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## Contents

|   | Page      |
|---|-----------|
| Title: Lethabo Solar PV Plant Non-Lethal Energized Perimeter Detection System Security Fence: System<br>Technical Specification ..... | 1         |
| <b>Contents .....</b>   | <b>2</b>  |
| <b>Figures .....</b>  | <b>4</b>  |
| <b>Tables .....</b>   | <b>4</b>  |
| <b>1. PROJECT DEFINITION .....</b>  | <b>5</b>  |
| 1.1 OBJECTIVES .....  | 5         |
| 1.2 LOCATION .....  | 5         |
| 1.3 SITE CONDITIONS, SCREENING AND SELECTION .....  | 6         |
| 1.3.1 General .....   | 6         |
| 1.3.2 Site Access .....   | 7         |
| 1.3.3 Soil Condition .....  | 7         |
| 1.4 EXISTING INFRASTRUCTURES AND SERVICES .....   | 8         |
| 1.4.1 Buildings and Associated Infrastructure .....   | 8         |
| 1.4.2 Potable and Process Water Supply .....  | 8         |
| 1.4.3 Sewage Management .....   | 8         |
| 1.4.4 Waste Management .....  | 8         |
| 1.4.5 Storm Water Management .....  | 8         |
| 1.4.6 High Security Fence .....   | 8         |
| <b>2. TECHNICAL REQUIREMENTS .....</b>  | <b>9</b>  |
| 2.1 SECURITY FENCE .....  | 9         |
| 2.1.1 Non-Lethal Energised Perimeter Detection System .....   | 9         |
| 2.1.2 High Security Mesh Fence .....  | 11        |
| 2.1.2.1 Outer Barrier High Security Mesh Fence .....  | 11        |
| 2.1.2.2 Inner Barrier High Security Mesh Fence .....  | 11        |
| <b>3. INSPECTION TESTING AND COMMISSIONING .....</b>  | <b>12</b> |
| 3.1 GENERAL REQUIREMENTS .....  | 12        |
| 3.2 TESTS BEFORE INSTALLATION .....   | 12        |
| 3.3 TESTS AFTER INSTALLATION .....  | 13        |
| 3.3.1 Test Pre-Requisite – Minimum System Documentation Requirement .....   | 14        |
| 3.3.2 Mechanical Completion Test .....  | 15        |
| 3.3.2.1 General .....   | 16        |
| 3.3.2.2 Foundation and Civil works .....  | 16        |

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When downloaded from the EDMS database, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised Version on the database.

|                    |   |           |
|--------------------|---|-----------|
| 3.3.2.3            | Labelling and Identification: .....   | 16        |
| 3.3.3              | Electrical Completion Test .....  | 16        |
| 3.3.3.1            | Tests on AC circuits .....  | 16        |
| 3.3.3.2            | Tests on DC Circuits .....  | 17        |
| 3.3.3.3            | Functional Tests .....  | 17        |
| 3.3.3.4            | Certificate of Compliance .....   | 17        |
| 3.3.3.5            | Test Reporting .....  | 18        |
| 3.4                | TESTS AFTER COMPLETION .....  | 19        |
| 3.4.1              | The Final Acceptance Test (FAT).....  | 19        |
| 3.4.1.1            | Criteria for Issuance of Handover Certificate .....                                 | 19        |
| <b>4.</b>          | <b>EQUIPMENT WARRANTY .....</b>   | <b>21</b> |
| 4.1                | O&M TRAINING .....  | 21        |
| 4.2                | SPARE PARTS AND TOOLS.....  | 21        |
| <b>5.</b>          | <b>AUTHORISATION .....</b>  | <b>22</b> |
| <b>6.</b>          | <b>REVISIONS .....</b>  | <b>22</b> |
| <b>7.</b>          | <b>DEVELOPMENT TEAM .....</b>   | <b>22</b> |
| <b>8.</b>          | <b>ACKNOWLEDGEMENTS .....</b>   | <b>22</b> |
| <b>APPENDIX A:</b> | <b>CODES AND STANDARDS.....</b>   | <b>23</b> |
| Table 1            | Codes & Standards – Civil Engineering Design Work .....                             | 23        |
| Table 2            | Codes & Standards – Equipment & Services .....                                      | 24        |
| Table 3            | Codes & Standards – Regulatory Approvals, Requirements & Normative References ..... | 29        |
| <b>APPENDIX B:</b> | <b>SITE LAYOUT AND SINGLE LINE DRAWINGS LIST .....</b>                              | <b>32</b> |
| Table 19           | Lists Drawings Issued by the Employer .....   | 32        |

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Figures

Figure 1: Proposed outline of NLEPDS security fence .....6  
Figure 2: Lethabo solar PV facility general arrangement layout .....6

Tables

Table 1: Codes & Standards - Civil Engineering Design Work .....23  
Table 2: Codes & Standards - Equipment & Services .....24  
Table 3: codes & Standards - Regulatory Approvals, Requirements & Normative References.....29  
Table 19: List Drawings Issued by the Employer.....32

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## **1. PROJECT DEFINITION**

This document provides technical requirements for Engineering, Procurement and Construction (EPC), including Commissioning of the Proposed Non-Lethal Energized Perimeter Detection System (NLEPDS) security fence for the Solar PV Plant at Lethabo Power Station, situated in the Free State. It also sets out requirements relating to expected plant performance, quality, codes, and standards.

This document must be read in conjunction with the Engineering & Construction Contract (NEC3) Part 3: Scope of Work – Employer and Contractor's Works Information.

### **1.1 OBJECTIVES**

Lethabo P/S is constructing a Solar PV Plant. No security is currently provided for the selected area.

The main objective of this project is to provide an integrated security system comprising of a NLEPDS security fence to safeguard Solar PV Plant equipment. This report pertains to the NLEPDS security fencing component of the security system.

