TITLE:	**STANDARD FOR UPGRADE, REFURBISHMENT AND MAINTENANCE OF METAL STRUCTURED TRANSMISSION LINES UNDER DEAD CONDITIONS**	REFERENCE	REV
		CP_TSSTAN_116	**1**
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FOREWORD

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INTRODUCTION

City Power Johannesburg has a mandate to supply the City of Johannesburg Municipal areas sustainable electrical transmission network.

In order to fulfil this mandate, City Power relies on a well-maintained and reliable network infrastructure.

Due to the volume and intensity of the work, there is a need for supplementary services to augment the existing City Power resources. This shall no way replace the existing City Power structure, which shall always be the first level of response to any requirement for maintenance of installations.

1. NORMATIVE REFERENCES

The following document contains provisions that, through reference in the text, constitute requirements of this specification. At the time of publication, the editions indicated were valid. All standards and specifications are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the documents listed below.

CP_TSSTAN_117: Standard for Refurbishment and Maintenance of Metal Structured Transmission Lines-Live Line (Energised).

CP_TSSTAN_118: Standard for Inspection of Metal Structured Transmission Lines.

CP_TSSPEC_124: Specification for High Voltage Insulators.

CP_TSSPEC_131: Specification for The Testing and Analysis of Transmission Tower Earthing.

SANS 10280-1: Overhead power lines for conditions prevailing in South Africa Part 1: Safety.

SANS 60826: Overhead transmission lines - Design criteria.

SANS 218-1: Radio interference characteristics of overhead power lines and high-voltage equipment Part 1: Description of phenomena.

SANS 218-2: Radio interference characteristics of overhead power lines and high-voltage equipment Part 2: Methods of measurement and procedure for determining limits.

SANS 218-3: Radio interference characteristics of overhead power lines and high-voltage equipment Part 3: Code of practice for minimizing the generation of radio noise

SANS 182-1: Conductors for overhead electrical transmission lines Part 1: Copper wires and stranded copper conductors.

SANS 182-2: Conductors for overhead electrical transmission lines Part 2: Stranded aluminium conductors.

SANS 182-3: Conductors for overhead electrical transmission lines Part 3: Aluminium conductors, steel reinforced.

SANS 182-4: Conductors for overhead electrical transmission lines Part 4: Copper-covered steel wire for telecommunication purposes.

SANS 182-5: Conductors for overhead electrical transmission lines Part 5: Zinc-coated steel wires for conductors and stays.

240-82421511: Maintenance Standard for Metal Structured Power Lines (Eskom).

34-1441: Routine Inspection and Maintenance of Sub transmission and Distribution Lines.

2. ABBREVIATIONS AND DEFINITIONS

Preventative Maintenance - is a maintenance that is performed proactively on an asset with the goal of lessening the likelihood of failure, reducing unexpected downtime and prolonging its useful life.

Corrective Maintenance – is a reactive maintenance strategy employed to restore an equipment to its optimal working condition after a failure or malfunction has occurred.

OEM – Original Equipment Manufacturer.

ACSR - Aluminium Conductors Steel Reinforced

ACC - Aluminium Stranded Conductors

AACSR- Aluminium Alloy Conductors Steel Reinforced

AAAC - All Aluminium Alloy Conductors

HTLS - High Temperature Low Sag

OPGW - Optical Ground Wire

ADSS - All-Dielectric Self-Supporting

SANS/SABS– South African National Standard

SHERQ – Safety, Health, Environment, Risk and Quality

3. SCOPE

The purpose of this standard is to require maintenance of City Power's overhead metal structured transmission line infrastructure under dead conditions.

4. Overhead transmission line infrastructure components

The overhead transmission line infrastructure includes the following components:

4.1 Foundation and Stubs

Foundations are required to provide support for the structure. The stub is a steel member that is partially inserted into the concrete and thus provides the attachment point for the tower/pylon/poles.

4.2 Steel Structures (Lattice and Steel poles)

Steel poles and lattice structure towers include tower legs, main members, bracing members, anti-climb devices, step bolts, nuts and bolts, cross arms/cross ropes, stays, jumpers, bird guards and tower labels.

Overhead power line structures are used to support the phase conductors and earth wires. The type of structures used usually depend on the range available for the particular voltage level, power transfer capacity requirements, number of circuits and conductors per phase, number of earth wires and size, terrain which determines span lengths, safety requirements, maintainability, and economic factors.

Steel lattice structures are made up of numerous angle members bolted together to support conductors in strain or suspension modes. The structure members fall into 2 categories: main members and bracing members. Main members are the tension and/or compression members that carry the loads to the foundations. Bracing members serve to reduce the un-braced length of main members by providing intermediate support. Bracing members are generally smaller in size than main members. Among the most important main members in a tower are the legs.

