SPECIFICATION FOR ELECTRIC FENCES

PL675

REV. 000

DOCUMENT APPROVAL PROCESS

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2. INTRODUCTION

The objective of this Specification is to establish standards and codes of practice that are required to be adhered to by both Contractor and Client in the design, supply and installation of Electric Security Fences, on all Transnet Pipelines Sites. The work defined in this document should be executed in accordance with the project and quality procedures, life-cycle stages and standard deliverables of the Contractor.

3. SCOPE

This Transnet Pipelines Specification defines, as a minimum the technical requirements and general responsibilities regarding the safety, design, supply, manufacture, population, type-testing, performance, constructional and routine testing, delivery to site, site erection, site testing and commissioning requirements for permanent perimeter wall-top Electric Security Fences. Contractors are required to familiarise themselves with all applicable Standards and Codes of Practice listed herein, and to ensure compliance in the execution of any work in terms of this document. Failure to comply may render the contractor liable for corrections at his own cost.

This document does not include specialised security measures that may be required such as CCTV, security guards and other specialty fencing systems.

Any Additional required components not included in the bill of quantities to achieve full system functionality shall be included by Contractor.

These Standards and Codes of Practice should be read in conjunction with all other Specifications and drawings as issued for a particular contract. Where discrepancies occur, these must be brought to the attention of Transnet Pipelines in writing before commencement of work. In the event of any conflict between the contents of any documents forming part of a contract (as listed in the Schedule of Contract Documents) and this document, the former shall prevail.

3.1 BACKGROUND TO NKP REQUIREMENTS

The Grading of National Key Points (NKP): Security Advisory Services has graded the Transnet Pipeline Depots in order to determine the Class of the Facilities and the level of security required. The following aspects / phenomena were taken into consideration before grading the depots:

- Location
- Crime threat analysis
- History of aggression against resident / residence
- Strategic reason / value for being a National Key Point

The Transnet Pipelines depots were subsequently classified as National Key Points with a High Level of Security: Level 3.

As a result of this classification NKP provided guidelines for the types and details of acceptable perimeter barriers and gates.

4. REFERENCES

Annexure A of the Grading of National Key Points: Security Advisory Service was used as the basis for this specification. It is noted that said document must be used as a guideline and that threats, topographical description and other factors may influence the security system(s) proposed for a site.

4.1 LEGISLATION, SPECIFICATIONS, DRAWINGS, ATTACHMENTS AND EXHIBITS

All Work shall be performed in strict accordance with the following described specifications, drawings and other documents, where applicable and which by this reference are made a part hereof.

Where reference is made to a Code, Specification or Standard, the reference shall be taken to mean the latest edition of the Code, Specification or Standard, including addenda, supplements and revisions thereto, in content or numbering.

4.1.1 Applicable Legislation

Standard	Subject
SANS 10400	The application of the National Building Regulations
OHS Act	Occupational Health and Safety Act No. 85 of 1993 as amended
Post Office Act	Act No 44 of 1958
Telecommunications Act	Act No 103 of 1996
Government Regulation R1593	Government Gazette No. 11458

4.1.2 SANS Codes of Practice

Code No.	Title
SANS 10108	The classification of hazardous locations and the selection of electrical apparatus for use in such locations.
SANS 10142-1	The Wiring of Premises Part 1: Low-voltage installations

SANS 10222 -3	Electrical security installations Part 3: Electric security fences (non-lethal)
SANS 60335 -2-76	Household and similar electrical appliances - Safety Part 2-76: Particular requirements for electric fence energizers
SANS 60079	Explosive atmospheres: Part 14: Electrical installations design, selection and erection; Part 17: Electrical installations inspection and maintenance; Part 25: Intrinsically safe electrical systems
SANS 214-1	Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus Part 1: Emission
SANS 60529	Degrees of protection provided by enclosures (IP Code)
SANS 1274- 2014	Coatings applied by the powder-coating process
SANS 1091 - 2012	National colour standards

4.1.3 Transnet Pipelines Specifications

The following Transnet Pipelines standard specifications are to be read in conjunction with this document and require separate statements of compliance, which should be included in the tender documents.