### **1.2 LOCATION**

The Proposed Site at Lethabo Power Station (Site) is located with the following address/coordinates:

|                  |   |
|------------------|---|
| Address:         | Metsimahalo Local Municipality, Lethabo, Free State, South Africa |
| GPS Coordinates: | 26.44°S; 27.57°E, Elevation: 1,462m above sea level               |

A NLEPDS security fence is to be installed in the areas exposed to the public. The location of the proposed NLEPDS security fence is shown in Figure 1 and Figure 2.

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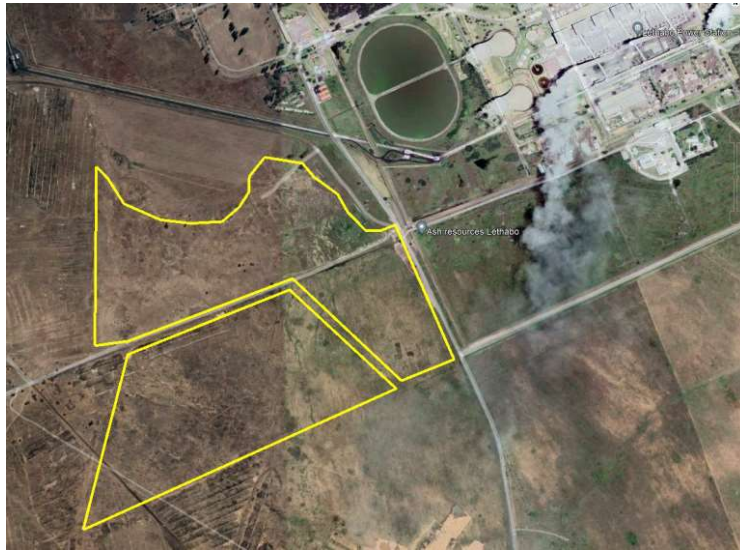


Figure 1: Proposed outline of NLEPDS security fence.

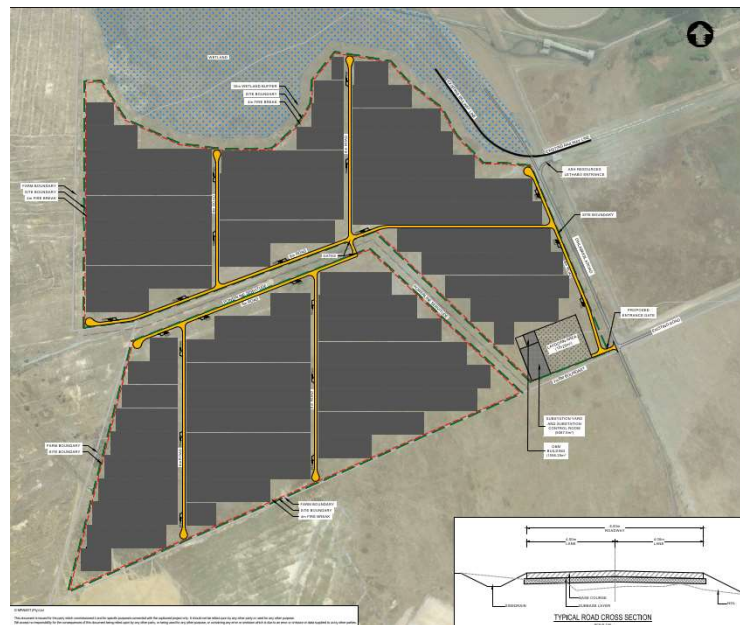


Figure 2: Lethabo solar PV facility general arrangement layout

No pre-existing security mesh fence exists at the Lethabo PV site.

### 1.3 SITE CONDITIONS, SCREENING AND SELECTION

#### 1.3.1 General

The proposed Site is situated within the boundary of the Lethabo Power station and occupies the remaining extent of Farm no. 1814 within the Metsimahalo Local Municipality. The Site is not directly adjacent to major buildings or power plant zones of the Lethabo Power Station. The northern and

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eastern edges of the Site are partially bounded by wetlands. The northern edge is also near an existing railway line, with the eastern edge next to the ash resource plant entrance for the Lethabo Power Station.

### **1.3.2 Site Access**

Suggested access gates to the proposed Site are situated roughly 620 m from the entrance to the ash resource plant.

### **1.3.3 Soil Condition**

The area's geology comprises of sandstone, grit and shale of the Vryheid Formation, Ecca Group, together with Quaternary deposits. The predominant soils are grey or yellow-brown, sandy or loamy apedal soils on soft (or occasionally hard) plinthite. The depths vary somewhat, with zones of shallow, disturbed soils or wetted clay soils also occurring.

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## **1.4 EXISTING INFRASTRUCTURES AND SERVICES**

The operations and maintenance department at Lethabo will be responsible to operate and maintain the PV plant once completed. The Power Station has existing infrastructure and services. The Bidder shall not utilize any of the existing infrastructure as part of his proposed design.

### **1.4.1 Buildings and Associated Infrastructure**

The Power Station has no common buildings and infrastructure that could be utilised for the operation, maintenance, and services of the NLEPDS security fence. The Bidder shall not utilise any existing building or infrastructure.

### **1.4.2 Potable and Process Water Supply**

Water is to be provided via a borehole system as determined by maintenance strategy of the solar PV plant for module washing and dust suppression. If potable water is required, additional tankers from the Lethabo Power Station can be arranged during cleaning periods. An existing water line runs across the proposed Site. Connection thereto is preferred to minimise costs of transporting water via tankers from the Lethabo Power Station to the PV site, as well as additional water treatment requirements.

### **1.4.3 Sewage Management**

The PV plant is expected to include a sewage system. The preferred option for sewage management at the PV Site is a new sewage disposal system, consisting of a conservancy tank. Alternatively, a tap-in with existing sewage infrastructure at the Lethabo Power Station can be pursued if the latter is able to handle the additional flow.

