy of the equipment. The *Contractor* lists maintenance spares (with detailed specifications) for the life expectancy of the equipment.

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4.5 CONSTRUCTION

- (1) The *Contractor* is responsible for the erection, maintenance and removal of all temporary bracing or propping required for the execution of the works.
- (2) The *Contractor* shall adhere to the Eskom Standards and the relevant SANS standards
- (3) The *Contractor* provides all relevant welding procedures for acceptance to the Project Manager.

The works described in this scope include the following:

4.5.1 CONSTRUCTION AND ERECTION PHASE

- (1) The *Contractor* constructs and erects the *works* in accordance with the detail design approved by the *Employer*.
- (2) All *works* performed in accordance with the *Contractor's* accepted Quality Control Plan. All construction and erection work conducted on site is subject to inspection by the *Employer*.
- (3) The *Contractor* is required to provide suitably qualified and experienced supervision personnel for his supervision of the *works*. The *Employer's* Supervisor is appointed to carry out technical and quality assurance.
- (4) All equipment required for the erection and completion of the *works* is supplied by the *Contractor*. The *Contractor* ensures that the Equipment is in good condition and complies with the *Employer's* safety requirements.
- (5) The *Contractor* supplies all Plant and Materials where new Plant and Materials are required for the completion of the works.
- (6) All Plant and Materials used complies with the requirements regarding quality, method of manufacturing, testing and performance specification as given in the relevant SABS/SANS specification, or where such a specification does not exist, the requirements of the relevant internationally accepted standard. All plant and materials shall be suitable for use or operation under the operating conditions applicable to the system.

4.6 TEMPORARY WORKS, SITE SERVICES & CONSTRUCTION CONSTRAINTS

4.6.1 Restricted Working Conditions

The erection of any temporary *works* such as formwork is subject to acceptance of the *Employer*. The *Contractor* is to take all necessary precautions to ensure that no damage to any existing plant and equipment takes place during the *works*. The *Contractor* supplies all equipment necessary for the construction of the *works*. The *Contractor* takes cognisance of existing plant and equipment as well as safety and housekeeping constraints. It is the *Contractor's* responsibility to overcome any issues that may arise due to space constraints with prior consent from project management and no extra payment or claim of any kind will be allowed on account of difficulties of access to the *works*

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4.6.3 Employer's Site Entry and Security Control, Permits, And Site Regulations

All the *Contractor's* employees are required to attend a safety induction course before they will be allowed to work on the Site. It is the responsibility of the *Contractor* to ensure that all employees have attended the safety induction. The *Contractor* has to compile his/her safety file for approval at the safety officer. The safety officer must first approve this file, before the *Contractor* can attend the safety induction course.

A list of employees requiring safety induction must be submitted at least 2 days in advance of arrival on site with the date and time of arrival so that safety induction can be arranged.

Site access control to the Power Stations will be arranged with the *Project Manager* after successfully completing the safety induction course.

Alcohol testing will be conducted at any time on all employees entering the Power Stations premises. All staff that tested positive for alcohol abuse will not be allowed on site.

4.6.4 Security

The Contractor provides security measures for Meteorological Masts units during the period of construction. The contractor complies to all statutory requirements regulating the Security Industry (PSIRA). The minimum-security measures shall cater for prevention of theft and vandalism. The site has livestock e.g. sheep and cattle that must also be prevented from damaging the unit.

4.6.5 Restrictions to Access On Site, Roads, Walkways And Barricades

All vehicles must comply with the Road Traffic act.

Vehicle inspections will be conducted on a daily basis and check sheets must be kept at the *Contractor's* offices.

4.6.6 Hazardous Locations

A hazardous location in terms of SANS 10108, clause 3.15, or by performing a risk assessment of the plant, is an area where there might be a significant risk of igniting gas, dust or vapour. There are special requirements for apparatus used in such areas. The explosion protection rating of the apparatus determines whether it is suitable for application in the area depending on the Hazardous Location classification (SANS 10108). There are also specific authority approval requirements for the different explosion rated apparatus (SANS 10108).

The power station approved hazardous location procedure shall be applicable for the lighting and small power installation (and other Plant). The lighting and small power installation shall conform to the authorised power station hazardous location classification document. When an area is classified (like the battery rooms) the luminaires used in that area should be approved by the required authority to be suitable for that area e.g. if an area is classified as Zone 2, only luminaires with an Explosion Rating of "Ex ia" shall be used (refer to Annex F in SANS 10108).

