Eskom	Standard	Technology

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1. Introduction

In South Africa the Electric Machinery Regulations which is administered by the Chief Inspector of Occupational Health and Safety of the Department of Labour, requires that all electric fence installations (nonlethal), temporary or permanent, comply with the requirements of SANS 10222-3. The aim of this standard is to prescribe the minimum requirements for the electrical components for Non-lethal Energised Perimeter Detection System (NLEPDS).

Note: The terms Non-lethal Energised Perimeter Detection System (NLEPDS) and Non-lethal Electric Fence System (NLEFS) shall refer to the same system in this document.

2. Supporting clauses

2.1 Scope

This document outlines the requirements of the electrical components to be complied with for a NLEPDS.

2.1.1 Purpose

This technical document specifies functional, operational performance and other technical requirements that shall be met to satisfy the needs of a high quality NLEPDS for the protection of Eskom installations.

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited, its divisions, subsidiaries and entities wherein Eskom has a controlling interest.

2.2 Normative/informative references

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

2.2.1 Normative

[1] ISO 9001 Quality Management Systems.

[2] SANS 10222-3, Electrical Security installations – Part 3: Electric fences (non-lethal)

[3] SANS 60335-2-76, Household and similar electrical Energizers – Safety, Part 2-76: Particular requirements for electric fence energizers

[4] SANS 60335-1, Household and similar electrical appliances – Safety, Part 1: General requirements

[5] SANS 60529, Degrees of protection provided by enclosures (IP Code)

[6] SANS 61000-1-1, Part 1 - General: Application and interpretation of fundamental definitions and terms

[7] 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

[8] 240-55410927, Cyber security standard for operational technology

[9] 240-71555472, Drawing Creation Control of Secondary Plant Drawings

[10] 240-64139144, AC boards and junction boxes for substations

[11] 240-64100247, Standard for earthing of secondary equipment in substations

[12] 240-82736997, Stringing, Cabling Earthing and Erection Specification for Transmission substations

[13] 240-83684419, PTM&C technology development

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[14] 240-60725641, Specification for Standard (19 Inch) Equipment Cabinets

[15] SANS 10142-1, The wiring of premises

[16] SANS 1091, National Colour Standard

[17] 240-64636794 Standard for Wiring and Cable Marking in Substations

[18] 240-70413291 Specification for Electrical Terminal Blocks

[19] 240-62773019 Specification For Low Voltage Auxiliary Electrical Components Standard

[20] 240-62629353 Specification for Panel Labelling Standard

[21] 240-64685228 Generic Specification For Protective Intelligent Electronic Devices (IEDs)

[22] 240-75655504 Corrosion Protection Standard

[23] 0.54-393 Earthing Standards

[24] 0.52/30122 Electric fence systems: 2-way energizer kiosk

[25] 0.52/30123 Electric fence systems: 4-way energizer kiosk

[26] 0.52/30124 Electric fence systems: Energizer controller kiosk

[27] 0.52/30125 Electric fence systems: Energizer guard house GUI kiosk

2.2.2 Informative

[28] 240-86738968, Specification for integrated security alarm system for protection of Eskom Installations for protection of Eskom installation and its subsidiaries

[29] 240-102220945, Specification for Integrated Access Control System (IACS) for Eskom sites

[30] 240-91190304, Specification for CCTV surveillance with intruder detection

[31] 240-170000096, Physical Security Integration Standard

[32] 240-170000098, Security Public Address Systems for Substations and Telecoms High Sites

2.3 Definitions

2.3.1 General

Definition	Description
Sectorizing (sectors)	Electric fence installation that consists of one energizer and monitoring system connected to an electric fence, which is divided into sections for monitoring purposes (SANS10222 part 3)
Zone	A predefined length of an electric fence which is energized / monitored by an energizer

2.3.2 Disclosure classification

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

2.4 Abbreviations

Abbreviation	Description
°C	Degrees Celsius
AC	Alternating Current

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Abbreviation	Description
DC	Direct Current
EMC	Electro-magnetic Compatibility
EMI	Electro-magnetic Interference
GUI	Graphical user interface
HT cables	High Tension cables
HV	High Voltage
Hz	Hertz
IDF	Intermediate Distribution Frame
IEC	International Electro-technical Commission
IP	Ingress protection
kg	Kilogram
kV	Kilovolt
m	Meter
mm	Millimetre
ms	Millisecond
MTBF	Mean Time Between Failures
NB	Nota Bene “Latin” take notice
NC	Normally closed
NLEPDS	Non-Lethal Energized Perimeter Detection System
NO	Normally open
OHS	Occupational Health and Safety
PC	Personal Computer
SABS	South African Bureau of Standards
SANS	South African National Standards
SCOT	Steering Committee of Technology
UV	Ultra Violet

2.5 Roles and responsibilities

a) The Security Technologies Care Group shall ensure that the technology developed is adequate for application across Eskom sites where it will be utilized.

b) Group security shall be responsible for auditing to ensure compliance with the requirements of this standard.

c) The procurement team shall utilise this document for the enquiry process for the electrical components of a NLEPDS.

2.6 Process for monitoring

Group Security risk analysis will determine the effectiveness of this standard.

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2.7 Related/supporting documents

Not applicable.

3. Requirements for high quality NLEPDS

3.1 Overview of NLEPDS

The NLEPDS has a three-fold function which is firstly to deter any unauthorised intruders from entering a protected site, secondly to detect and alarm any unauthorised attempt to enter a protected site and lastly to delay the adversary from illegally entering a protected site.

An electric fence/NLEPDS is an electrified barrier consisting of bare conductors erected against the trespass of persons or animals. The bare wires carry pulses of electric current generated by an energiser to provide a non-lethal shock to deter potential intruders. The energiser is a device that delivers a periodic non-lethal amount of electrical energy to an electric fence connected to it.

Tampering with the fence results in an alarm that is logged by the security electric fence energiser system. The intrusion alarm condition will occur if the fence wire is either cut or short circuited which will be displayed on the Guard house GUI kiosk indicating which zone was triggered. The electric fence controller unit will via the energizer alarm output trigger the security lights covering that particular zone. It can also trigger a siren, PA systems and alarm notifications to a control room (both local and remote) or directly to the authorised Eskom personnel via email or SMS.

In practical terms, security electric fences are a type of sensor array that acts as a (or part of a) physical barrier, a psychological deterrent to potential intruders; and is part of an integrated security intrusion detection and deterrence system.

The number of energizers deployed depends on the length of the perimeter to be secured. If more than one energiser is used, a synchronising mechanism is needed to make sure that the energizers all pulse at the same time. The Guard house GUI unit is used as the graphical user interface of the NLEPDS system used to indicate the status of the different zones along the perimeter.

The NLEPDS generally comprise of the following components / sub-systems (but not limited to) as indicated in Figure 1:

a) Electric fence conductors

b) Energizer(s)

c) Electric fence control unit incorporating synchronisation equipment, security light control and communication interfaces

d) User interface / display unit

3.2 Types of NLEPD systems

There are generally two types of NLEPD systems based on their operating principles. The required system needed for a particular site will be indicated in the technical schedules.

3.2.1 Multi-zone monitoring system

The perimeter which needs to be protected is broken up into multiple zones and each zone is energized / monitored by a dedicated energizer. The energizers are deployed along the fence in energizer kiosks and the electric fence control unit kiosk is located in a central location as indicated in Figure 1.