### **1.4.4 Waste Management**

Available Waste Management Systems and processes are adequate to meet any requirements placed by Lethabo Solar PV Plant NLEPDS security fence requirements.

### **1.4.5 Storm Water Management**

Storm water management infrastructure should be designed for and implemented at the PV Site.

### **1.4.6 High Security Fence**

The Lethabo PV site contains no pre-existing security fences and related infrastructure.

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## 2. TECHNICAL REQUIREMENTS

### 2.1 SECURITY FENCE

Among other security measures, a 3-tier security fence (the focus of this report) comprising of an outer barrier high security mesh fence, non-lethal electrified fence and an inner barrier high security fence is required to secure the PV plant assets. The NLEPDS has two main functions, which is to deter unauthorised intruders from entering the premises and to detect and alarm any unauthorised attempt to enter the site. The perimeter length of the required fence exposed to the public to be installed within the Preferred Area of installation (refer to Drawing #: R00000014-MPA-XX-DR-C-0001 Rev P01 – Lethabo Solar PV Facility General Arrangement Layout attached in Appendix A) is approximately 7785.7 m in total. This is split into approximately 4452.9 m for the northernmost site and 3332.8 m for the southernmost site. The height of the electric fence is not required to align with any pre-existing fences.

Although electric fence (NLEPDS) infrastructure is installed beforehand, the energisation, commissioning and testing thereof should occur at a later date as determined by Eskom. Eskom will notify the Contractor at least one month before the Contractor is required to return to site for installation and commissioning of the NLEPDS's energisation system. After successful installation and commissioning of the energisation system, the inspection testing and commissioning of the NLEPDS security fence must be completed.

The technical evaluation of the design, supply, installation, testing, and commissioning of the NLEPDS security fence will be carried out in compliance with the Technical Evaluation Criteria for Non-lethal Energized Perimeter Detection System (NLEPDS) (240-134779125).

#### 2.1.1 Non-Lethal Energised Perimeter Detection System

- 1) The *Contractor* shall be responsible for the design, manufacture/procurement, supply, off-loading, construction, quality control and assurance, testing, provision of training, commissioning and handover of a non-lethal electrified security fence complete with power, control, protection, earthing, lightning protection in accordance with the following *Employer* Specifications:
  - 240-78980848 Specification for Non-Lethal Energized Perimeter Detection System (NLEPDS) for Protection of Eskom Installations and its Subsidiaries.
  - All wire mesh fences shall be constructed in compliance with the Standard for High

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Security Mesh Fences (240-76368574).

- 2) The *system* shall comprise as a minimum, energizers, control unit, user interface/display, synchronising equipment, electric fence conductors and associated insulators, relays cards, power supply, surge arrestors, cabinets, kiosks, interfaces to the Security Control Room, communication infrastructure, cabling and cable accessories (HT, power, fibre and alarm cables).
- 3) The system shall support multi-sector monitoring (resistive sectorizing) or multi-zone.
- 4) Specific requirements for the NLEPDS are presented in Appendix B:Table 4 .
- 5) The NLEPDS should comprise of the following components and sub-systems:
  - Electric fence
  - Energisers
  - Mimic and PC with configuration. Front end software.
  - Synchronising equipment
  - Relay alarm output cards
  - Communications
  - Power supply
- 6) The energized fence shall be constructed as follows:
  - Free standing 24 strand energized fence.
  - Fence height at 2.4 m above ground level.
  - Gate to match fence construction and be energized with suitable contactor(s).
  - Minimum energy output at end-of-line to match 5 Joule.
  - Zones to be setup on the four sides, i.e. eastern side – Zone 1, southern side – Zone 2, western side – Zone 3, northern side – Zone 4.
  - Remote arming/disarming and alarming of the fence system with GUI for control room operator.
  - T-plinth installed under fence at 600 mm wide by 100 high top slab with 100 mm wide by 600 mm deep anti-burrowing plinth as per specification.
  - System integrated with site PSIM (Physical Security Integration Management). The site is to utilise a suitable PSIM platform to integrate the site security systems into one platform. The system is to enable integration between the access control, CCTV, PA and intrusion detection systems. The system solution selected is to be mimicked at the Zero control room to enable operators to respond to and manage the incident remotely.
  - Pedestrian access gate to be provide with high security, all weather padlock installed in protective sleeve (sleeve required to prevent lock tampering).
  - Connected to station earth mat.

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- Energizer(s) to be installed in lockable enclosure within control room.

### **2.1.2 High Security Mesh Fence**

The Contractor shall design, supply, and install an outer barrier and inner barrier high security mesh fence in compliance to Eskom Standard: High Security Mesh Fencing - 240-76368574.

#### **2.1.2.1 Outer Barrier High Security Mesh Fence**

The outer perimeter fence should be constructed as follows:

- 1) The outer perimeter shall be constructed of a Category 2 high security mesh fence.
- 2) Fence height at 2.4 m with double-V overhang with BTC installed at 600 mm in diameter.
- 3) Access gate to match fence construction.
- 4) Anti-burrowing plinth as per standard (100 mm wide by 600 mm deep).
- 5) Galvanized coating as per standard.
- 6) Connected to station earth mat.
- 7) Pedestrian access gate to be provided with high security, all weather padlocks installed in protective sleeve (sleeve required to protect lock tampering).

#### **2.1.2.2 Inner Barrier High Security Mesh Fence**

The outer perimeter fence should be constructed as follows:

- 1) Fence height at 2.4 m above ground level with V overhang with BTC installed at 600 mm in diameter.
- 2) Pedestrian access gate to be provided with high security, all weather padlock installed in protective sleeve (sleeve required to prevent lock tampering).
- 3) Foundation of concrete wall to cater for integrated sleeve for network infrastructure with appropriately positioned draw boxes and draw wires installed.
- 4) Connected to station earth mat.