IP 65 luminaires shall be used in areas where there is likely to be dust. The luminaire must comply with SANS 10108 and the applicable standard for the type of apparatus e.g. increased safety apparatus should comply with the relevant parts of SANS 60079.

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5. SITE PROCEDURES AND REGULATIONS

5.1 Permit to work system

- (1) The *Contractor* to have his site supervisor trained, tested and declared competent as responsible person, by the employer prior to commencement of the *works*.
- (2) No work is required to be carried out without a "PERMIT TO WORK".
- (3) The *Contractor's* Responsible Person must satisfy himself that all sources of possible danger are isolated.
- (4) Plant with a prohibitive sign attached may only be operated by the *Employer's* personnel. Any employee of the *Contractor* found tampering with such plant will be permanently removed from the *Site*.
- (5) The *Contractor* must provide a facility to lock valves, switchgear and other equipment in accordance with the Permit to Work system.

5.2 Safety induction course

- (1) All the *Contractor's* employees are required to attend a safety induction course before they will be allowed to work on the site. It is the responsibility of the *Contractor* to ensure that all employees have attended the safety induction. The *Contractor* has to compile his/her safety file for approval at the safety officer. The safety officer must first approve this file, before the *Contractor* can attend the safety induction course.
- (2) A list of employees requiring safety induction must be submitted at least 2 days in advance of arrival on site with the date and time of arrival so that safety induction can be arranged.

5.3 LOCAL SAFETY PROCEDURES

The *Contractor* adheres to all local procedures. A list of local procedures is available on request from the *Project Manager*.

5.3.1 Incidents/Accidents

- (1) Incidents and accidents must be reported and investigated as detailed in the Eskom Safety, Health and Environmental Procedure 32-95. All incidents must also be reported to the Project Manager before end of shift.
- (2) First aid must be available either by the *Contractor* or use can be made of the specific Power Stations medical centre at a fee. The availability of the *Contractor's* own first aid does not relieve the *Contractor* of his obligation to report and investigate the incident in accordance with the Power Stations procedures.

5.3.2 Safety and Fire Hazards

The installation in its entirety is to comply with the electrical safety and supply interference suppression requirements, with SABS and/or and local authorities' by-laws.

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All safety devices are to be tested by the *Contractor* under the simulated or actual fault conditions for which the safety devices are installed to prevent damage to system equipment and/or building. The *Contractor* confirms proper functioning of these safety devices in the form of signed inspection reports.

5.3.3 Inspection of equipment

- 1) The *Contractor's* equipment is inspected by an authorised employee of the *Employer* on arrival at the Site.
- 2) The following documentation is required to accompany the equipment where applicable: copies of all test certificates and maintenance records.
- 3) Lifting equipment and electrical equipment must be marked with a unique number, code or colour code for identification. If the equipment is found to be in an unsatisfactory condition or if insufficient maintenance has been carried out on the equipment, then it will not be accepted for use on site.
- 4) A list of all lifting equipment and electrical equipment is submitted to the *Project Manager* at least 2 days prior to the occupation date. This list must indicate the unique number and description of the equipment.
- 5) Training of operators must comply with the *Works Information* and statutory requirements.
- 6) Each and every piece of workshop equipment and tools, the *Contractor* brings on site must be declared and logged at Protective services, the *Employer* will not issue gate release permits to take *Contractors* workshop equipment/tools off site.

5.3.4 Documentation

The Contractor is responsible for having the following documentation available on site in accordance with Safety, Health and Environmental Requirements.

- 1) Copies of all site accident report forms as required by the OHS Act.
- 2) Copies of minutes of health and safety meetings held on site.
- 3) Copies of inspection reports produced by the Accident Prevention Officer.

5.3.5 Title to materials from demolition and excavation

Before the Contractor removes any items of Plant, Equipment or Materials from site, he must obtain permission from the Project Manager to effect such removal.