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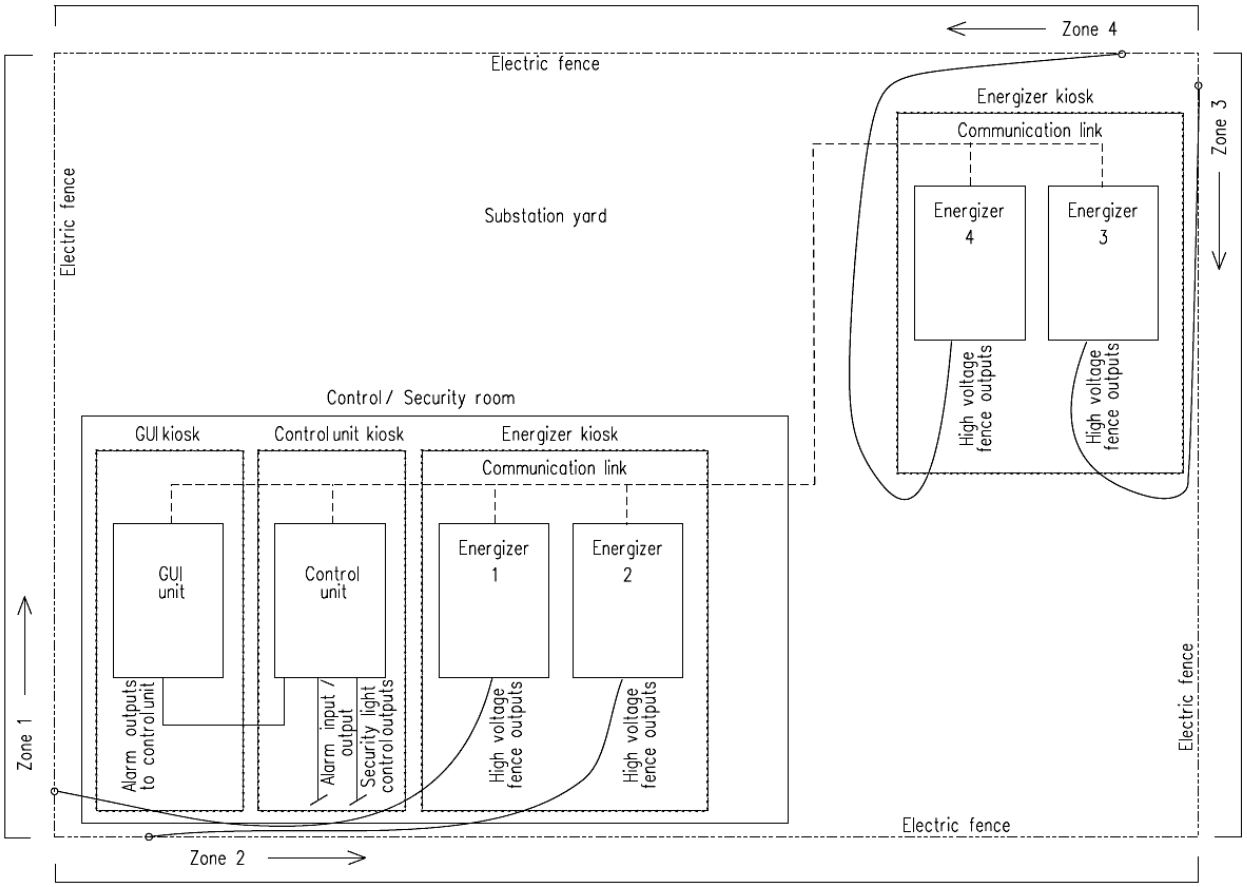

Figure 1: NLEPDS block diagram – multi-zone configuration

3.2.2 Multi-sector monitoring system (resistive sectorizing)

The perimeter which needs to be protected is defined as one zone and is broken up into multiple sectors along the vertical plane of the fence. The entire fence is energized / monitored by energizers which use a method of resistive partitioning to divide the fence into multiple sectors. The energizers are deployed in energizer kiosks together with the control unit kiosk in a central location as indicated in Figure 2.

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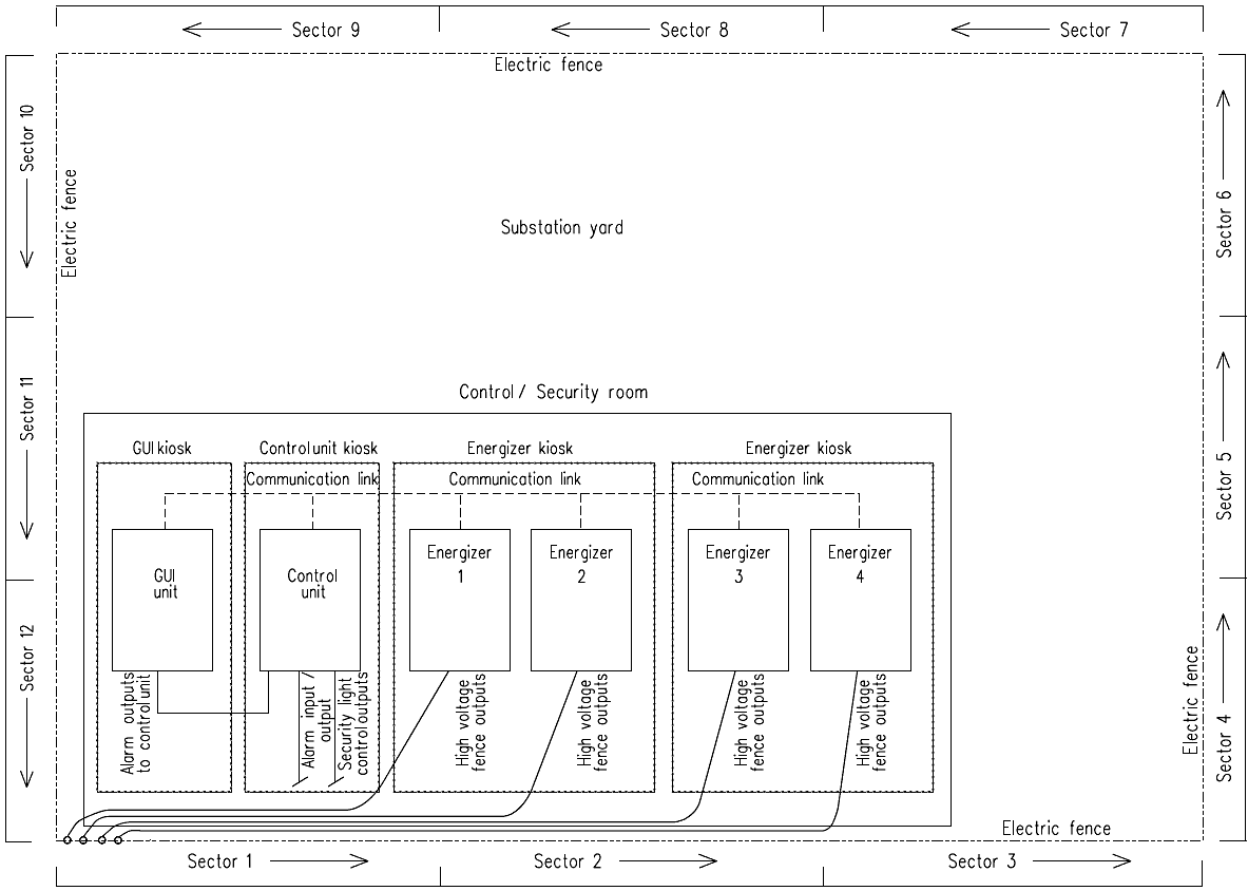

Figure 2: NLEPDS block diagram – multi-sector configuration

3.3 General Environmental conditions

a) All the elements of the NLEPDS shall be able to function in all climatic conditions prevailing in South Africa (hot, cold, dusty & humid). The conditions described below shall be taken as minimum conditions which the NLEPDS and its associated equipment should be able to withstand without the performance being out of limits or the life cycle being shortened:

1) Ambient air temperature: -10 °C to +60 °C (control / equipment room installed); or -10 °C to +70 °C (Installed within enclosures in the substation yard).