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### **3. INSPECTION TESTING AND COMMISSIONING**

#### **3.1 GENERAL REQUIREMENTS**

The Contractor shall provide facilities necessary to enable the inspection, testing, commissioning, and performance testing of the NLEPDS security fence to be satisfactorily completed including labour, equipment, materials, instruments, consumable materials, electrical power, fuel, lubricants, water, and such like.

The Contractor shall provide the opportunity to the Employer and Employer's representatives to witness all commissioning tests. The Employer shall provide reasonable and adequate notice to the Contractor that other parties have been invited to witness the tests and the Contractor shall provide all facilities and support that are reasonably required by the Employer for such parties to witness the tests

The Contractor shall provide any instruments or other equipment for the Employer and Employer's representatives to review the accuracy, quality and performance of the NLEPDS security fence. The Contractor shall provide any assistance required by Employer and Employer's representatives in the use of instruments and measuring equipment.

The Contractor shall ensure that instruments used for survey work, checking, inspection, testing, commissioning, and performance monitoring are correctly calibrated and up to date, according to their relevant standards. The contractor shall submit the valid calibration certificates with method statements and test records.

The Contractor shall provide temporary communication equipment as necessary to enable the commissioning team to carry out their tasks safely and effectively. The Contractor shall ensure temporary communication equipment does not cause interference with equipment owned or operated by any other parties. Note that although electric fence (NLEPDS) infrastructure is installed beforehand, the energisation and commissioning thereof should occur at a later date as determined by Eskom. Eskom will notify the Contractor at least one month before the Contractor is required to return to site for installation and commissioning of the NLEPDS's energisation system. After successful installation and commissioning of the energisation system, the inspection testing and commissioning of the NLEPDS security fence must be completed. The tenderer shall allow for the interface requirements between the SCADA system installer and the electric fence system.

#### **3.2 TESTS BEFORE INSTALLATION**

The Contractor shall submit for review and approval to Employer and Employer's Representatives the

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test program for Factory Acceptance Test comprising but not limited to:

- 3.2.1** Detailed description of inspections/test types.
- 3.2.2** Component certificates, technical data sheets.
- 3.2.3** Manufactures' quality certificates.
- 3.2.4** Standards to be followed during testing/inspection.
- 3.2.5** Test results of former inspections/tests, if available.

Upon the successful completion of the Factory Acceptance Test, the Contractor shall submit the test report along with the relevant documents. All test reports shall be prepared by the Contractor and shall contain the following minimum information:

- 3.2.6** Definition of each test type and test methods
- 3.2.7** Technical data along with the component certificate of tested component
- 3.2.8** Test evaluation and technical data of testing components including relevant certificates
- 3.2.9** Compliance with the requirement for the project and/or Industry practice
- 3.2.10** Summary and conclusion regarding acceptance or rejection of equipment

The test reports shall be reviewed and approved by the Employer and the Employer's Representatives prior to shipment of the tested components to the project site. The test reports and its supporting documents must be signed by the Contractor and the Employer's Representative prior to shipment of tested components.

The Contractor shall be responsible for all arrangements for the Factory Acceptance Tests and will be responsible for management and any additional expenses that is caused due to requirement on repetition of Factory Acceptance Tests.

The Contractor shall verify that all components delivered to the site are free from any defects and all documents (technical data sheet, certificates, warranty documents, Factory Test reports, and component manuals) are available. The Site Acceptance Test shall be witnessed and approved by the Employer and the Employer's representative.

### **3.3 TESTS AFTER INSTALLATION**

Tests after Installation are the inspections and tests that are performed on site after civil, mechanical and electrical installation work has been completed. These tests are related to document verification,

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visual inspections on site, electrical measurements, and safety checks. They must demonstrate:

**3.3.1** Completeness of the civil, mechanical, and electrical construction works.

**3.3.2** Correctness of the assembly and installation.

**3.3.3** Safety and reliability of the works under all operating conditions.

**3.3.4** Inspection and functional tests.

**3.3.5** Proper functioning of the components and system under all operating conditions.

Tests after Installation are considered successful if the Plant complies with the requirements defined for each type of inspections described in this specification.

The supplier shall install the system on site (energizers, relays, control unit, synchronisation equipment, fence conductors & communication infrastructure) inclusive of all interconnections between the system modules. The supplier shall avail themselves for Site Acceptance Testing at site after installation. All test procedures required to ensure the correct functioning shall be specified with a list of required test equipment and tools.

Copies of all tests and data are provided to the Project Manager for review and acceptance.

### **3.3.1 Test Pre-Requisite – Minimum System Documentation Requirement**

Upon giving notice on readiness for Tests after Installation and prior to the commencement of Civil, Mechanical and Electrical Completion Inspection, the Contractor provides As Built Drawings as well as the Operation and Maintenance Manuals of the Plant to the Employer and Employer's representative.

The completeness of the documentation is reviewed and accepted by the Project Manager before commencement of the tests.

The following non-exclusive list of Plant sections are documented and checked during the Tests after Installation:

- Basic system information:
  - Project location and installation date
  - Installation date
  - Commissioning date (to be updated later if time schedule of tests not met).
- System designer's information (name, affiliate, contact details).
- System installer/Contractor information (name, affiliate, contact details).
- Detailed single line diagram of the electrical reticulation, including detailed connection, and

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wiring diagrams for energiser kiosks.

- Earthing and over voltage protections including a single line diagram showing the details of all earthing, lightning protection systems, and details of surge protection devices.
- A single line diagram including DC and AC isolators' location, type and rating along with similar information for AC over-current protection device.
- Plant safety regulation following all MCB's, MCCB's, Isolators employed in the AC electrical boards with a padlocking facility.
- Technical data sheet of all components.
- Full documentation of the SCADA.
- Description and documentation of all mechanical structures including details such as material type, structure mounting solution, foundation design, and geotechnical study.
- Warranty documentation for all strategic parts such as energisers, with the information of starting date of warranty and period of warranty.
- Documentation of all required legal and administrative permits if any.
- Confirmation on project design and installation compliance with all permits (Environmental, Water Use license and grid code).
- The complete design, network diagram, test certificates and test results.