Steel Poles are made up of single steel sections to support conductors. The insulators are composite or long rod insulators normally horizontal connected to the pole, with or without suspension insulators.

4.3 Insulators

Insulators are required to provide mechanical support and electrical isolation of the conductor. The insulators/insulator strings are appropriately specified for the mechanical load and electrical stress conditions. The insulators are typically glass, porcelain/ceramic, composite disc types or long rod type normally horizontally connected to the pole, with or without suspension insulators

4.4 Load-bearing hardware

The load-bearing hardware is appropriately specified for the mechanical load and stress conditions. The hardware connects the conductor to the insulator and the insulator to the tower. Examples of load bearing hardware are shackles, sag adjuster, extension link, ball tongue, ball oval eye, ball clevis, socket clevis, yoke plate, compression dead-end, suspension clamp, pistol grip, thimble clevis, as shown in the figure below.

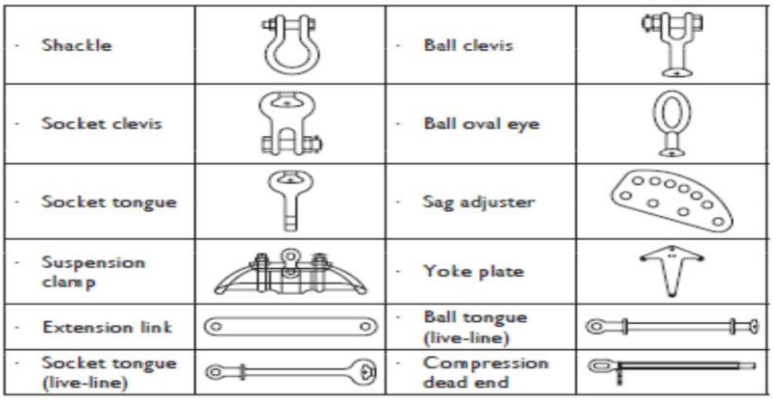

Figure 1: Examples of load bearing hardware

4.5 Conductors

Electrical current flows through transmission line conductors facilitating the movement of energy throughout transmission systems. These conductors are supported by metal structures to which they are attached by insulator strings suitable for the voltage at which the conductors operate.

Conductors include the following:

- **Earth wires -** Overhead power lines are often equipped with a ground conductor (shield wire, static wire, or overhead earth wire). The ground conductor is usually grounded (earthed) at the top of the supporting structure, to minimize the likelihood of direct lightning strikes to the phase conductors

- **Conductor splices and dead-end fittings** that provide a low impedance and mechanically strong connection of conductors in tension;

- **Vibration dampers -** a device installed on overhead power lines to reduce wind-induced vibrations, which can cause fatigue and damage to the conductors over time; essentially, it absorbs the energy of these vibrations, minimizing their amplitude and protecting the line from wear and tear by acting as a tuned mass damper.

- **Spacer dampers** that maintain sub-conductor separation and prevent damage to sub-conductors from wind-induced vibration.

- **Surge divertors -**a protective device for limiting voltage on equipment by discharging or bypassing surge current

- **Warning spheres/visibility markers -** Visibility markers, often found near mountain passes, in deep valley areas, near major freeway crossings and around airports, are placed on power lines to make the conductor crossings visible to aircraft pilots.

- **Bird flapper -** also known as bird flight diverters, are devices that make power lines more visible to birds to reduce the risk of collisions

- **Armour and patch rods** that stiffen, protect, and maintain a continuous profile of conductors at points where hardware attaches to them.

Typical electrical transmission (Distribution and Transmission) systems use aluminium-based conductors of the following types:

- Aluminium Conductors Steel Reinforced (ACSR),
- Aluminium Stranded Conductors (AAC),
- Aluminium Alloy Conductors Steel Reinforced (AACSR)
- All Aluminium Alloy Conductors (AAAC)
- High Temperature Low Sag (HTLS)

4.6 Shield wires

Overhead ground wires, including Optical Ground Wire (OPGW) that shield against lightning, provide a low resistance path for line-to-ground fault currents and in the case of OPGW, also carry optical fibres for information transmission. All-Dielectric Self-Supporting (ADSS) is used as an alternative for OPGW. These conductors can be of steel or ACSR or AAAC construction.

4.7 Earthing and Tower footing resistance

For safety (touch potentials) and ensuring that lightning strike induced voltages in shield wires and towers are conducted to earth, towers needs to be solidly connected to earth.

Tower footing resistance maximum levels:

- 88 and 132kV- 10 Ω,
- 220 and 275kV- 30 Ω,
- 400kV- 40 Ω and
- 765kV- 50 Ω.