5.3.6 Co-operating with and obtaining acceptance of others

The Contractor is required to make his own assessment of the problems and difficulties which may be encountered and no extra payment or claim of any kind will be allowed on account of providing reasonable access to and interfacing with Others. Restrictions and hours of work may apply on some sites. It is very important that the Contractor keeps records of his people on site, including those of

his Subcontractors which the Project Manager or Supervisor have access to at any time. These records may be needed when assessing compensation events.

5.3.7 Contractor's Equipment

- 1) The Contractor provides all Equipment that is required to complete the *works*.
- 2) The *Contractor's* Equipment does not impair the operation or access to the plant.
- 3) The *Contractor* provides all or any temporary or expendable materials required for the storage of material.

Any Equipment, or appliances, used by the *Contractor* conforms to the applicable OHS Act safety standards and is maintained in a safe and proper working condition. The *Project Manager* has the right to stop the *Contractor's* use of any Equipment which, in the opinion of *Project Manager*, does not conform to the foregoing.

Off-loading and material handling Equipment such as cranes and fork lifts are available on Site (within the station's security fence) and must be arranged with the *Project Manager* if required by the *Contractor*. Off-site requirements for cranes and fork lifts are not provided by the *Employer* and must be arranged by the *Contractor* at his own expense.

The *Contractor* has to submit a list of all tools and equipment entering site. Equipment and tools not declared will become the *Employer's* property.

On completion of the project, all tools and equipment will be removed only with permission from the *Project Manager* on the applicable approved *Employer* documents.

5.3.8 Equipment provided by the Employer

No equipment will be supplied by the Employer.

5.3.9 Site Services and Facilities

5.3.9.1 Roads

In some areas main access roads are surfaced and complete and may be used by the *Contractor* with the necessary care. There is no constructed road to access the location of the meteorological masts, the Contract shall use the available land for access. The *Employer* maintains the Site roads, described above, to a fair condition. Any costs incurred by the *Project Manager* from damage caused to underground services, structures, etc. as a result of the *Contractor* not using the prescribed routes is recovered from the *Contractor*.

5.3.9.2 First aid and fire fighting

The *Contractor* in cases of emergencies or accidents calls upon the services of the first aid and firefighting resources at the Power Stations.

5.4 FACILITIES PROVIDED BY THE CONTRACTOR

5.4.1 Sanitary Facilities

The Contractor shall provide own sanitary facilities for the duration of the Works.

5.4.2 Supply of Electricity

The location of the meteorological masts is secluded; therefore no power supply is available in the location. Power supply shall be provided by the Contractor.

5.4.3 LAY DOWN AREAS

No Plant, Material and Equipment lay down areas are permitted on the terrace. The *Contractor* delivers all Plant, Materials and Equipment to the point of erection as and when needed. Plant, Materials and Equipment not used within 14 days are removed from the terrace and stored in the site yard.

5.4.4 Security

The *Contractor* provides security necessary for the protection of the *works* at all times until the Completion of the whole of the *works*.

The *Contractor* is informed of the access procedures through Site Regulations and note that such procedures may change depending on the prevailing security situation.

All persons entering the site pass through the control points at the main access gate and are required to have temporary permits that are issued to *Contractor's* staff on request. If it is necessary to bring Equipment onto site a list is submitted which is verified by security staff prior to Equipment entering the security area.

No firearms, weapons, alcohol, illegal substances and cameras (including cell phones with cameras) are permitted on Site.

6. COMMISSIONING AND TESTING

Testing and commissioning shall include as a minimum:

- 1) The services of skilled Engineers to supervise the testing and commissioning and making ready for the full duty operation of the complete *works*.
- 2) All management, supervision, labour, tools, instruments, chemicals, test apparatus, calibration equipment and any other equipment and facilities as may be necessary.
- The Contractor's preliminary trials and commissioning of the works shall be carried out by the Contractor's representatives, who shall remain in attendance until such time as the works are working to the Employer's satisfaction. A requirement of these trials is a 72 hour test to determine that all activities as laid down in the operating manuals are correct and are carried

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out in the correct sequence and to determine that all the plants have been provided as required in the scope of work.