PL727 - Cable, Racking, Trenching & Earthing Reticulation Codes of Practice
PL711 - Equipment Cabinets to house Electronic Equipment Safety Regulations for Contractors
PL631 - Low Voltage Switchgear And Distribution Boards

5. ABBREVIATIONS

For the purpose of understanding these Standards, the following abbreviations apply.

AC	Alternating current
CT	Current Transformer
DC	Direct Current
EMC	Electro magnetic compatibility
FAT	Factory Acceptance Test
fn	Rated frequency

HRC	High Rupturing Capacity
IEC	International Electrotechnical Commission
IP	Ingress Protection
ISO	International Organisation for Standardisation
LV	Low Voltage
mcb	Miniature Circuit-breaker
MCC	Motor Control Centre
OEM	Original Equipment Manufacturer
OHS Act	Occupational Health and Safety ACT
PE	Protective Conductor
PEN	Combined Protective Earth & Neutral
PTTA	Partially Type-tested ASSEMBLY
RCC	Regulatory Certificate of Compliance
SAT	Site Acceptance Test
SABS	South African Bureau of Standards
SANS	South African National Standards
SCPD	Short Circuit Protective Device
SPD	Surge Protection Device
TPL	Transnet Pipelines
TTA	Type-tested ASSEMBLY
UPS	Uninterruptible Power Supply
Ue	Rated operational voltage
Uimp	Rated impulse withstand voltage
Un	Rated voltage
VT	Voltage Transformer

6. DEFINITIONS

The following Definitions are consistent with the Transnet E5 Agreement and General Conditions of Contract and apply to this specification in its entirety.

CHIEF EXECUTIVE (Transnet Pipelines) means the officer appointed as Chief Executive (Transnet Pipelines) of Transnet Limited or any person lawfully acting in that capacity.

ENGINEER means any officer in the office of the Chief Executive (Transnet Pipelines) deputed by the Chief Executive (Transnet Pipelines) to supervise and take charge of the contract.

PLANT means any machine, excluding a tool, and any vehicle, excluding a passenger vehicle, used on site for the carrying out of the Works.

EQUIPMENT means any device not forming a permanent part of the Works, used on site for the carrying out of the Works, and also any temporary building, which is required for the carrying out of the Works, and which is erected on site.

TOOL means any instrument, powered or otherwise, which is accepted as a hand tool by the industry concerned and which is normally used in a manual operation by an individual labourer, artisan or workman.

MATERIAL means any constructional substance or ingredient that shall form part of the permanent Works and the substances in excavations and earthworks.

DRAWINGS means the drawings referred to in any specifications, schedule of quantities and prices and any alterations of such drawings made or approved in writing by the Engineer and such other drawings as may from time to time be furnished or approved in writing by the Engineer.

SITE means the land and any other place on, under, over, in or through which the Works are to be executed or carried out and any other land or place made available by Transnet in connection with the Works.

WORKS means the works to be executed in accordance with the Contract.

7. SITE CONDITIONS

7.1 The equipment shall be designed to operate continuously at its rated capacity, at the specified ambient temperature and site elevation conditions as detailed in the datasheets. Typically these conditions are tabulated below:

Ambient operating temperature	-5 to 40 °C (Daily average +35 °C)

Maximum relative humidity	0 to 95 %
Maximum altitude	0 to 2000 above sea level
Lightning conditions	Severe, max ground flash density 11 flashes per km² per annum
Exposure conditions	Salt laden as well as industrial atmosphere

7.2 **Electrical Conditions**.

7.2.1 The system of supply shall be 3 phase, 4 wire, 50 Hz alternating current with earthed neutral at a nominal voltage of 400/230 Volts.

7.2.2 The voltage may vary within the range of 95% to 105% of the nominal. All equipment installed shall be suitably rated.

8. GENERAL

8.1 The Controlgear Enclosure, components, busbar systems and cables shall comply with Transnet Pipelines specification **PL631** (Specification For Low Voltage Switchgear And Distribution Boards).