2) Altitude: ≤ 2 500 m

3) Relative humidity (24 h average): 98%

3.3.1 Electrical operating environment

a) The electrical environments at which the system will be installed are near or under power lines where inductive coupling with the electrified fences could place high-induced voltages on the fences. All components of the NLEPDS shall function under these conditions without failure/malfunctioning.

b) The functioning of the NLEPDS components shall be immune to electromagnetic interference due to devices such as cell phones, portable radios, telephones, communication transmitters, dc relays operations, switching ac supplies and cable-borne interference.

c) All components of the NLEPDS shall be able to adapt and function without being affected by its immediate electrical environment where high voltage switching occurs often and as such, be subjected to high levels of radiated electrical interference due to their physical placement or their direct connection to electrical plant.

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d) All components of the NLEPDS shall not generate any interference, which could hinder their own performance or the performance of the other equipment in the vicinity.

3.4 Requirements for energizers

3.4.1 General

a) The energizer shall be a Type A energizer as defined in SANS 60335-2-76. This is a battery-operated energizer suitable for connection to the mains consisting of an impulse generating circuit, a battery charging circuit and a battery, the impulse generating circuit being connected to the mains or the battery when the energizer is in operation.

b) The energizer shall meet the applicable requirements of a class II appliance as outlined in SANS 60335-1 with respect to protection against electric shock. This is an appliance in which protection against electric shock does not rely on basic insulation only but in which additional safety precautions are provided, such as double insulation or reinforced insulation, there being no provision for protective earthing or reliance upon installation conditions.

3.4.2 Certification requirements

a) The energizers shall be certified as compliant to SANS 60335-2-76. Certificates stating compliance and type test reports shall be provided with tender documentation.

3.4.3 Electrical requirements

3.4.3.1 Power supply

a) Ancillary equipment and energizers shall have the capability to be supplied with power through the substation AC and DC supply routed from the AC & DC distribution boards.

a) The power supply to the energizer shall be provided through the site's 220V (± 10%), 50Hz (± 2%) AC or DC. The DC voltage supplies available are 48V, 110V and/or 220V DC depending on the site type.

b) The AC and DC supply shall be protected by Class 1 and 11 surge protection.

c) There shall be no system malfunctioning on the failure, restoration, under or over voltage of the power supply to the unit.

d) The existing standby power systems at site shall be used as the primary standby power sources, provided that the standby time (autonomy) requirements of the site are not adversely affected.

e) In cases where the above is not possible, the standby power systems requirements for security systems at Eskom sites shall comply with the following:

1) The system design shall comply with the requirements of 240-91190294, *DC & Auxiliary Supplies Philosophy*.

2) Security systems are required to ensure that the site is protected at all times, hence the standby time of these systems shall be in line with the overall required standby time for the site. The requirements of 240-118870219, *Standby Power Systems Topology and Autonomy for Eskom sites*, shall be adhered to.

3) Standard or technically acceptable equipment shall be used. This equipment is available on Eskom National Contracts (ENCs) or recommended technically acceptable equipment lists.

4) In the absence of ENCs for specific equipment or recommended technically acceptable equipment, the offered equipment shall comply with the technical standards as indicated in Table 1 below:

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Table 1: Technical Standards for Standby Power Systems equipment

Equipment	Technical Standard
Nickel Cadmium Batteries	240-56360086, *Stationary Vented Nickel Cadmium Batteries Standard*
Vented Lead Acid Batteries	240-56360034, *Stationary Vented Lead Acid Batteries Standard*
Valve Regulated Lead Acid Batteries	240-51999453, *Standard Specification for Valve-Regulated Lead Acid Cells*
Power Electronics	240-53114248, *Thyristor and Switch Mode Chargers, AC/DC to DC/AC Converters and Inverter/Uninterruptible Power Supplies Standard*
Low Voltage Protective Devices, Cubicles and wiring	240-64139144, *AC Boards and Junction Boxes for Substations* 240-76628687, *AC/DC Reticulation Equipment for Breaker-and-a-Half Substations* 240-75658628, *Distribution Group's Specific Requirements for AC/DC Distribution Units*

3.4.3.2 Energizer High Voltage Output requirements

The output characteristics of the energizer, when operating at rated voltage with a 500Ω load connected across the fence terminals shall be as follows:

a) The energy delivered to the 500Ω load shall be above 5J but not exceed 8J.

b) Maximum voltage delivered to the load shall not exceed 10kV.

c) The impulse repetition rate shall not exceed 1Hz.

d) The impulse duration shall not exceed 10ms.

3.4.4 Mechanical requirements

3.4.4.1 Energizer IP rating

a) Energizer(s) shall have an IP rating of IP51 at minimum.

3.4.4.2 Markings used on energizer

a) The general markings on the energizer shall comply with SANS 60335-1 and at minimum shall include the following markings:

1) rated voltage or rated voltage range in volts;

2) symbol for nature of supply, unless the rated frequency is marked;

3) rated power input in watts or rated current in amperes;

4) name, trade mark or identification mark of the manufacturer or responsible vendor;

5) IP number according to degree of protection against ingress of water, other than IPX0;

6) The energizer shall be marked with the warning: "Before obtaining access to terminals, all supply circuits must be disconnected".This warning shall be placed in the vicinity of the terminal cover.

3.4.5 Functional requirements

3.4.5.1 General

a) A minimum of two energizers shall be used per installation to improve the reliability and availability of the system.

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b) The minimum expected life of the energizer and associated equipment (PC hardware & software, relay card(s), synchronisation mechanism etc.) shall be 10 years.

c) The energizer shall be self-monitoring and alarm any out-of-bounds condition or system failure to the master control unit.

d) The NLEPDS shall be triggered by either of the following which could indicate an intrusion:

1) Electric fence conductors been short circuited

2) Electric fence conductors been cut (open circuit)

e) When a NLEPDS is triggered/alarmed the following sequence of events and interoperation of different security technologies deployed at site shall be possible:

1) Each violation shall be reported to the security control centre remotely and/or locally.

2) The security perimeter lights shall be illuminated at the affected fence zone(s) or sector(s).

3) The security controller shall be able to confirm the arrival of the responders on site following an alarm/intrusion event.

f) All security alarms and events shall be date-and-time stamped accurately for traceability and investigation purposes.

3.4.5.2 Synchronising equipment/mechanism

a) A synchronising mechanism shall be used to synchronize multiple energizers in order to be regarded as one energizer with multiple outputs, all firing at the same time, as one single pulse.

3.4.5.3 Energizer safety

a) The Energizer shall be constructed so that in normal use, they function safely so as to cause no danger to persons or surroundings, even in the event of carelessness that may occur in normal use.

b) There shall be a safety mechanism (such as a watchdog) to ensure that the energizer(s) output voltage and energy levels are within the legal non-lethal levels. When the maximum level is exceeded, then the output shall be shut down and an alarm generated.

c) The energizers shall shut down if there is a synchronisation failure.