- The operating and maintenance manuals shall be submitted at least 2 weeks prior to the start of commissioning for acceptance by the relevant Employer's representative. The Contractor is to supply all data books with signed ITPs and as build drawings of the works.
 - Commissioning of the system shall be done by the Contractor's staff with the Employer's dedicated operations/commissioning staff.
 - The Contractor submits a commissioning schedule and program for acceptance by the Project Manager by the contract date.
 - Before plant and equipment is placed in service the Contractor certifies that it is in a suitable and safe condition. In addition, the Contractor provides 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 system has been wired in accordance with these diagrams.
 - Prior to the time when commissioning is to commence, the Project Manager will appoint a representative who will co-ordinate the commissioning of all plant and equipment forming an integral part of the system being commissioned. The Contractor is responsible for the commissioning of all the plant and equipment he/she is to supply to the requirements of this specification in conjunction with the Project Manager and the employer's C&I representatives. Where various components are already in place or are supplied by the Employer to form an integrated system, the Contractor at the time of commissioning, carries the responsibility for the correct functioning of the whole system.
 - In the event of incorrect functioning, the Contractor determines the cause and he/she corrects the defect if the defect is within plant and equipment of his/her own supply. The Contractor, at the time of commissioning, has the agreement, or alternatively, the attendance of the Project Manager involved in a particular phase, before proceeding with commissioning. Consequently, the Contractor must assure himself/herself as to the safety of his/her own 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 commissions the works and ensures conformance to the Employer's performance requirements for the works. The Employer takes over sections of the system as required once the system performance requirements have been verified by the Contractor.
- 3) The Inspection Test Plans shall cover all stages of inspections like, in-process, final inspections and tests at factory, preservation, transportation, storage, erection and commissioning - field quality checks.
- 4) All sensors shall be calibrated, and calibration certificates be provided.

6.1 LIFE EXPECTANCY

The site design life for the Met Lattice Tower shall be a minimum of twenty (20) years. The life expectancy of all instrumentation shall be a minimum of two (2) years.

6.2 SUPPORTABILITY

The *Contractor* shall be able to fully support the system from resources within the Republic of South Africa regarding:

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- Technical service and support for the duration of the contract.

6.3 MAINTAINABILITY

The system should preferably be supplied and supported locally for the duration of the contract.

7. MANAGEMENT AND START-UP

7.1 QUALITY MANAGEMENT

7.1.1 CONTRACT QUALITY MANAGEMENT PLAN REQUIREMENT

The *Employer* places emphasis on the provision of a comprehensive Quality Management System (QMS) for all phases of the project. The QMS shall comply with the requirements of ISO 9001. The Contractor and all of the *Contractors'* suppliers shall hold a valid certificate of compliance for their QMS to the requirements of ISO 9001:2008. The *Employer* may at his sole discretion carry out an audit any supplier or sub-supplier QMS for compliance.

Documents submitted for review and acceptance by the *Project Manager* after the Contract Date and prior to the commencement of work.

The *Contractor* submits a fully detailed Quality Control Plan for acceptance within two weeks of the Contract Date.

No work is allowed on Site until the *Employer* accepted the Quality Control Plan.

The *Contractor* utilises the *Employer's* quality documentation or NEC forms whichever applicable for requesting access, erection checks etc. These request forms are to be submitted to the *Supervisor* at least one week prior to the requested activity, or as agreed to by the *Project Manager*.

Apart from any statutory data packages required, the *Contractor* also compiles a data package of the relevant drawings, test certificates etc. for each section of work which is to be reviewed and signed off by the *Supervisor* at erection check stage prior to the commencement of the commissioning phase.

7.2 CONFIGURATION AND DOCUMENTATION MANAGEMENT

Any documents received during the *Works* such as datasheets, operating manuals, maintenance manuals for equipment supplied must be stored in accordance with the station specific configuration management procedure.

7.2.1 Documentation Management

The *Contractor* establishes a document tracking system to record the dates for the supply and receipt of all drawings and requests for information.

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7.2.2 Document identification

The *Contractor's* documents and all documentation are sent to the Employer in the Master Document List (MDL) template.

7.2.3 Documents Submission

All project documents must be submitted to the delegated *Employer* Representative with transmittal note according to Project / Plant Specific Technical Documents and Records Management Work Instruction (240-76992014). To portray a consistent image, it is important that all documents used within the project follow the same standards of layout, style and formatting as described in the Work Instruction above. The *Contractor* is required to submit electronic documents using SharePoint Transmittal and Eskom large file transfer system <http://zendto.eskom.co.za>. Hard copies must be delivered to the delegated *Employer* representative with the transmittal note.