8.2 The electric fence shall be 8 strands mounted on top of a solid wall, steel palisade perimeter fence or steel mesh fence, and cantilever sliding gate and shall provide a physical barrier to detect any intrusion attempts.

8.3 The system shall operate as 2 to 16 zones (as specified), automatic, supervised, detection sensor system, capable of integration with the Security Management System (SMS) to detect and annunciate an attempted breach of the perimeter fence by an intruder. Should any person attempt to defeat the electric fence by way of climbing, touching, cutting or spacing the wires an alarm shall be annunciated as a perimeter alarm on the security management system.

8.4 The Electric Fence System (EFS) shall:

- Be installed on the perimeter barrier fence as described in the perimeter fence specification and integrated to the security management system.

- Monitor the status of fence cabling, devices, tampers and the like and provide control of zone status (i.e. isolate/access/secure)

- Provide independent zone control and alarm display via the security management system.

- Provide full performance and functionality as described in the relevant specification clauses.

9. SYSTEM REQUIREMENTS

9.1 The electric fence system shall be made up of a horizontal grid of alternate positive and earth wires. The electric fence shall be a proven system with demonstrated performance to detect:

a. A short on the fence caused by climbing or other interference with the fence structure.
b. Cutting of any wire or lead-out to the fence structure.
c. Tampering with any of the system enclosures, energizer monitor units, or remote keypads.
d. The accidental or willful loss of mains power, battery power, and the communication system of the electric fence controllers to the security management system.

9.2 Fence line energizer performance and alarm sensitivity programming in each zone shall be achieved through local keypad command, and will include the ability to cut power from the energizer in the event of alarm activation.

9.3 Warning signage as required by SANS 60335-2-76:2006(IEC 60335-2-76) shall be provided to both the internal and external sides of the fence to alert personnel of the dangers associated with the non-lethal voltage.

9.4 The EFS energisers should have test reports establishing compliance with safety standards and associated amendments of SANS 60335-2-76 and SANS 10222-3 Additionally the controllers should have test reports showing compliance with noise and emission standards SANS 214-1:2009 (CISPR 14 – 1) Electromagnetic compatibility.

9.5 The fence structure itself should be built to comply with the requirements of SANS 60335-2-76 and SANS 10222-3.

9.6 Any area of non-compliance must be stated.

10. ELECTRIC FENCE SYSTEM

The electric fence system equipment shall include but not limited to the following:

a. Control gear enclosure
b. Fence energizer unit

c. Lightning arrestors

d. High tension stainless steel wire of at least 1,6mm·

e. Fencing posts, stays, intermediates, brackets, wire tensioners and insulators.

f. Warning signs

g. High tension insulated cabling and conduit

h. Earthing System

10.1 CONTROLGEAR ENCLOSURES

10.1.1 Controlgear Enclosures shall be stainless steel, with minimum ingress protection of IP55. Particular attention shall be given to the ventilation of the enclosure, to eliminate build-up of excessive heat caused by the sun or internal heat generation. All necessary precautions shall be taken to ensure that the temperature of the air in any portion of the assembly does not rise more than 15°C above ambient air temperature.

10.1.2 Where specified, an enclosure shall be provided to house the energizer unit, energizer key-pad, surge suppressor, terminal strips and shall have cable access from the bottom.

10.1.3 Detailed information of the enclosure and frames shall be submitted to the TPL engineer for acceptance. The Contractor shall construct and install foundations , brackets , plinths , etc.

10.2 FENCE ENERGIZER

10.2.1 The sectors and zones of the electric fence shall be powered and controlled by programmable combined energizer monitor units.

10.2.2 The energizer units shall not have an output energy rating of less than 4.0 joules and shall be capable of maintaining an output voltage in excess of 8000 volts over the distance of the wire in any zone.

10.2.3 The energizer unit shall be programmed by PIN operated individual keypads that can be located up to 500m from the parent unit, if required.