3.4.5.4 Electric fence zones / sectors

a) The non-lethal energised fence shall comprise of various zones or sectors (depending on the NLEPD system).

b) The controller shall be used to configure the electric fence into zones or sectors.

c) It shall be configurable to accommodate at least the number zones or sectors along an electric fence's perimeter specified in the technical schedules.

d) It shall be possible to allocate and generate alarms for intrusions to each individual zone or sector.

e) The alarms shall be routed to individual relays for triggering other security systems.

3.5 Requirements for the NLEPDS equipment kiosks

3.5.1 General

a) Electrical equipment including the energizers, power supply circuitry, isolation switches, relays and relay cards (where required), surge protectors and lighting switches shall be housed in Eskom approved kiosk.

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b) The electric fence installations shall consist of three types of kiosks (refer to drawings 0.52/30122, 0.52/30123, 0.52/30124 & 0.52/30125):

1) Energiser kiosks which can support either two or four energizers

2) Electric fence control kiosk

3) User interface / display (GUI) kiosk

3.5.2 Requirements for the energizer kiosks

a) Two types of energizer kiosks are specified, the first which caters for two energizers and a kiosk which caters for four energizers.

b) The energizer kiosks can be applied in a number of ways to cater for various substation configurations and requirements. For a multi-sector application the kiosks will typically be installed in the same room as the master control unit kiosk. For a multi-zone application only the nearest energizer may be installed in the room and the rest of the kiosks will be installed outside along the electric fence.

3.5.3 Requirements for the Graphical User interface / Display unit kiosk

a) The intension is that this kiosk will typically be installed in the guard house away from the Control and Energiser kiosks.

b) The display unit shall be able to display the configured zones or sectors of the fence including all fence alarms.

c) Alarmed zone(s) or sector(s) of the fence shall be clearly depicted (shape and size) on the display unit.

d) The User interface shall be used to view, acknowledge and reset zone or sector alarms.

e) A panic button / switch shall be provided to send an alarm via the electric fence control unit and SCADA to remote control facilities. The panic button shall also trigger a siren outside the guard house / control room.

f) A security light override switch shall also be installed to switch on all security lights when required.

g) Strict configuration rights management shall be applied such that only authorised users can make configuration changes to the system.

3.5.4 Requirements for the control unit kiosk

a) The intension is that this kiosk will typically be installed in a room adjacent to the guard house with controlled access. For a multi-sector application the energizer kiosks may typically also be installed here and for a multi-zone application only the nearest energizer may be installed here.

b) The control unit kiosk will house the master control unit, a keypad or touch screen to apply and change configuration settings, a synchronisation unit (where required), a light relay card / relays, an alarm relay card / relays, contactors for the security lights, panic siren contactors and an IDF frame for routing the alarms to SCADA.

3.5.4.1 Master Control unit

a) Strict configuration rights management shall be applied such that only authorised users can make configuration changes to the system.

b) Alarm conditions shall be resettable and acknowledgeable from the graphical user interface.

c) Alarms received from the energisers and GUI (where applicable) will be routed to the alarm relay card, panic siren and security light relay card.

d) The system shall have an option of sending security alerts and confirmations through email and SMS.

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e) All security alarms and events shall be date-and-time stamped accurately for traceability and investigation purposes.

3.5.4.2 Alarm relay card

a) The alarm relay card will receive alarms from the master control unit and GUI and route them through to the SCADA interface in the substation.

b) The relay card shall cater for at least eight alarms. Typical alarm requirements are shown in Table 2 below:

Table 2: Energizer indications and alarms

Type	Duration	Description	Condition
Status	Continuous	System-on (for each energizer)	System on
Status	Continuous	Energizer armed (for each energizer)	System is armed
Alarm	Continuous	Fence intrusion alarm (for each zone/sector)	Alarm condition detected
Alarm	Continuous	Battery low (for each energizer)	Battery voltage less than minimum operating voltage
Alarm	Continuous	Mains supply fail	AC power fail
Alarm	Continuous	Synchronisation problems	Energizers not pulsing simultaneously
Alarm	Continuous	Equipment failure	Energizer energy at zero joules
Alarm	Continuous	Watchdog	Energizer Joules and voltage above legal levels

c) If analogue alarms are used, then all status and alarm indication relays shall use change-over contacts, so that either NO or NC contacts can be wired to the IDF as and when required.

d) The alarm relay card outputs shall be capable of triggering the following security systems at minimum:

1) Triggering of PA system recorded voice warnings
2) Switching on of substation security lighting
3) Sirens
4) Strobe lights
5) CCTV cameras

e) The indications shall be supplied as potential free change over contacts.

f) Remote resetting of alarms shall be possible. Compliance to Eskom's cyber security standard [8] shall be ensured.

g) If analogue alarming is used, then an IDF frame shall be provided which will accommodate minimum of eight alarm input / outputs.

3.5.4.3 Security lights relay card

a) The security lights relay card will receive alarms from the master control unit and GUI and switch the lights on at affected zones or sectors.

b) The relay card shall cater for at least ten relays.

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c) The relay outputs will be routed to contactors which will switch the security lights in the affected zones or sectors.

d) A security lights override relay/switch will ensure that all the security lights can be switched on through the security lights bypass button on the GUI kiosk.

3.5.5 Kiosk earthing requirements

a) The earthing of the equipment in the kiosk shall comply with requirements of Eskom standard for earthing of secondary plant equipment in substations [11].

3.5.6 Miniature circuit breaker (MCB) specification

a) The rating of the MCBs shall be adequate for the protection of installed equipment. The Contractor shall be responsible for selection of the appropriately sized MCB.

3.5.7 Surge arrester specification

a) Surge arrestors shall be installed to protect the kiosks electrical equipment from surges. The surge arrester shall be the metal oxide, DIN rail mount type with indication suitable for Zone 1 protection. The arrester shall comply with SANS 61643-1 and bear the SANS mark.

b) The technical specification for the surge arresters shall be as listed in Table 3 below:

Table 3: Surge arrester specification

Surge arrester parameter	Specification
I_{max} (8/20µs)	40kA or 65kA (4/20µs)
Response time	< 25ns
Max. Operating voltage	280V AC (phase to neutral) 360V DC
Frequency	50Hz
Internal fuse	Yes
Open circuit	Open circuit on expiration of the device
Indication	Clear change-of-state (functional or non-functional) e.g. LED on/off

3.5.8 Isolation switches

a) The energizer unit shall have a visible isolating switch for switching off the HV of the electrified fence. In the off state, the isolating switch shall be connected to earth.

b) The energizer isolation switch shall have visible ON/OFF positions and the contacts designed to handle high voltages.

3.5.9 Wiring

a) The kiosk shall be wired in accordance with Standard for Wiring and Cable Marking in Substations [17].

b) All wiring shall be done in stranded copper PVC insulated conductor, which shall comply with SANS 1507.

c) There shall be no joints or splices in the wiring.

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d) Not more than two conductors shall be connected to a terminal.

e) All conductors shall be terminated with crimped connectors using a tool recommended by the manufacturer of the lugs.

Note: No bare wiring or bare part of lugs shall be exposed at termination points on the energizers, the miniature circuit-breakers, the relays and the terminals.

3.5.10 Trunking

a) Cable trunking, location and sizing, shall be provided in accordance with the respective drawings to accommodate the necessary cables. The trunking shall be fastened to the kiosk using rivets or screws. Rivets and/or screws shall not protrude through to the front of the plate.

b) The HV cabling shall be situated in dedicated trunking.