### **3.3.2 Mechanical Completion Test**

Upon completion of the actual installation works, an inspection is conducted. The purpose is to verify that the Contractor has executed all installation works in accordance with the Contract and as built design and is compliant with applicable norms and standards. At this inspection it is tested that the works prove to be of good workmanship and are free from any material/construction defects. During the inspection, the correctness of the documentation of the works in the As-Built Drawings is checked and verified.

Prior to the Inspection, the Contractor conducts an internal inspection that verifies the compliance of the works with the design and the Employer's Requirements. The minor deviations on execution of work are recorded under the Punch-List. The Punch-List does not contain any outstanding issue which has an effect on safe operation, monitoring, plant performance, and administrative/legal requirements. The Punch-List must be reviewed and accepted by the Employer before the Mechanical Completion Test.

The Contractor undertake the following, but not limited to, to verify the physical installation is

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completed according to the design:

#### **3.3.2.1 General**

- Verify all parts of the NLEPDS security fence are in line with the Final Design;
- Verify the NLEPDS security fence construction is according to the provisions of the Contract;
- Verify all equipment and parts have been installed according to their manufacturer's installation manuals.

#### **3.3.2.2 Foundation and Civil works**

- Verify all civil works are completed according to design and according to permits for the Project;
- Verify that security system (fences, video surveillance) are installed according to Employer's requirement.

#### **3.3.2.3 Labelling and Identification:**

- Verify all circuits, protective devices, switches and terminals are suitably labelled;
- Verify the main AC isolating switch is clearly labelled;
- Verify Dual supply warning labels are fitted at point of interconnection;
- Verify a single line wiring diagram is displayed on site;
- Verify the Emergency shutdown procedures are displayed on site;
- Verify all signs and labels are suitably affixed and durable.

Upon the successful completion of Mechanical Completion Test, the Mechanical Completion Certificate will be issued by the Employer.

#### **3.3.3 Electrical Completion Test**

The Electrical Completion Test is performed to verify the proper functionality, configuration and installation of the NLEPDS security fence. The tests are witnessed by the Employer and Employer's representative. The Contractor undertakes the following, but is not limited to:

##### **3.3.3.1 Tests on AC circuits**

Tests on AC circuits in accordance with IEC 60364-6:

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- Continuity of conductors;
- An electrical continuity test be made on protective conductors, including main and supplementary equipotential bonding conductors, and live conductors in the case of ring final circuits;
- Insulation resistance of the electrical installation;
- The insulation resistance is measured between live conductors and the protective conductor connected to the Earthing arrangement;
- Protection by SELV, PELV or by electrical separation;
- Insulation resistance/impedance of floors and walls;
- Protection by automatic disconnection of the supply;
- Polarity test;
- Check of phase sequence;
- Functional tests; and
- Verification of voltage drop.

### **3.3.3.2 Tests on DC Circuits**

Tests on DC circuits in accordance with IEC 62446-1:

- Continuity of protective Earthing and/or equipotential bonding conductors, where fitted. Where protective or bonding conductors are fitted on the DC side, such as bonding of the array frame, an electrical continuity test is made on all such conductors. The connection to the main Earthing terminal should also be verified;
- The polarity of all DC cables is verified using suitable test apparatus. Once polarity is confirmed, cables be checked to ensure they are correctly identified and correctly connected into system devices such as switching devices or inverters.

### **3.3.3.3 Functional Tests**

The following functional tests be performed:

- 1) Switchgear and other control apparatus to be tested to ensure correct operation and that they are properly mounted and connected.

### **3.3.3.4 Certificate of Compliance**

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Work on an electrical installation shall be carried out under the control of a registered person who shall issue a CoC after inspection and tests are conducted on the installation. Registered person may not issue CoC where faults exist.

When issuing CoC, it is important to make sure that it extends as far as where the installation ends (point of consumption or supply terminals) and that it does not extend into the machinery connected to the installation.

The Contractor submits test reports of all electrical installations as per the sample test report (Certificate of Compliance) in SANS 10142-1.

CoC and test report is issued only by electrical tester, installation electrician or master electrician for single phase installation.

CoC and test report is issued only by installation electrician or master installation electrician for three phase and DC installations.

The CoC is also accompanied by as-built design package documentation.

### **3.3.3.5 Test Reporting**

Once the Electrical Completion tests are successfully performed, the Contractor provide the report to the Project Manager, for review and acceptance, including the following:

- A report, signed by the Contractor, summarizing each test performed and their acceptance or rejection according to the test protocol, relevant standards and requirements;
- Test raw data and processed data;
- Final Test protocol along with list of measurement equipment considered during testing and their specification;
- Certificate of Compliance (COC) for all electrical installations;
- Plant safety clearance certificate accompanied by the relevant as-built design package documentation, equipment type test certificate, calibration certificates for test equipment, routine test results.

Upon the successful completion of Electrical Completion Test, the Employer issue Substantial Completion Certificate to the Contractor.

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### **3.4 TESTS AFTER COMPLETION**

Tests after Completion refer to the “Final Acceptance Test (FAT)” which verifies the performance of the NLEPDS security fence against the Contractor’s guarantee.