10.2.4 Energizers shall be resistant to atmospheric surges entering from the fence.

10.2.5 The energizer monitor units shall have the following minimum features:

a. Be able to be programmed, networked and controlled from various user interfaces, local and remote. Remote access TCP/IP protocols supported shall include http, ppp and snmp.
b. Be able to be expanded into multi-zoned system.
c. Monitor the status of fence cabling, device, tampers and provide control of zone status (isolate/access/secure)
d. Provide independent zone control and alarm display via remote monitoring.
e. Have two monitored zones in both high voltage and earth wire.
f. An energizer unit shall provide potential free contacts for dual Zone Alarms, Energizer Healthy and Energizer Fault.
g. Detect a short on the fence caused by climbing or other interference with the fence structure.
h. Detect cutting of any wire or lead-out to fence structure.
i. Detect tampering with any of the system enclosures, energizer monitor units or remote keypads.
j. Detect the accidental or wilful loss of mains power, battery power, and the communication system of the electric fence controllers to the remote monitoring system.
k. Alarm outputs to include time programmable siren and strobe light to visually indicate an alarm condition.
l. High voltage and earth wire monitors to alarm if wires are tampered with.
m. Connectable to armed response.
n. Gate monitor input to monitor position of gate.
o. Lightning and power surge suppression.
p. Panic button input.
q. Battery backup system.

10.2.6 Programmable features shall include but not be limited to the following:

a. Fence line voltage options
b. Alarm trip voltage options
c. Fence Alarm Delay Time (system sensitivity) options
d. Duress alarm signalling
e. Keypad and controller cabinet tamper alarm signalling
f. FASE mode (Fence Alarm Stops Energizer)
g. Low voltage monitoring mode
h. Output tests and diagnostic mode

10.2.7 The model of Energizer Unit for Electric Fencing shall be Merlin Stealth (Nemtek) – Dual Zone or similar approved by TPL.

10.2.8 The Energizer Unit shall have a suitably certified mains power supply and battery backup of not less than 8 hours. The power supplies for all fence controllers shall be connected to a manufacturer approved surge arrestor and not directly to a mains power point. Fence controllers shall be earthed in accordance with applicable standards and the recommendations of manufacturers for specific energizer monitor units.

10.2.9 Electric fence energizers shall not be installed in close vicinity of alternating current or communications distribution boxes (or both) (see SANS 10142-1)

10.2.10 All electric fence energizers shall comply with the EMC requirements for electric fence supply units as given in SANS 214-1.

10.3 LIGHTNING ARRESTORS

10.3.1 Lightning arrestors shall comply with the requirements of SANS 10222-3, Annex G and shall be installed at the point of connection between the electric fence and the energizer or as close to it as possible.

10.3.2 Lightning arrestors shall be connected to the 'live' wire(s) and an earth electrode.

10.3.3 Two lightning arrestors shall be used, i.e. one on the outgoing 'live' wire and the other on the return 'live' wire. The three earth electrodes installed near the energizer may be used for earthing the lightning arrestor.

10.3.4 The lightning arrestor connection terminals cannot be installed in such a position as to be subject to any tensioning, but shall be connected to the electric fence by separate connecting wires.

10.4 CONDUCTING WIRE

10.4.1 The electric fence system shall form an array horizontal, pre-tensioned, electrified steel wires carried on high quality insulators with vertical spacing of not more than 100mm.

10.4.2 The fence wire shall be a minimum 1.6mm, solid stainless steel and shall provide the best current carrying capacity, resistance to corrosion, be of a low resistance (<10 Ω/metre) and be of sufficient tensile strength (as per manufacturer's specification) for its requirements and application.

10.4.3 Wire tensioning can be achieved by end and in-line spring strainers and should not be excessive – no more than 20kg load per wire. It should be possible to squeeze together any two neighbouring wires with moderate hand pressure.

10.4.4 If the fence is cascaded downwards in steps causing gaps bigger than 150mm an additional insulator and an additional earth wire must be strung to prevent gaps on the sloping.