3.5.11 Notices, labeling and packaging

3.5.11.1 Notices

a) Notices shall be provided as required by the Occupational Health and Safety Act. All notices shall be fastened to the kiosks by self-tapping stainless steel screws or by rivets.

b) A standard “Danger” notice in accordance with SANS 1186 shall be provided and placed on the front of the kiosk.

3.5.11.2 Labels

a) A label showing the name of the manufacturer, the date of manufacture and the various quality checks shall be placed on the inside of the kiosk door. The label shall be durable preferably of metal.

b) The following additional labels shall be placed in the kiosk to indicate the following:

- Energizer identification including associated sectors/zones energized by each energizer
- Cables identification though out the system cable routes
- Isolation switches and their ON and OFF positions
- Relay identification
- Lighting identification
- IDF identification

3.6 Communication infrastructure

a) All cables including power and communication cables shall ensure that there are no data losses/disruptions due to harsh operating conditions and voltage/current surges, as such cabling shall not be limited to copper cable only.

b) Communication between all components of the NLEPDS shall be through a communication medium (e.g. fibre optic cables) that will be immune to interruptions due to other devices in the equipment room as well as immune to EMI.

c) Communication protocols supported shall be made available to Eskom upon request to ensure integration of equipment from different suppliers. The NLEPDS system shall be required to interface to a security integration system.

d) Communication to remote security monitoring centres shall be via Eskom Telecom’s infrastructure. Where no Eskom Telecom’s infrastructure is installed, a third party communication infrastructure may be used while ensuring compliance to Cyber security standard for operational technology standard [8].

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3.7 Requirements for Electric fence conductors

3.7.1 Electric fence conductors

a) Conductors shall comply with requirements of SANS 10222-3 Electrical Security installations – Part 3: Electric fences (non-lethal).

b) Conductors shall be manufactured from 2.24mm diameter solid fully galvanised steel wire for inland installations. For coastal regions Eskom may opt to use a 1.6mm aluminium conductor, there shall be provision made for both these requirements. Eskom's approval shall be requested before using a multi-strand wire.

c) Ferrules used for crimping conductors and tensioners shall be of similar material as conductor (e.g. steel on steel).

3.7.2 HT cables

a) High Tension (HT) armoured cable shall be used to connect the energizer electrical output connectors to the conductor / trace wires of the NLEPDS structure.

b) The HT cables shall be UV stabilised and double insulated.

3.8 Requirements for Insulators

All insulators shall conform to the following requirements:

a) They shall comply with requirements of SANS 10222-3 standard.

b) They shall be designed in such a way that under no condition can/shall arcing occur including during high moisture or wet conditions.

c) They shall have a guaranteed UV protection for a minimum period of 10 years.

d) Requirements for Lightning Protection and over current on the HV circuits.

3.9 General lightning and over current requirements

a) The system will be installed where it will be subject to voltage surges due to lightning, a variety of line faults, power interruptions and high voltage switching conditions. The system shall be able to operate without failure under all of the above mentioned conditions. Therefore, it is imperative that the system be adequately earthed.

b) Protection against high voltage transients shall be provided on both the signal and power circuitry, without impairing the system's electrical parameters, sensitivity, or performance.

c) Lightning arrestors shall comply with the requirements of SANS 10222-3.

3.10 Earthing requirements

a) Three (3) earth pegs, 1,8 m apart in a triangular layout, shall be installed at both sides of the security equipment room. The pegs shall be connected to the main earth mat (where installed) and the first post on each side of the NLEPDS structure. The earth pegs shall be 1,5 m in length and be copper coated.

b) On both sides of the security equipment building, connect all earth pegs, lightning diverter and energizer ground connections together with 16 mm² copper earthing cables.

c) 16 mm² copper earth cables from the energizer to the earth pegs shall be laid on both sides of the security equipment building.

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3.11 Warning signs

a) Materials used for the manufacture of warning signs shall be of such a composition as to withstand anticipated weather conditions and the effects of ultra-violet radiation throughout their design life.

b) All electric fences shall be identified by prominently displaying warning signs.

c) The minimum warning sign dimensions shall be 200×100 mm.

d) The background colour of both sides of the warning sign shall be yellow (refer to Annex A). The inscription on the sign shall be black with the words “CAUTION: Electric fence”.

3.12 Documentation

a) Energizers shall be supplied with instructions that contain information regarding:

1) The installation of electric fences;

2) The means of connecting the energizer to the electric fence.

b) If the manner of installing components is not obvious, each component of NLEPDS shall be supplied together with instructions for the installation of the component. Any component that may be damaged by the reversal of the input polarity shall have this fact clearly stated in the instructions.

c) Advice on the application of the barrier, to avoid inappropriate use and potential false operation

d) List of all field replaceable spare parts

e) Electrical and mechanical specifications and parameters for the equipment

f) Wiring diagrams of the equipment

g) Installation, commissioning and maintenance procedures

h) All modules and circuit diagrams

i) Schematic diagrams

j) Installation drawings

k) The following additional information shall be provided:

1) Power supply requirements

2) Performance characteristics, including the MTBF

3) Wiring and mounting instructions

4) Output ratings

5) Instructions for adjustment, including specification of any special tools required

6) Programme for maintenance, testing and servicing

3.13 Installation and Site Acceptance Testing (SAT)

a) The supplier shall install the system on site (energizers, relays, control unit, synchronisation equipment, graphical user interface, fence conductors & communication infrastructure) inclusive of all interconnections between the system modules.

b) The supplier shall avail themselves for Site Acceptance Testing at site after installation.

c) All test procedures required to ensure the correct functioning shall be specified with a list of required test equipment and tools.

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3.14 System life cycle

a) The minimum system life cycle of the proposed product must be ten (10) years.

b) The life cycle of the product must be further supported in terms of spares availability for a minimum period of seven (7) years after discontinuation of the product.

3.15 Warranty and support

a) The system shall carry a minimum local (South African) warranty of 36 months with on-site as well as telephonic support from date of the system being commissioned. Eskom shall thereafter have the option to access on-going support in terms of a subsequent agreement.

b) The supplier must have a technician on call on a 24-hour basis for purposes of telephonic support.

c) Supplier spares holding should include minimum replacement spares to restore service of the system in its entirety.

d) All support shall also include all firmware upgrades of the initial system version installed over the operational life of the system.

e) The support shall include first line level maintenance training.

f) The supplier shall also provide operator training on site to the end-user.

g) Product support must include national as well as international support through the local branch.

h) The supplier shall be willing to enter into an SLA with Eskom

i) The supplier should have a history of supplying products of this nature in South Africa for at least a minimum period of five (5) years.

j) The supplier to provide a list of reference sites where the product on offer has been installed and the year of implementation.

4. Functional and detailed design specifications

4.1 Function design specification

The tenderer is required to produce and submit a Functional Design specification and a System Design Report. The Functional Specification details Eskom's functional requirements in the context of the product that is offered by the Tenderer. The System Design Report documents the design that has been developed in order to meet the requirements as specified in the Functional Specification (240-78980848). At minimum the functional design specification and System design report shall cover the functional and interconnection details of system components listed below:

a) Electric fence conductors

b) Power supply

c) Control unit

d) Graphical User interface / Display unit

e) Synchronising equipment/mechanism

f) Relay cards

g) Communication infrastructure

h) Energizer(s)

Note: The Functional Specification and the System Design Report can be combined as one document.