The following is to be completed before the start of FAT:

**3.4.1** Mechanical Completion Certificate, Certificate of Compliance (COC) for electrical installations, safety clearance certificates for plant installations, Substantial Completion Certificate have been issued;

**3.4.2** Training on Construction and Commissioning to the Employer’s representative and Employer’s staff have been completed;

**3.4.3** The Contractor has provided O&M Manual to the Employer and the Employer’ representative, which include, but not limited to:

- 1) Procedures for verifying correct system operation;
- 2) Safety Guidelines including emergency shutdown/isolation procedures;
- 3) Preventive and corrective maintenance procedures including site inspection checklist for each component making up the integrated security systems;
- 4) Scheduling of routine maintenance;
- 5) A checklist of what to do in case of system failure;
- 6) Documentation on stock of spare parts and spare parts management including contact information and procedures for replacement of defective components;
- 7) Performance monitoring and reporting procedures.

#### **3.4.1 The Final Acceptance Test (FAT)**

The Contractor executes the FAT and is witnessed by the Employer and the Employer’s representative.

The Contractor prepares a detailed test program and test protocol based on requirements described in this document and submits to the Employer for approval.

The Test program and the test protocol must be accepted by the Employer/Employer’s representative before the commencement of the test.

##### **3.4.1.1 Criteria for Issuance of Handover Certificate**

The Handover Certificate is issued by the Project Manager, if:

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- FAT requirements are successfully completed.
- The complete O&M manual is provided by the Contractor and accepted by the Project Manager.
- Punch List is reviewed and accepted by the Project Manager.
- All Guarantees and Warranties are successfully transferred to the Project Manager and the plant is substantially handed-over to the Employer.
- The Contractor has stored on-site the minimum required spare parts for the Project.
- The site is free from any wastes, residues from site establishment and construction.
- If applicable, any delay liquidated damage payable to the Employer by the Contractor is completed.

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## **4. EQUIPMENT WARRANTY**

### **4.1 O&M TRAINING**

O&M Training is provided to the Employer and Employers' representatives. The Training is based on Classroom and Onsite Training.

The Contractor provides formal classroom training of the operations and maintenance to ensure Employer's representatives have a sound understanding of the NLEPDS security fence, layout, characteristics, functionality and O&M.

Training material for classroom training is based on O&M manual content and contains evaluation criteria on each section of the plant covered in order to establish the level of Employer's representatives' understanding.

Training material for on-site training is based on O&M manual in addition to detailed operating and maintenance plans and procedures.

The Contractor provides all training materials in hard copy and electronic copy to the trainees prior to the actual commencement of O&M training.

The Contractor ensures that experienced personnel (minimum 5 years of experience in operation and maintenance of NLEPDS security fences) conduct all trainings in professional manner.

The tenderer/s shall provide Eskom with a proposed maintenance/cleaning strategy for the luminaires offered. This strategy must ensure that a maintenance factor of at least 0.80 will be maintained for the LED luminaires through its expected service life.

### **4.2 SPARE PARTS AND TOOLS**

The Contractor must provide a list of spare parts and tools recommended by equipment manufacturers for operation and maintenance of the NLEPDS security fence for 10-year lifetime period. The Contractor considers such list as minimum required spare parts and tools for the Project.

The Contractor recommends any additional spare parts and tools if the minimum requirement on spare parts and tools provided by the equipment manufacturers is considered as not sufficient for operation and maintenance for 10 year lifetime period.

The Employer, at its option, may decide to purchase such additional spare parts and tools subject to schedule of delivery to be agreed upon.

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## 5. AUTHORISATION

This document has been seen and accepted by:

| Name & Surname   | Designation                       |
|------------------|-----------------------------------|
| Tshepo Serameng  | Project Manager                   |
| T H Mukwevho     | Security Manager                  |
| Sifiso Maringa   | Risk & Assurance Manager          |
| David Kunene     | Senior Technologist Electrical    |
| Rajiv Beharie    | Senior Engineer C&I               |
| Fisher Magowa    | Senior Advisor Finance Division   |
| Nicolan Govender | Senior Engineer Prof Civil        |
| Miranda Skaka    | Engineer Engineer Prof Electrical |
| Remofilwe Ranaka | Senior Technologist               |

## 6. REVISIONS

| Date       | Rev. | Compiler       | Remarks     |
|------------|------|----------------|-------------|
| 13/09/2022 | 0    | Hilda Mukwevho | First issue |
|            |      |                |             |

## 7. DEVELOPMENT TEAM

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

- Hilda Mukwevho
- Miranda Skaka
- Tshepo Serameng

## 8. ACKNOWLEDGEMENTS

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## **APPENDIX A: CODES AND STANDARDS**

### **Table 1 Codes & Standards – Civil Engineering Design Work**

All Civil Engineering Design Work Shall Comply with The Following:

Table 1: Codes & Standards - Civil Engineering Design Work.

| <b>Standard/Code</b>         | <b>Description</b>   |
|------------------------------|--|
| SANS 10400                   | Code of Practice – The Application of the National Building Regulations  |
| SANS 10100                   | The structural use of concrete   |
| SANS 10160                   | Basis of structural design and actions for buildings and industrial standards  |
| SANS 10162-1                 | The structural use of steel Part 1: Limit states design of hot-rolled steelwork  |
| SANS 10162-2                 | The structural use of steel Part 2: Limit states design of cold-formed steelwork                                       |
| SANS 10162-4                 | The structural use of steel Part 4: The design of cold-formed stainless steel structural members                       |
| SANS 10021 Ed4.0             | The waterproofing of buildings (including damp-proofing and vapour barrier installation)                               |
| SANS121:2011 Ed2             | Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods                    |
| SANS 2001 – CS1:2012 Ed.1.01 | Construction works Part CS1 – Structural steel works   |
| SANS 1921-3:2004 Ed.1        | Construction and Management requirements for works contracts – Part 3 Structural steel works                           |
| SANS 1200H: 1990 Ed3         | Standard specification for Civil Engineering construction - Structural steel work installation                         |
| SANS 1200HC: 1988            | Standardized specification for civil engineering construction Section HC: Corrosion protection of structural steelwork |
| SANS 2001                    | Construction   |

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## Table 2 Codes & Standards – Equipment & Services

All Equipment and Services Supplied Shall Comply With The Standards Listed Below:

Table 2: Codes & Standards - Equipment & Services.

| Standard/Code                                     | Description   |
|---|---|
| <b>General</b>                                    |   |
| SANS 10142  | The wiring of Premises – Part 1: Low voltage installation   |
| <b>Electrical Cabling</b>                         |   |
|   | Requirements for cables for use in photovoltaic systems 2Pfg1169" by TÜV  |
| SANS 1507 Part 1                                  | General - Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300 V)                          |
| SANS 1507 Part 2                                  | Wiring Cables - Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300 V)                    |
| SANS 1507 Part 3                                  | PVC Distribution cables - Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300 V)          |
| SANS 1507 Part 4                                  | XLPE Distribution cables – Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3300 V)        |
| SANS 1507 Part 5                                  | Halogen-free Distribution Cables - Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300 V) |
| SANS 1507 Part 6                                  | Service cables - Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300 V)                   |
| SANS 10198:2004 Parts 1-14                        | The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 1 to 14                                    |
| SANS 1213   | Mechanical Cable Glands   |
| NRS 074-1/2                                       | Low Voltage cables systems  |
| <b>Earthing, Lightning &amp; Surge Protection</b> |   |
| IEC 60364-4-41                                    | Low-voltage plants installation. Part 4-41 - Protection for safety – protection against shock   |
| SANS 10313  | Protection against lightning  |
| SANS 62305  | Earthing and Lightning Protection   |

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|                                       |   |
|---------------------------------------|---|
| SANS 10292:2001                       | Earthing of low-voltage (LV) distribution systems   |
| SANS 1063:1998                        | Earth rods and coupling   |
| SANS 10199                            | The design and installation of earth electrodes   |
| IEEE 80                               | Earthing  |
| IEEE 665:1995                         | Guide for Generating Station Grounding  |
| SANS 61312-3:2006/IEC TS 61312-3:2000 | Protection against lightning electromagnetic impulse Part 3: Requirements of surge protective devices (SPDs)  |
| SANS 62305-1 to 4 /IEC 62305-1 to 4   | Protection against lightning - Parts 1 to 4   |
| SANS 10313:2008                       | Protection against lightning - Physical damage to structures and life hazard  |
| SANS 10200:1985                       |   |
| NRS 039                               | Surge arresters for use in distribution systems   |
| IEC 61009                             | Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBO's)                             |
| SANS 61024                            | Protection of structures against lightning  |
| <b>Metering and Measurements</b>      |   |
| IEC 62053                             | Electricity metering equipment (A.C.) – particular requirements   |
| IEC 60051-1                           | Direct acting indicating analogue electrical measuring instruments and their accessories - definitions and general requirements common to all parts |
| IEC 61036                             | Alternating current static watt-hour meters for active energy   |
| NRS 057/ SANS 474                     | Code of practice for electricity metering   |
| NRS 049                               | Advanced metering infrastructure ( ) for residential and commercial customers   |
| <b>Switchgear</b>                     |   |
| IEC 60898                             | Electrical accessories - circuit breakers for overcurrent protection for household and similar installations  |
| IEC 61009                             | Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBO's)                             |
| IEC 60269                             | Low-Voltage fuses   |

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| SANS 62271- 100 /IEC 62271 - 100   | High-voltage switchgear and control gear – Alternating Current Breakers  |
| SANS 60694:2003/ IEC 60694:2002  | Common specifications for high-voltage switchgear and control gear standards   |
| SANS 1973-1 to 4   | Low-voltage switchgear and control gear Assemblies Parts 1 to 4  |
| SANS 1765:2003   | Low-voltage switchgear and control gear assemblies (distribution boards) with a rated short-circuit withstand strength up to and including 10 kA         |
| SANS 60439-1 to 5 /IEC 60439-1 to 5  | Low-voltage switchgear and control gear assemblies parts 1 to 5  |
| SANS 60947 / IEC60947  | Low-voltage switchgear and control gear  |
| IEC 60529  | Specification for degrees of protection provided by enclosures (IP code)   |
| <b>Control and Monitoring System Field Equipment, Cabling and Installation</b> |  |
| IEC 61850-7  | Communication networks and systems for power utility automation - Part 7-420: Basic communication structure – Distributed energy resources logical nodes |
| IEC 60870  | Tele control equipment and systems. Remote control of photovoltaic power plants.   |
| EIA/TIA 568  | Standard for structured cabling  |
| EIA/TIA 569  | Standard for communication pathways and spaces   |
| EIA/TIA 607  | Standard for grounding and bonding of communication cabling  |
| TIA/EIA 485  | Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems  |
| SANS 10142-1-2012  | The Wiring of Premises Part 1: Low-voltage installations   |
| SANS 10340-1   | Installation of telecommunication cables part 1: Fibre optic cables in buildings   |
| SANS 10340-2   | Installation of telecommunication cables part 2: Outdoor fibre optic cables  |
| SANS 60794-1-1   | Optical fibre cables - Part 1-1: Generic specification – General   |
| SANS 60794-1-2   | Optical fibre cables - Part 1-2: Generic specification - Basic optical cable test procedures   |
| SANS 61312   | Protection against lightning electromagnetic impulse   |
| SABS 1411: Parts 2-6   | Materials of Insulated Electric Cables and Flexible Cords  |