10.4.5 Bare high-tension conductor shall be positioned as follows:

a. bare high-tension conductors shall be used in the composition of the physical electric fence barrier;

b. plant growth and vegetation shall be kept from coming into direct contact with the conductor or causing arcing, and should be maintained regularly;

c. any foreign objects and conductors not forming part of the electric fence installation shall be kept from coming into direct contact or causing arcing;

d. the bare high-tension conductors shall be at least 30 mm from any foreign object that is not part of the electric fence installation;

e. additional factors such as wind, dew, rain, frost and snow shall be taken into account when positioning the bare high-tension conductors, to prevent inadvertent contact or causing arcing to any foreign objects; and

f. bare high-tension charged conductors shall not be placed inside any wireway.

10.4.6 For protection against electromagnetic induction from overhead power lines, the requirements specified in SANS 60335-2-76 shall be adhered to.

10.5 FENCE POSTS, INSULATORS AND LEAD OUT CABLE

10.5.1 Fencing posts or brackets shall be manufactured from heavy galvanized steel and be sufficiently rigid to withstand the tension of the electric fence. Each Electric fence post shall be installed on top of the perimeter fence and on top of sliding gate posts.

10.5.2 Posts should be spaced no more than 3m apart.

10.5.3 For posts requiring pre-punching or pre-drilling galvanizing shall occur after all fittings, mounting holes and the like are provided.

10.5.4 Insulators shall be made from high quality 100% virgin High Density Polyethylene and guaranteed against UV degradation and shall comply with the requirements of SANS 10222-3; Annexure A.

10.5.5 .5All high voltage lead-out or underground cable shall be double insulated with an alloy or steel wire core of not less than 1.6mm· diameter. Double core double insulated cables may be used for long lead-outs.

10.5.6 All lead-out cabling should be contained in metal/bosal conduit and every effort must be made to keep it in a single unbroken length leading out to the zone.

10.5.7 Joining of lead-out cabling to the fence line wires must be done using crimp sleeves, crimp connectors, and heavy duty line clamps. All joints shall be suitably insulated.

10.5.8 Joints and terminations shall not:

a. adversely affect the current-carrying capacity of the conductor;

b. adversely affect the insulation resistance of the cable in the case of insulated conductors;

c. be made in any connector, bend, elbow or tee-piece of a conduit;

d. allow the strands of a stranded conductor to spread; and

e. require strands of a stranded conductor to be cut away to allow connection of the conductors (e.g. to terminals).

10.5.9 Joints on the fence bare conductors shall be:

a. made with ferrules;

b. soldered, where wire wrap joints are used; and

c. sealed with a suitable insulating material or by soldering, to reduce the galvanic effect caused by using dissimilar materials.

10.5.10 No Joints on insulated high-tension conductors shall be permitted unless authorised by the Transnet Engineer, and then shall be made in such a way that it would not be possible to touch any live part with the standard test finger (see SANS 60529).

10.5.11 Insulated fence high-tension cable shall not run:

a. in the same trench or wireway with a mains alternating current supply cable;

b. in the same wireway with the cables or wires of telecommunication, radio and signaling circuits;

c. where it is likely to be damaged by liquids such as oil, acid, acetone and alkali or by gases such as sulphur dioxide;

d. within 150 mm of hot services such as hot pipes and flues if the heat is likely to damage the cable, unless the cable is cooled or shielded from heat;

e. in a position where it is likely to be damaged, unless it is mechanically protected;

f. parallel to any other cable(s) for a distance exceeding 200 mm if the distance between the parallel cables is less than 200 mm. In the event of one of the cables being run in steel conduit, or the other cable being steel armoured cable, this requirement shall not apply.

g. in high risk areas such as chemical plants, gas storage areas (see SANS 10087), flammable liquids, etc. In this, the safety requirements of the relevant specifications shall be taken into account.

10.5.12 All such HV cabling must be kept at least 150mm away from any LV cabling. Site engineers should be consulted to ensure there is no risk of interference with any data, communication, PLC, or other LV cabling on site.