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4.2 Detailed Design Specification

The tenderer is required to produce a Detailed Design Specification for both hardware and software components of the system and Acceptance Testing Procedures. At minimum the detailed design specification shall cover details listed in the following index.

a) Overview of functional specification

b) High Level Integration

1) Local vs remote monitoring and control capabilities

2) Software and network configuration files.

3) Cause and effect matrices (e.g. if alarm on fence, lights are switched on)

c) System Architecture (to include logical and physical design)

d) Lifespan of system and product software versions (include 10 year life span support)

e) Recommended Maintenance (Procedures, Spares and FMECA- Failure mode effects and criticality analysis, tools and test equipment, training requirements-engineering and field operations)

f) System commission and acceptance testing procedure (commissioning results to be provided prior to system handover.

g) Appendix A – Drawings

- Site Security Zoning
- System Configuration
- Security LAN and communication Reticulation
- Cable and trench layout
- Power reticulation
- Control Panels
- Electric fence and energiser
- kiosks

h) Appendix B – Equipment Specification

- Energisers
- Electric fence conductors
- Power supply
- Configuration PC / Controller
- User interface / Display unit
- Synchronising equipment/mechanism
- Relay cards
- Communication infrastructure
- kiosks

i) Appendix C – Datasheets

- Energisers
- Electric fence conductors
- Power supply

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- Control unit
- Graphical user interface / Display unit
- Synchronising equipment/mechanism
- Relay cards
- Communication infrastructure
- kiosks

j) 10 Appendix D- Bill of Materials

5. Authorization

This document has been seen and accepted by:

Name and surname	Designation
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Nelson Luthuli	Senior Manager (Acting) – PTM&C
Cornelius Naidoo	Telecomms and physical Security T&S Middle Manager – PTM&C
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Aletta Mashao	Senior Manager – PTM&C DX
Sikelela Mkhabela	Senior Manager – DX Network Operations
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6. Revisions

This document cancels and replaces revision 3 of document number 240-78980848

Date	Rev	Compiler	Remarks
Nov 2021	4	R Moshoeshoe	Referenced kiosk drawings and added technical requirements for the kiosks Removed reference to outdated Government gazette 34154
July 2020	3	M Omar / H Groenewald/R Moshoeshoe	Complete overhaul of the document. Removed all the civil components from the standard. Provided for two options for NLEPDS zoning methods

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Date	Rev	Compiler	Remarks
March 2018	2	R Moshoeshoe	Changed the maximum distance between intermediate posts from 5 meters to maximum distance of 3000mm to comply with the new SANS 10222-3 standard. Modified numbering to align with the new SANS 10222-3 standard. Changed the maximum distance between electric fence conductors to 100 mm to comply with new requirements of SANS 10222-3. Removed EBI integration requirements. Removed informative reference to obsolete documents (ETSP426, 34-1618,DISSCABK1). Removed informative to outdated drawings (0.52-/30078, 0.54/8282, D-DT.5237, 0.54/7470). Added monitoring requirements. Added type testing compliance requirements for energizers. Added integrated intrusion alarm management requirements. Removed reference to SANS 7253 (document withdrawn. Added monitoring requirements. Added Electrical operating conditions requirements.
Jan 2015	1	R Moshoeshoe	Document revised and reference number changed from 32-402 to 240-78980848

7. Development team

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

- Tejin Gosai
- Albertus Hendriks
- Henri Groenewald
- Joe Verissimo
- Victor Lehobo

8. Acknowledgements

Not applicable.

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Annex A – Symbol for warning sign

(Normative)

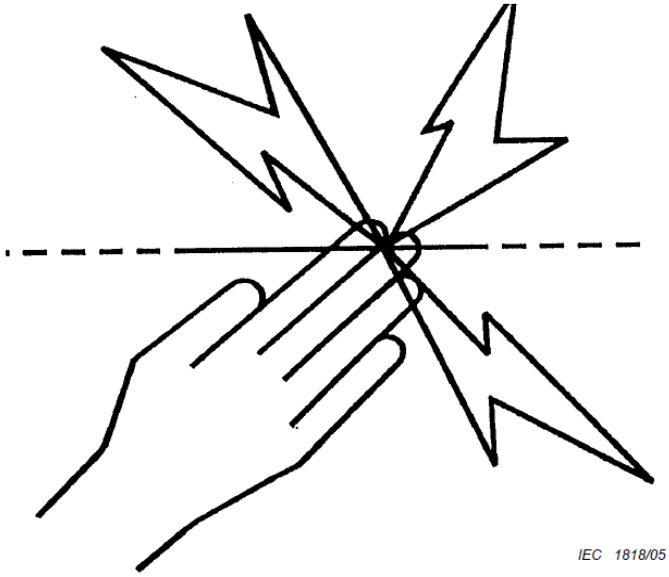

Figure A.1: Symbol for warning sign

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Annex B – Technical Schedule A & B

	TECHNICAL SCHEDULES A AND B FOR STANDARD FOR NON-LETHAL ENERGIZED PERIMETER DETECTION SYSTEM 240-78980848 **Schedule A**: Purchaser's specifications **Schedule B**: Guarantees, compliance, and technical particulars of equipment offered • The clauses and numbering in this table are not necessarily the verbatim clauses as per 240-78980848. Therefore it is OBLIGATORY on the TENDERER to review the applicable clauses in 240-78980848 in order to provide an informed response. • When completing the Schedule B and the References section, The Tenderer is required to state clearly, for each clause that requires a statement of compliance, with one of the following options: a) Comply – Confirmation of FULL Compliance to all clauses of the applicable section of the Technical Standard. No deviations b) Partially Comply – Confirmation of PARTIAL Compliance and that FULL Compliance is not possible. Deviations taken. c) Do Not Comply - Confirmation of Non-Compliance to ALL requirements in the applicable section • Reference to evidence in the form of datasheets, equipment manuals, drawings, hyperlinks shall be included in the References section • Where there are any deviations taken from the clauses in the applicable section, these should be indicated under the References and Deviations section • The Comments section shall be used by the Tenderer to provide any further information to complement/explain the compliance/Non-Compliance and evidence provided.				
	Description	**Schedule A**	**Schedule B**	**References/Statement (supporting evidence) & Deviations**	**Weight**
3	**Requirements for high quality NLEPDS**				
3.1	**Overview of NLEPDS**				

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3.2	**Types of NLEPD systems**				
3.2.1	The energizer shall support Multi-zone monitoring.	comply			1
3.2.2	The system shall support Multi-sector monitoring (resistive sectorizing).	comply			1
3.3	**General Environmental conditions**				
a)	All elements of the system shall be able to function in all climatic conditions in section 3.3 a) of 240-78980848 without the performance being out of limits or the life cycle being shortened.	Comply with reference			3
3.3.1	**Electrical operating environment**				
a)	All components of the NLEPDS shall function under electrical environments that are near or under power lines without failure/malfunctioning.	comply			3
b)	The functioning of the NLEPDS components shall be immune to electromagnetic interference.	comply			3
c)	All components of the NLEPDS shall be able to adapt and function without being affected by high voltage switching.	comply			3
d)	All components of the NLEPDS shall not generate any interference, which could hinder their own performance or the performance of the other equipment in the vicinity.	comply			1
3.4	**Requirements for energizers**				
3.4.1	**General**				
a)	The energizer shall be a Type A energizer as defined in SANS 60335-2-76.	Comply with reference			1