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| SANS 60947-7-1 and 60947-7-2                           | The terminal blocks for the junction box terminations  |
| SANS 60429   | Degree of protections provided by enclosures (IP)  |
| <b>Inspection, Testing and Commissioning</b>           |  |
| IEC 60364 – 6 Ed. 1                                    | Low Voltage Electrical installations,  |
| IEC 62337  | Commissioning of Electrical, Instrumentation and Control systems   |
| IEC 62381  | Factory acceptance test (FAT), site acceptance test (SAT), and site integration test (SIT)   |
| IEC 62382  | Electrical and Instrumentation loop check activities   |
| IEC 62337  | Commissioning of electrical, instrumentation & control systems   |
| <b>Plant Coding and Labelling</b>                      |  |
| ISO 10007:2003   | Guidelines for configuration management  |
| VGB-R 171e VGB   | Guideline - Provision of Technical Documentation (Technical Plant Data, Documents) for Power Plants, 2nd Edition 2010                  |
| <b>Fire Safety Standards</b>                           |  |
| SANS 10400-T:2011                                      | South African National Standard Part T: Fire Protection  |
| SANS 10139   | Fire detection and alarm systems for buildings - System design, installation and servicing   |
|  | International Fire Code 2012   |
| <b>Non-Lethal Energised Perimeter Detection System</b> |  |
| 240-78980848   | Specification for Non-Lethal Energized Perimeter Detection System (NLEPDS) for Protection of Eskom Installations and its Subsidiaries. |
| SANS 10222-3   | Electrical Security installations – Part 3: Electric fences (non-lethal)   |
| SANS 60335-2-76  | Household and similar electrical Energizers – Safety, Part 2-76: Particular requirements for electric fence energizers                 |
| SANS 60335-1   | Household and similar electrical appliances – Safety, Part 1: General requirements   |
| SANS 60529   | Degrees of protection provided by enclosures (IP Code)   |

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|                |  |
|----------------|--|
| SANS 61000-1-2 | Electromagnetic compatibility – Part 1-2: General – Methodology for the achievement of functional safety of electrical and electronic systems including equipment with regard to electromagnetic phenomena |
|----------------|--|

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**Table 3 Codes & Standards – Regulatory Approvals, Requirements & Normative References**

List of Regulatory Approvals, Requirements and Normative References

Table 3: codes & Standards - Regulatory Approvals, Requirements & Normative References.

| Standard/Code | Description                 |
|---------------|-----------------------------|
| Act 4 of 2006 | Electricity Regulation Act, |

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|                      |   |
|----------------------|---|
| Act, of 2006         | Electricity Regulation Amendment Act, 2006  |
| Act, No. 73 of 1989  | Department of Environmental Affairs & Tourism in terms of Environment Conservation Act  |
| Act, No. 107 of 1998 | National Environmental Management Act, (as amended)   |
| No. 26 of 1956       | Explosives Act, as amended  |
| Act, No. 85 of 1993  | Occupational Health & Safety Act, as amended  |
| Act 5 of 2008        | Compulsory Specifications Act   |
|                      | South African Distribution Code (all parts)   |
|                      | South African Grid Code (all parts)   |
| IEC 60068-2-1        | Environmental Testing – Part 1 Cold   |
| IEC 60068-2-2        | Environmental Testing – Part 2 Dry Heat   |
| IEC 60068-2-30       | Environmental Testing – Part 30 Damp heat, cyclic (12h + 12h cycle)   |
| IEC 60255-3          | Electrical relays Part 3: Single input energizing quantity measuring relays with dependent and independent time                 |
| IEC 60255-6          | Electrical relays Part 6: Measuring relays and protection equipment   |
| IEC 60255-21         | Electrical relays Part 21: Vibration, shock, bump and seismic tests on measuring relays and protection equipment (all sections) |
| IEC 60255-22         | Electrical relays Part 22: Electrical disturbance tests for measuring relays and protection equipment (all sections)            |
| IEC 61727            | Photovoltaic (PV) systems - Characteristics of the utility interface  |
| IEC 62271-100        | High voltage alternating current circuit breakers   |
| IEC 62116            | Test procedure of islanding prevention measures for utility- interconnected photovoltaic inverters                              |
| IEEE 1547            | IEEE Standard for interconnecting distributed resources with electrical power systems   |
| IEEE 1547.1          | IEEE Standard conformance test procedures for equipment interconnecting distributed resources with electric power systems       |
| NRS 029              | Current transformers for rated a.c. voltages from 3,6kV up to and including 420kV   |

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|                    |   |
|--------------------|---|
| NRS 030            | Electricity distribution – Inductive voltage transformers for rated a.c. voltages from 3.6kV up to and including 145kV for indoor and outdoor applications  |
| NRS 031            | Alternating current disconnectors and earthing switches (above 1000V)   |
| NRS 037-1          | Telecontrol Protocol for stand-alone remote terminal units NRS 048-2: Electricity Supply – Quality of Supply Part 2: Voltage characteristics, compatibility levels, limits and assessment methods NRS 048-4: Electricity Supply – Quality of Supply Part 4 : Application guidelines for utilities |
| NRS 048-7          | Electricity Supply – Quality of Supply Part 7: Application practices for end-users  |
| NRS 054            | Rationalized User Specification – Power Transformers  |
| NRS 057 (SANS 474) | Code of Practice for Electricity Metering   |
| NRS 097-1          | Code of Practice for the interconnection of embedded generation to electricity distribution networks: Part 1 MV and HV  |
| NRS 097-2          | Grid interconnection of embedded generation: Part 2 Small scale embedded generation   |
| SANS 1019          | Standard voltages, currents and insulation levels for electricity supply  |
| SANS IEC 60529     | Degrees of protection provided by enclosures (IP Code)  |
| SANS IEC 61000-4   | Electromagnetic compatibility (EMC): Test and measurement techniques (all sections)   |

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## APPENDIX B: SITE LAYOUT AND SINGLE LINE DRAWINGS LIST

### Table 19 Lists Drawings Issued by the Employer

The table below lists drawings issued by the *Employer*

Table 4: List Drawings Issued by the Employer.

| Drawing number                     | Revision | Title  |
|------------------------------------|----------|--|
| R00000014-MPA-XX-DR-C-0001/Rev P01 | 0        | LETHABO SOLAR PV FACILITY GENERAL ARRANGEMENT LAYOUT |
|                                    |          |  |
|                                    |          |  |

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