7.2.4 Drawings Format and Layout

- The creation, issue and control of all Engineering Drawings will be in accordance to the latest revision of 240-86973501 Engineering Drawing Common Requirements Standard.
- Drawings issued by the Contractor will be a minimum of one hardcopy and an electronic copy in native CAD (.dwg/.dgn) format. No drawings in .tiff or any other electronic format will be accepted.
- Issued drawings will not be "Right Protected" or encrypted.
- All drawings are A3 size unless otherwise stated. The Contractor shall use the Employer border frame for all drawings and the Contractor insert their own title block also on the frame. The title block of the Contractor contains the following: Contractor drawing number, Contractor drawing description, Contractor drawing revision, Contractor drafts person signature and date, Contractor's drawing verifier signature and date and Contractor's drawing approver signature and date.
- All drawings shall have a grid and referencing indicating the drawing number, sheet number and grid code for all contents etc.
 - The Contractor shall not provide any drawing to the Employer if the drawing was not signed by the Contractor's draft person, Contractor's drawing verifier and the Contractor's drawing approver.
 - The *Contractor* awaits acceptance, during the period of reply specified in the Contract, prior to submitting a final drawing for construction.
 - Updated versions of a document or drawing must include a compilation of any comments provided by the Employer regarding the preceding version, if applicable, along with the Contractor's response/actions taken. Modifications must be documented in a revision table within each drawing or document.

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7.2.5 Plant Identification

7.2.5.1 Plant Coding Allocation

Coding of the design will be based on the Power stations specific coding system and the Employer will undertake the coding in line with Power Stations Label Specification and Plant Codification Procedure (240-64550692). The coding system shall be applied during the design review stage(s) and cross referenced to all arrangement drawings, schematics, wiring diagrams, instructions, and manuals and where practical to spare parts list/manuals. The *Contractor* will be required to include allocated coding to the electronic design drawings.

7.2.5.2 Configuration change control

Any changes to the design baselines will be formally managed according to the Employer Project Engineering Change Procedure (240-53114026). All design reviews will be conducted according to the Design Review Procedure (240-53113685).

8. ENVIRONMENTAL ONSTRAINTS AND MANAGEMENT

The *Contractor* adheres to all applicable Environmental Acts including all latest amendments and regulations in the *services* including but not limited to the following:

- National Environmental Management Act – Act 107 of 1998
- National Water Act - Act 36 of 1998
- National Environmental Management: Waste Act - Act 59 of 2008

9. CONTRACTOR MANAGEMENT, SUPERVISION AND KEY PEOPLE

- The *Contractor* is required to submit a preliminary organogram of all key persons including *Subcontractor's* at tender stage and two (2) weeks after contract award.
- The organogram submitted at tender stage is required to contain the following key people as a minimum:
 - Project Manager
 - Lead Design Engineers for all involved disciplines
- As a minimum, the Lead Engineer for the *Works* shall be professionally registered as an Engineer with ECSA.

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10. WORKS DELIVERABLES

10.1 Data Management and Tower Maintenance Documents

Met Masts:

- The Contractor shall ensure that data retrieval occurs at least once daily to guard against data loss, corruption, calibration deviations, and instrument malfunctions.
- Data transmission is to be executed electronically via GSM connection.
- The Contractor to provide all raw and processed data to Eskom on a monthly basis.
- The Contractor to log and report all maintenance activities.
- The Contractor shall maintain a suitable inventory of spare parts readily available for instrument replacements for the 2-year period.

10.2 Detailed design Documentation

- The *Contractor* establishes a document tracking system to record the dates for the supply and receipt of all design drawings, calculations, requests for information and design documentation.
- The *Contractor* is to supply the following documentation as the minimum requirements of this specification in the design package before any manufacturing, construction or commissioning commences:
- The *Contractor* produces the following deliverables as part of the scope:
 - Completed detailed design file.
 - Design drawings
 - Preliminary O & M manual
 - Electrical load schedule
 - Arrangement and wiring diagrams are required for each skid, junction box, cubicle, and lighting and small power device.
 - Single Line Diagram depicting source of power supply for the major equipment.
 - Priced bill of quantities
 - Document submittal schedule indicating when all documents will be submitted.
 - Drawing Register indicating when drawings will be submitted.
 - General Arrangement Drawing of System and boundaries.
 - Quality Control Plan and Inspection and Test Plan
 - Commissioning procedures or construction method statement
 - Technical, Operation and Maintenance Manuals of all plant equipment
 - Control Philosophies
 - Maintenance Philosophy
 - Field termination drawings