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b)	The energizer shall meet the applicable requirements of a class II appliance as outlined in SANS 60335-1 with respect to protection against electric shock.	Comply with reference			1
3.4.2	**Certification requirements**				
a)	The energizers shall be certified as compliant to SANS 60335-2-76. Certificates stating compliance and type test reports shall be provided with tender documentation	Comply with reference			3
3.4.3	**Electrical requirements**				
3.4.3.1	**Power supply**				
a)	Ancillary equipment and energizers shall have the capability to be supplied with power through the substation AC and DC supply routed from the AC & DC distribution boards.	comply			1
b)	The power supply to the energizer shall be provided through the site's 220V (± 10%), 50Hz (± 2%) AC and/or DC.	Comply			1
c)	The AC and DC supply shall be protected by Class 1 and 11 surge protection.				1
d)	There shall be no system malfunctioning on the failure, restoration, under or over voltage of the power supply to the unit.	comply			3
d)	The existing standby power systems at site shall be used as the primary standby power source, provided that the standby time (autonomy) requirements of the site are not adversely affected.	comply			1
e)	Standby power systems shall comply with requirements of section 3.4.3.1(e) of 240-78980848.	comply			3
3.4.3.2	**Energizer High Voltage Output requirements**				

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a)	The energy delivered to the 500Ω load shall be above 5J but not exceed 8J.	Comply with reference. Submit certificate of compliance to SANS 60335-2-76 including test reports			3
b)	Maximum voltage delivered to the load shall not exceed 10kV.	Comply with reference. Submit certificate of compliance to SANS 60335-2-76 including test reports			3
c)	The impulse repetition rate shall not exceed 1 Hz.	Comply with reference. Submit certificate of compliance to SANS 60335-2-76 including test reports			3
d)	The impulse duration shall not exceed 10 ms.	Comply with reference. Submit certificate of compliance to SANS 60335-2-76 including test reports			3
3.4.4	**Mechanical requirements**				
3.4.4.1	**Energizer IP rating**				
a)	Energizer(s) shall have an IP rating of IP51 at minimum.	Comply with reference			1
3.4.4.2	**Markings used on energizer**				
a)	The general markings on the energizer shall comply with SANS 60335-1 and at minimum shall include marking listed in section 3.4.4.2 (a) of 240-78980848	comply			6
3.4.5	**Functional requirements**				

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3.4.5.1	**General**				
a)	A minimum of two energizers shall be used per installation to improve the reliability and availability of the system.	comply			1
b)	The minimum expected life of the energizer and associated equipment (PC hardware & software, relay card(s), synchronisation mechanism etc.) shall be 10 years.	comply			3
c)	The energizer shall be self-monitoring and alarm any out-of-bounds condition or system failure to the master control unit.	comply			3
d)	The NLEPDS shall be triggered by either electric fence conductors been short circuited or electric fence conductors been cut (open circuit)	comply			3
e)	When a NLEPDS is triggered/alarmed the following sequence of events and interoperation of different security technologies deployed at site shall be possible:				
i	Each violation shall be reported to the security control centre remotely and/or locally.	comply			3
ii	The security perimeter lights shall be illuminated at the affected fence zone(s) or sector(s).	comply			3
iii	The security controller shall be able to confirm the arrival of the responders on site following an alarm/intrusion event.	comply			3
f)	All security alarms and events shall be date-and-time stamped accurately for traceability and investigation purposes.	comply			3
3.4.5.2	**Synchronising equipment/mechanism**				

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a)	A synchronising mechanism shall be used to synchronize multiple energizers in order to be regarded as one energizer with multiple outputs, all firing at the same time, as one single pulse.	comply			3
3.4.5.3	**Energizer safety**				
a)	The Energizer shall be constructed so that in normal use, they function safely so as to cause no danger to persons or surroundings, even in the event of carelessness that may occur in normal use.	comply			1
b)	There shall be a safety mechanism (such as a watchdog) to ensure that the energizer(s) output voltage and energy levels are within the legal non-lethal levels. When the maximum level is exceeded, then the output shall be shut down and an alarm generated.	comply with reference			3
c)	The energizers shall shut down if there is a synchronisation failure.	Comply with reference			3
3.4.5.4	**Electric fence zones / sectors**				
a)	The non-lethal energised fence shall comprise of various zones or sectors (depending on the NLEPD system).	comply			1
b)	The controller shall be used to configure the electric fence into zones or sectors.	comply			3
c)	It shall be configurable to accommodate at least the number zones or sectors along an electric fence's perimeter specified in the technical schedules	comply			1
d)	It shall be possible to allocate and generate alarms for intrusions to each individual zone or sector.	comply			1
e)	The alarms shall be routed to individual relays for triggering other security systems.	comply			3
3.5	**Requirements for the NLEPDS equipment kiosks**				

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3.5.1	**General**				
a)	Electrical equipment including the energizers, power supply circuitry, isolation switches, relays and relay cards (where required), surge protectors and lighting switches shall be housed in Eskom approved kiosk.				1
b)	**The electric fence installations shall consist of three types of kiosks:**				
i	Energiser kiosks which can support either two or four kiosks	comply			1
ii	Electric fence control kiosk	comply			1
iii	User interface / display (GUI) kiosk	comply			1
3.5.2	**Requirements for the energizer kiosks**				
a)	Two types of energizer kiosks are specified, the first which caters for two energizers and a kiosk which caters for four energizers.	comply			1
b)	The energizer kiosks can be applied in a number of ways to cater for various substation configurations and requirements. For a multi-sector application the kiosks will typically be installed in the same room as the master control unit kiosk. For a multi-zone application only the nearest energizer may be installed in the room and the rest of the kiosks will be installed outside along the electric fence.	comply			3
3.5.3	**Requirements for the Graphical User interface / Display unit kiosk**				
a)	The intension is that this kiosk will typically be installed in the guard house away from the Control and Energiser kiosks.	comply			1

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b)	The display unit shall be able to display the configured zones or sectors of the fence including all fence alarms.	comply			3
c)	Alarmed zone(s) or sector(s) of the fence shall be clearly depicted (shape and size) on the display unit.	comply			3
d)	The User interface shall be used to view, acknowledge and reset zone or sector alarms.	comply			3
e)	A panic button / switch shall be provided to send an alarm via the electric fence control unit and SCADA to remote control facilities. The panic button shall also trigger a siren outside the guard house / control room.	comply			3
f)	A security light override switch shall also be installed to switch on all security lights when required.	comply			3
g)	Strict configuration rights management shall be applied such that only authorised users can make configuration changes to the system.	comply			3
3.5.4	**Requirements for the control unit kiosk**				
a)	The intension is that this kiosk will typically be installed in a room adjacent to the guard house with controlled access. For a multi-sector application the energizer kiosks may typically also be installed here and for a multi-zone application only the nearest energizer may be installed here.	comply			1
b)	The control unit kiosk will house the master control unit, a keypad or touch screen to apply and change configuration settings, a synchronisation unit (where required), a light relay card / relays, an alarm relay card / relays, contactors for the security lights, panic siren contactors and an IDF frame for routing the alarms to SCADA.	comply			3
3.5.4.1	**Master Control unit**				