10.6 CONDUCTOR IDENTIFICATION

10.6.1 A conductor shall be identifiable at its terminations unless its purpose is obvious.

10.6.2 The means of identification for an AC circuit shall be in accordance with SANS 10142-1.

10.6.3 The means of identification of a high-tension insulated circuit may be by colours, letters, or a combination of these as follows:

a. the neutral/earth continuity conductor shall be identified by colours black, green or green/yellow only or by being a bare conductor;

b. the neutral/earth continuity conductor shall be identified by the letters “HT-“;

c. the live continuity conductor shall be identified by the colour red only;

d. the live continuity conductor shall be identified by the letters “HT+”; and

e. the colours, symbols or letters shall be applied at both the ends of the insulated conductor by means of durable marking (e.g. insulating sleeves with colours, symbols or letters).

10.7 WARNING SIGNS

10.7.1 Warning signs shall be placed:

a. at each gate;
b. at each access point;
c. at intervals not exceeding 10 m;
d. adjacent to each sign relating to chemical hazards for the information of the emergency services.

10.7.2 Any part of an electric security fence that is installed along a public road or pathway shall be identified at frequent intervals by warning signs securely fastened to the fence posts or firmly clamped to the fence wires.

10.7.3 The size of the warning sign shall be at least 100 mm × 200 mm. The background colour of both sides of the warning sign shall be yellow.

10.8 EARTHING AND LIGHTNING PROTECTION

10.8.1 All earthing and lightning protection shall be in accordance with the requirements of SANS 10222-3.

10.8.2 The system to be employed shall be copper electrodes plus return earth wire.

10.8.3 The electric fence energizer shall not be earthed to the same earth systems as used by the local electricity supplier or communication provider (or both).

10.8.4 The minimum distance between the electric fence earth electrode and any electric supplier or communication system earthing shall be in accordance with the requirements of SANS 10222-3; Annex C.

10.8.5 All earth electrodes shall be a minimum length of 1.2 m with a minimum diameter of 16 mm.

10.8.6 Earth electrodes shall be manufactured out of copper clad steel, copper or stainless steel.

10.8.7 Earth electrodes should be inserted into the ground as vertically as possible. In the event of areas with loose rocks, the earth electrodes can be inserted at a maximum angle of 45 °.

10.8.8 All the earth wires on an electric fence shall be connected together when connected to an earth electrode.

10.8.9 The connecting lead used to connect to any earth electrode, from the energizer or the electric fence wire conductor, shall be of a similar or larger diameter than the electric fence's wire conductors. (This will exclude stainless steel wire, unless the diameter is a minimum of 2 mm).

10.8.10 In the case of very rocky areas, where earth spikes cannot be inserted, measures shall be taken to provide an earthing system that will provide the same characteristics as those applicable when an earth spike is inserted.

10.8.11 A distance of at least 2 m shall be maintained between the energizer earth electrode and any other earthing system's connected parts such as the power supply system protective earth or the telecommunication system earth.

10.8.12 Three earth electrodes shall be installed in a close proximity to the electric fence energizer. The earth electrodes shall be linked together and inserted at a minimum distance of the length of the earth spike from each other.

10.8.13 The energizer shall be connected to the earth electrode with an insulated wire-conductor connecting lead. The earth electrode shall be connected to the electric fence earth conductor.

10.8.14 Electric security fences shall have earth electrodes inserted at a maximum distance of 30 m apart, measured from the energizer or fence connection point. These additional earth electrodes will exclude the three earth electrodes installed near the energizer.

10.8.15 A maximum earth resistance of 300 Ω, shall be maintained between electric fence earth electrodes. The measurement of this is to be done with an earth resistance meter.

10.8.16 All connections to earth electrodes shall be made above ground, by means of bolts, crimped lugs and PVC taped. Inspection wells shall be provided comprising of steel, pre-cast concrete or PVC surrounds complete with covers, to facilitate periodic inspection and testing.

10.8.17 Earthing conductors rising through paving or other concrete work shall be run in suitable protective sleeves which shall project above finished level.