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- Electrical cable schedules
- Electrical termination schedules
- Schematics for the electrical design
- Critical Spares List
- Functional Specifications
- Assembly procedures
- Welding Procedure Specifications
- Welding Procedure Qualification Record

11. HAND OVER

The Contractor submits data books to the Employer for their review for all equipment and *Works* undertaken with the applicable requirements and specifications.

Apart from any statutory data packages required, the Contractor also compiles and signs off a data package of the relevant drawings, test certificates etc. to the Employer for acceptance. These include, but are not limited to:

- Geotechnical Investigations
- Surveys
- Approved ITPs, QCPs
- Method statements and specifications adhered to
- Risk assessments
- Approved Drawings
- Design Calculation Reports
- Inspection Reports
- Corrosion Protection Consumables Certificates
- Calibration Certificates.
- Notifications
- Modifications
- Concessions
- Technical Queries, Engineering Responses and communications with Employer
- Non-conformance reports.
- Internal Release Notes
- Transport notifications
- Calculations for any temporary *Works* that may be required for the safe execution of the *Works*.

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The deliverables for the above scope will be as follows:

- Constructability report
- Defects report
- Commissioning Acceptance and Operations Readiness Report
- As-built documentation
 - o As-built drawings.
 - o Construction completion report.
- PEC certificates for completed *Works*.
- Drawings including the contractor camp site and related facilities.

12. TRAINING AND TECHNOLOGY TRANSFER

- The *Contractor* shall train Eskom Personnel in all components and functions of the Plant i.e. Data monitoring and evaluating, method of maintenance, fault finding, correction, routine maintenance etc. Training will include familiarisation with documentation (maintenance plan, procedures etc.).
- The *Contractor* shall provide training to Eskom personnel in the following:
 - Data monitoring, collection, analysis, and verification
 - Maintenance of the Tower

As part of added value, the *Contractor* shall propose training to be offered.

The Contractor allows secondment of the Employer's staff to benefit from the technical and/or project management services to be provided by assigning the Employer's staff full time to the project. The Employer's personnel are assigned to the Contractor to actively mentor the Employer's personnel and allow for skills transfer under the supervision of the Contractor's professionally registered Engineers. The assigned Employer's personnel perform as much as possible of the specific tasks under the guidance of the Contractor and in line with the SoW.

13. AUTHORISATION

This document has been seen and accepted by:

Name	Designation
Nitesh Rabikrisson	Lead Engineer – Grootvlei Power Station
Simphiwe Mbanga	Design and Specification Manager - Grootvlei Power Station
Imraan Dindar	Lead Engineer – Komati Power Station
Douglas Mugweni	Lead Engineer – Camden Power Station
Lennox Dukashe	Lead Electrical Engineer – Gx Engineering

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Sthembelenkosini Mthethwa	Lead Engineer – Hendrina Power Station
Isaac Blou	Subject Matter Expert
Motlatsi Tshupe	Lead Engineer – Tutuka Power Station
Nomcebo Mathekgane	Project Developer
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14. REVISIONS

Date	Rev.	Compiler	Remarks
April 2023	0.1	KR Matene	

15. DEVELOPMENT TEAM

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

- Kgaugetlo Matene
- Sibusiso Maphumulo

16. ACKNOWLEDGEMENTS

The author would like to acknowledge the development team for their support and inputs in putting together this document.