4.8 Fibre optic cable

The following fibre optic cables are found on the City Power transmission network

- ADLASH,
- WRAP,
- OPGW,
- ADSS,
- including joint boxes and terminations

4.9 Servitudes/Right of way/Gates, fences, third party structures

A servitude is the land acquired for the building, construction and operation of power lines as part of the greater utility electricity supply infrastructure. Width of a typical 88kV servitudes is 22 m wide (11 m from the centre) for a single circuit and will vary for different voltage and circuit configurations.

Access to such land is required for maintenance and operational purposes. The use of such land may be restricted to ensure uninterrupted power supply and safety to general public.

4.10 Typical Tower structure with main components

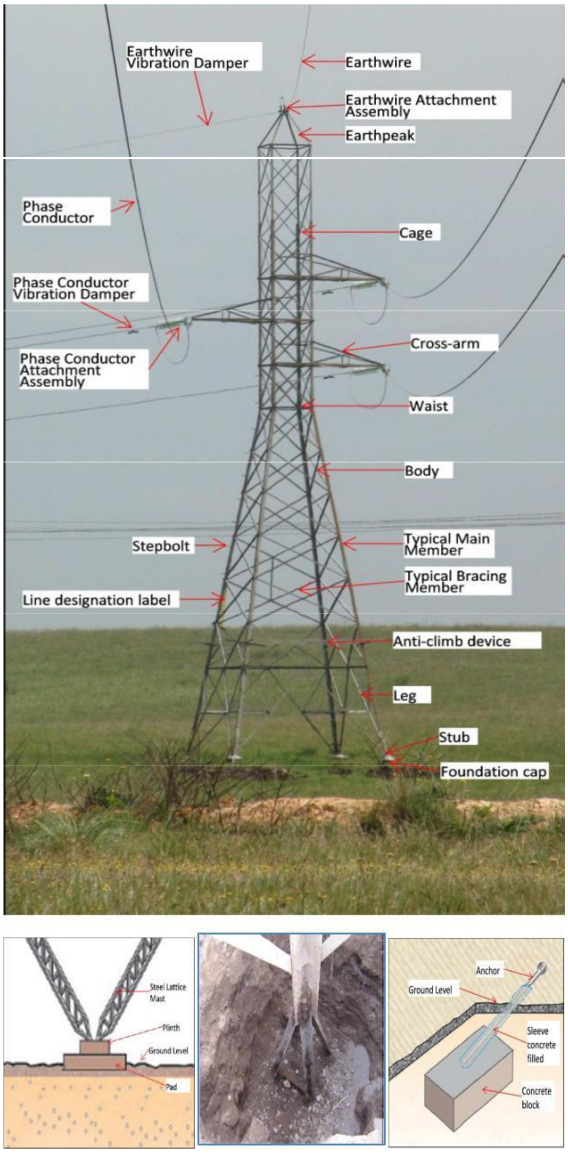

Figure 2: Steel/Lattice Structure main components

5. GENERAL REQUIREMENTS

5.1 The Service Provider shall provide, deliver and procure all tools and equipment required to carry out the works in a safe manner.

5.2 The Service Provider shall supply all lattice steel and fasteners for the refurbishment or replacement of the existing towers, where deemed required by the responsible City Power official.

5.3 Any bypass systems required shall be supplied and installed by the Service Provider.

5.4 The Service Provider shall determine if the insulation levels of insulators and fittings have been compromised by pollution.

5.5 Service Providers shall ensure safe working conditions at all times.

5.6 It may be required for the Service Provider to replace the existing earth wire. If so, the Service Provider shall be responsible for the repairs or replacement of the complete earth wire installation between the affected substations.

5.7 The Service Provider shall establish a site camp if required and provide electricity, water and sanitation. The site camp shall adhere to the City of Johannesburg bylaws.

5.8 The Service Provider shall be responsible to acquire wayleave approval from Johannesburg Roads Agency where work shall be done in the road reserves.

5.9 Any road closure approval shall also be done by the Service Provider with support of the relevant authorities.

5.10 Where provincial or national roads, railway lines, or ESKOM power lines, need to be crossed, the Service Provider shall be responsible to get approval from the relevant authorities.

5.11 The Service Provider shall make provision for any temporary access roads, if required, to and from as well as within the servitudes to complete the project.

5.12 The Service Provider shall replace all corroded, missing and damaged tower members identified during the inspection assessment.

5.13 The identified tower members shall be replaced with the nearest metric size member. All members shall be galvanized steel according to the City Power requirement.

5.14 All maintenance and refurbishment shall be done by the Service Provider. The Service Provider shall ensure that the restringing forces do not exceed the maximum tensile strength permissible on the existing towers.