11. INSTALLATION REQUIREMENTS

11.1 CONSTRUCTION

11.1.1 The electric fence system shall be installed by a manufacturer approved contractor with specialist expertise and experience in their required fields. The use of suitably licensed tradesmen is compulsory

11.1.2 The fence structure itself should be built to comply with the requirements of SANS 10222-3.

11.1.3 The system shall be installed such that corners, gates, wall interfaces and posts do not cause a security weakness. Anti-climb configurations shall be fitted at all corners, double end strains, gate posts, and any other location where applicable.

11.1.4 The electric fence system shall be installed such that the safety of all persons is maintained during installation and subsequent system of operation.

11.1.5 The electric fence contractor shall be responsible for all cabling, conduit or duct, trenching, concrete, cutting and making good to the satisfaction of the Transnet representative.

11.1.6 All equipment shall be installed in the locations directed by the Transnet representative.

11.1.7 All electric fence equipment shall be labelled as detailed in the latest revision of Transnet Pipeline Specification PL 631.

11.1.8 A complete fence layout drawing shall be provided indicating as a minimum the position of the different zones, energiser, access gates and strain tensioners.

11.2 INSPECTION AND TESTING

11.2.1 The contractor is responsible for all inspection and testing. TPL reserves the right to inspect the items at any time during fabrication to ensure the materials and Workmanship are in accordance with the specifications and reference drawings.

11.2.2 All electronic modules and components utilized within the system shall be functionally tested and burned in by the manufacturer prior to system assembly.

11.2.3 A test program shall be established to demonstrate that each system component will perform satisfactory in service.

11.2.4 The contractor shall submit a test procedure to the TPL Project Manager or his representative for review and approval.

11.2.5 These test procedures shall include the provision for assuring that the pre-requisites for a given test have been met and that the test is performed under suitable environmental conditions by appropriately trained personnel using recently calibrated test equipment.

11.2.6 All zones shall be tested and a test report signed off by the contactor and Transnet representative. Testing shall include the following:

a. Test fence line voltages
b. Test all fence alarms by shorting the fence and cutting a wire
c. Test FASE mode
d. Test all tamper alarms
e. Test all system controls and monitoring
f. Any other tests as appropriate for the site

11.2.7 The Contractor shall provide Valid Electric Fence System Certificate of Compliance as detailed in SANS 10222-3.

11.2.8 The Electric Fence System Certificate of Compliance shall be accompanied by a test report in a format approved by the Electrical Engineer.

11.2.9 Where an addition, alteration, replacement or change has been effected to an electric fence installation for which an Electric Fence System Certificate of Compliance was previously issued, the Contractor shall provide a certificate for at least the addition, alteration, replacement or change.

11.3 SPARES AND SPARE TOOLS

11.3.1 The contractor shall submit a list of two (2) years operational and maintenance spare parts, special tools (if required) with prices and provide complete commissioning, start-up spare parts for all equipment..

12. DRAWINGS AND INSTRUCTIONS

The Contractor shall issue to the Engineer, documentation as per specific contract requirements. Where not specified, the Contractor shall provide one set of sepias, 3 copies of drawings and 1 electronic media of “As Built” drawings, in their native format, of equipment which have been installed on site.

Handbooks, spares lists and maintenance instructions shall be issued to the Engineer in triplicate at the time of handing over the equipment.

All Documentation issued shall be in full compliance with Transnet Pipelines Specification PL100 Drawing Standard and in particular:

- **PL101** Plant & equipment Tag numbering Standards
- **PL102** Equipment, Instrument & Electrical Symbology Standard
- **PL103** General Drawing Standards

The CONTRACTOR shall furnish the following documentation as a minimum:

a. Datasheets.
b. Mechanical and Electrical Detailed Design Documentation.
c. General Assembly Drawing with foundation load data, cable connection and support details.
d. List of Operational Spare Parts.
e. Operation and Maintenance Manuals.
f. Electric Fence System Certificate of Compliance as detailed in SANS 10222-3.