17. ANNEXURES: EMPLOYERS STANDARDS

Number	Title
General	
240-53113685	Design Review Procedure
240-53114002	Engineering Change Management Procedure
240-105658000	Supplier Quality Management Specification
240-109607332	Eskom plant Labelling Abbreviation Standard
240-53114026	Project Engineering Change Management
240-66920003	Documentation Management Review and Handover Procedure for Gx Coal Projects

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240-71432150	Plant Labelling Standard
240-76992014	Project / Plant Specific Technical Documents and Records Management Work Instruction
240-93576498	AKZ/KKS Coding Standard
32-136	<i>Contractor</i> Health and Safety Requirements
240-86973501	Engineering drawing Standard – Common Requirements
36-681	Generation Plant Safety Regulations
240-83539994	Standard for Non-Destructive Testing (NDT) on Eskom Plant
Civil & Structural	
240-56364545	Structural Design and Engineering Standard
240-107981296	Constructability Assessment Guideline
240-57127955	Geotechnical and Foundation Engineering Standard
240-57127953	Execution of Site Preparation and Earth <i>Works</i> Standard
240-57127951	Standard for the Execution of Site Investigations
240-91244751	Specification for Geotechnical Investigations Standard
SANS 10120 Series	Code of practice for use with standardized specifications for civil engineering construction and contract documents
SANS 10400	The Application of the National Building Regulations
SANS 1200 Series	Standardised specification for civil engineering construction
SANS 1921 Series	Construction and management requirements for <i>Works</i> contracts
SANS 2001-BE1	Construction <i>Works</i> Part BE1: Earth <i>Works</i> (general)
SANS 2001-BS1	Construction <i>Works</i> Part BS1: Site clearance
SANS 2001-CC1	Construction <i>Works</i> Part CC1: Concrete <i>Works</i> (structural)
SANS 2001-CS1	Construction <i>Works</i> Part CS1: Structural steelwork
SANS 2001-DP3	Construction <i>Works</i> Part DP3: Cable ducts
Electrical	
240-56356396	Earthing and Lightning Protection Standard
240-55714363	Coal Fired Power Stations Lighting and Small Power Installation Standard
240-56227443	Requirements for Control and Power Cables for Power stations Standard
SANS 10313	Protection against lightning - Physical damage to structures and life hazard

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SANS 10142-1:	The wiring of premises - Part 1: Low-voltage installations
Control & Instrumentation	
240-563555	Junction box and cable termination standard
240-56227443	Requirements for Control and Power Cables for Power Stations Standard.
240-40643427	Coding and Labelling Standard.
240-56355754	Field Instrument Installation Standard
Mechanical	
32-632	Requirements for Non-Destructive Testing (NDT) on Eskom Plant
240-56241933	Control of Plant Construction, Repair and Maintenance Welding Activities
240-56246601	Personnel and Entities Performing Welding Related Special Processes on the Employer's Plant
SANS 1091	National colour standards of paint
SANS 10140-1:	Identification colour markings Part 1: General
SANS 10140-2	Identification colour marking Part 2: Identification of hazards and equipment in work situations
SANS 10142-1:	The wiring of premises - Part 1: Low-voltage installations
SANS 60364	Low-voltage electrical installations
SANS 10160-3:	Basis of structural design and actions for buildings and industrial structures - Part 3: Wind actions
240-106365693	Standard for the External Corrosion Protection of Plant, Equipment and Associated Piping with Coatings
Fire Protection	
SANS 246	Code of Practice for Fire Protection for Electrical Equipment Installations
IEC Standards	
IEC 61853-1	Photovoltaic (PV) module performance testing and energy rating - Part 1: Irradiance and temperature performance measurements and power rating
IEC 61730-1 and IEC 61730-2	Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction; Part 2: Requirements for testing
IEC 62109-1 and IEC 62109-2	Safety of power converters for use in photovoltaic power systems - Part 1: General requirements; Part 2: Particular requirements for inverters

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IEC 61215	Terrestrial photovoltaic (PV) modules – Design qualification and type approval
IEC 60060-1:	High-voltage test techniques - Part 1: General definitions and test requirements
IEC 60870-5-x:	Telecontrol equipment and systems - Part 5: Transmission protocols (various parts, depending on the specific protocol used for communication)
IEC 62305:	Protection against lightning (various parts, depending on the specific requirements)
IEEE (Institute of Electrical and Electronics Engineers) Standards	
IEEE 802.3:	Ethernet standard for data communication and networking
IEEE 802.11:	Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications
IEEE 802.15.4:	Wireless Medium Access Control (MAC) and Physical Layer (PHY) specifications for Low-Rate Wireless Personal Area Networks (LR-WPANS)
IEEE 1003.1:	Standard for Information Technology - Portable Operating System Interface (POSIX)

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