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a)	Strict configuration rights management shall be applied such that only authorised users can make configuration changes to the system.	comply			3
b)	Alarm conditions shall be resettable and acknowledgeable from the graphical user interface.	comply			3
c)	Alarms received from the energisers and GUI (where applicable) will be routed to the alarm relay card, panic siren and security light relay card.	comply			3
d)	The system shall have an option of sending security alerts and confirmations through email and SMS.	comply			3
e)	All security alarms and events shall be date-and-time stamped accurately for traceability and investigation purposes.	comply			3
3.5.4.2	**Alarm relay card**				
a)	The alarm relay card will receive alarms from the master control unit and GUI and route them through to the SCADA interface in the substation.	comply			3
b)	The relay card shall cater for at least eight alarms listed in Table 2 of 240-78980848	comply			8
c)	If analogue alarms are used, then all status and alarm indication relays shall use change-over contacts, so that either NO or NC contacts can be wired to the IDF as and when required.	comply			1
d)	The alarm relay card outputs shall be capable of triggering the security systems listed in section 3.5.4.2 (d.) of 240-78980848	comply			4
e)	The indications shall be supplied as potential free change over contacts.	comply			1

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f)	Remote resetting of alarms shall be possible. Compliance to Eskom's cyber security standard (240-55410927) shall be ensured.	comply			3
g)	If analogue alarming is used, then an IDF frame shall be provided which will accommodate minimum of 20 alarm input / outputs.	comply			1
3.5.4.3	**Security lights relay card**				
a)	The security lights relay card will receive alarms from the master control unit and GUI and switch the lights on at affected zones or sectors.				1
b)	The relay card shall cater for at least ten relays.				3
c)	The relay outputs will be routed to contactors which will switch the security lights in the affected zones or sectors.				3
d)	A security lights override relay/switch will ensure that all the security lights can be switched on through the security lights bypass button on the GUI kiosk.				3
3.5.5	**Kiosk earthing requirements**				
a)	The earthing of the equipment in the kiosk shall comply with requirements of Eskom standard for earthing of secondary plant equipment in substations				1
3.5.6	**Miniature circuit breaker (MCB) specification**				
a)	The rating of the MCBs shall be adequate for the protection of installed equipment. The Contractor shall be responsible for selection of the appropriately sized MCB.	comply			1
3.5.7	**Surge arrester specification**				

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a)	Surge arrestors shall be installed to protect the kiosks electrical equipment from surges. The surge arrester shall be the metal oxide, DIN rail mount type with indication suitable for Zone 1 protection. The arrester shall comply with SANS 61643-1 and bear the SANS mark.				1
b)	The technical specification for the surge arresters shall be as listed in Table 3 of 240-78980848				7
3.5.8	**Isolation switches**				
a)	The energizer unit shall have a visible isolating switch for switching off the HV of the electrified fence. In the off state, the isolating switch shall be connected to earth.				3
b)	The energizer isolation switch shall have visible ON/OFF positions and the contacts designed to handle high voltages.				1
3.5.9	Wiring shall comply with requirements listed in section 3.5.9 of 240-78980848				5
3.5.10	Trunking shall comply with requirements listed in section 3.5.10 of 240-78980848				2
3.5.11	Notices, labelling and packaging shall comply with requirements listed in section 3.5.11 of 240-78980848				3
3.6	**Communication infrastructure**				
a)	All cables including power and communication cables shall ensure that there are no data losses/disruptions due to harsh operating conditions and voltage/current surges, as such cabling shall not be limited to copper cable only.	comply			1

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b)	Communication between all components of the NLEPDS shall be through a communication medium (e.g. fibre optic cables) that will be immune to interruptions due to other devices in the equipment room as well as immune to EMI.	comply			1
c)	Communication protocols supported shall be made available to Eskom upon request to ensure integration of equipment from different suppliers.	Comply with reference			1
d)	Communication to remote security monitoring centres shall be via Eskom Telecom's infrastructure. Where no Eskom Telecom's infrastructure is installed, a third-party communication infrastructure may be used while ensuring compliance to Cyber security standard for operational technology standard (240-55410927).	comply			1
3.7	**Requirements for Electric fence conductors**				
3.7.1	**Electric fence conductors**				
a)	Conductors shall comply with requirements of SANS 10222-3 Electrical Security installations – Part 3: Electric fences (non-lethal).	comply			1
b)	Conductors shall be manufactured from 2.24mm diameter solid fully galvanised steel wire for inland installations. For coastal regions Eskom may opt to use a 1.6mm aluminium conductor, there shall be provision made for both these requirements.	comply			1
c)	Ferrules used for crimping conductors shall be of similar material as conductor (e.g. steel on steel).	comply			1
3.7.2	**HT cables**				
a)	High Tension (HT) armoured cable shall be used to connect the energizer electrical output connectors to the conductor / trace wires of the NLEPDS structure.	comply			1

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b)	The HT cables shall be UV stabilised and double insulated.	comply			1
3.8	Insulators shall comply with requirements of section 3.8 of 240-78980848	comply			4
3.9	**General lightning and over current requirements**				
a)	The system will be installed where it will be subject to voltage surges due to lightning, a variety of line faults, power interruptions and high voltage switching conditions. The system shall be able to operate without failure under all of the above mentioned conditions. Therefore, it is imperative that the system be adequately earthed.	comply			1
b)	Protection against high voltage transients shall be provided on both the signal and power circuitry, without impairing the system's electrical parameters, sensitivity, or performance.	comply			1
c)	Lightning arrestors shall comply with the requirements of SANS 10222-3.	comply			1
3.10	Earthing shall comply with requirements listed in section 3.10 of 240-78980848	comply			3
3.11	Warning signs shall comply with requirements listed in section 3.11 of 240-78980848	comply			3
3.12	Equipment shall be supplied with information listed in section 3.12 of 240-78980848	Comply with reference			10
3.13	**Installation and Site Acceptance Testing (SAT)**				

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a)	The supplier shall install the system on site (energizers, relays, control unit, synchronisation equipment, graphical user interface, fence conductors & communication infrastructure) inclusive of all interconnections between the system modules	comply			1
b)	The supplier shall avail themselves for Site Acceptance Testing at site after installation.	comply			1
c)	All test procedures required to ensure the correct functioning shall be specified with a list of required test equipment and tools.	comply with reference			3
3.14	**System life cycle**				
a)	The minimum system life cycle of the proposed product must be ten (10) years.	comply			3
b)	The life cycle of the product must be further supported in terms of spares availability for a minimum period of seven (7) years after discontinuation of the product.	comply			3
3.15	**Warranty and support**				
a)	The system shall carry a minimum local (South African) warranty of 36 months with on-site as well as telephonic support from date of the system being commissioned. Eskom shall thereafter have the option to access on-going support in terms of a subsequent agreement.	comply			3
b)	The supplier must have a technician on call on a 24-hour basis for purposes of telephonic support.	comply			3
c)	Supplier spares holding should include minimum replacement spares to restore service of the system in its entirety.	comply			3

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d)	All support shall also include all firmware upgrades of the initial system version installed over the operational life of the system.	comply			3
e)	The support shall include first line level maintenance training.	comply			3
f)	The supplier shall also provide operator training on site to the end-user.	comply			3
g)	Product support must include national as well as international support through the local branch.	comply			3
h)	The supplier shall be willing to enter into an SLA with Eskom	comply			3
i)	The supplier should have a history of supplying products of this nature in South Africa for at least a minimum period of five (5) years.	Comply with reference			3
j)	The supplier to provide a list of reference sites where the product on offer has been installed and the year of implementation.	Comply with reference			3
4	**Functional and Detailed Design specifications**				
a)	Functional design specification (basic design)	The Tenderer shall submit a functional design specification as per section 4.1 of 240-78980848	submit a functional design specification as per section 4.1 of 240-78980848		10
b)	Detailed design specification	The Tenderer shall submit a detailed design specification as per section 4.2 of 240-78980848	submit a detailed design specification as per section 4.2 of 240-78980848		20

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