5.15 The Service Providers if required shall supply and install all temporary structures (towers, members, foundations).

5.16 Where required by City Power, the Service Provider shall be requested to conduct a complete assessment on the condition of any specific line.

5.17 The maintenance and replacement exercise must take place under controlled conditions. A detailed work's plan and programme must be submitted once the lines and towers' condition assessment has been concluded. The plan, programme and cost must be approved by the responsible City Power official, prior to any work being carried out.

5.18 All documentation and legal appointment letters must be kept in the site file for scrutiny and audit purposes.

6. Maintenance Tasks

City Power maintenance shall be done on towers and isolated lines.

The towers shall be inside a servitude or in the road reserve where temporary road closures may be required.

The following maintenance functions shall be required under:

6.1 Condition Assessment

6.1.1 Triggered by Inspections and/or Performance
6.1.2 Measure tower footing resistance
6.1.3 Remove insulators for pollution conductivity testing (ESDD).
6.1.4 inspect and test conductor strength.
6.1.5 Investigate conductor sag / Retention Line

The Service Provider shall establish the following conditions on site:

6.1.6 Condition of structures
6.1.7 Above ground level condition of the concrete foundations
6.1.8 Integrity of local soil
6.1.9 Condition of line hardware and fittings
6.1.10 The assessment shall include all mechanical inspections, earthing conditions and clearances.
6.1.11 The Service Provider shall provide a detailed report on his/her findings and proposed remedial actions required.
6.1.12 Allowance shall be made that every line is a single circuit with one or more conductor per phase.
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6.1.14 Allowance shall be made that every line is a single circuit with one or more conductor per phase.

6.2 Corrective Maintenance

6.2.1 **Steel Structures, Stays and Foundations.**

6.2.1.1 Clean and treat corroded tower legs, cross-members, foundation stubs and stay anchors.
6.2.1.2 Replace corroded tower legs, cross-members, foundation stubs and stay anchors and stays.
6.2.1.3 Structure members shall be replaced with nearest metric size member and all labels replaced.
6.2.1.4 Clean and repair and/or secure foundation concrete cap and sealing and repair soil erosion.
6.2.1.5 Replace and tighten missing and or lose bolts/rivets/swaged bolts and nuts.
6.2.1.6 Tighten, repair or replace loose, corroded and missing earth straps.
6.2.1.7 Install additional earthing and/or counterpoises.
6.2.1.8 Install surge diverters
6.2.1.9 Install or repair terminal tower connections to substation earth mat.
6.2.1.10 Repair or replace damaged and missing bird guards, warning signs and tower labels.
6.2.1.11 Repair or replace corroded, displaced or missing anti climb devices.
6.2.1.12 Damaged and faded warning labels shall be replaced.
6.2.1.13 Damaged and incorrectly fitted split pins shall be replaced.

6.2.2 Insulators

6.2.2.1 Spray wash insulators.

6.2.2.2 Replace broken insulators in a string.
6.2.2.3 Replace polluted and/or damaged insulators with composite insulators.
6.2.2.4 Replace insulators with corroded pins and sockets.
6.2.2.5 Remove / relocate birds' nest where necessary.

6.2.3 Conductors

6.2.3.1 Damaged conductors shall be replaced/repaired with approved conductor types.
6.2.3.2 Spacers shall be replaced where necessary.
6.2.3.3 Loose or shifted dampers shall be repositioned and re-tightened if the conductor is not damaged.
6.2.3.4 Damaged dampers shall be replaced with new ones, and of the correct conductor diameter.
6.2.3.5 Stringing of conductors shall be done where necessary.

7. Data Acquiring

7.1 The Service Provider shall be required to do detailed site investigations to determine the detailed scope of work to be performed during execution.
7.2 The scope of work shall include both repairs and maintenance to existing infrastructure and the upgrade of existing lines and towers as detailed within this Standard.

8. Bird Nests

The Service provider shall remove / relocate birds' nest where necessary with following rules:

8.1 Bird nests shall not be removed from structures without permission from the responsible City Power official unless the possibility for a flashover exists.
8.2 All structures where bird nests are found shall be identified and reported.
8.3 A photograph of the nest shall be taken, if possible, to identify the type of bird.
8.4 The trees shall be trimmed back without damage to the nest if possible.

9. REQUIREMENTS

9.1 Quality and Workmanship

9.1.1 All work shall be done in accordance with applicable standards and latest City Power technical documents (standards, specifications, etc.).
9.1.2 Where there are no existing specifications with regards to any items, materials or equipment supplied, the latest relevant SANS/SABS, IEC or NRS standards and specifications shall be applied.
9.1.3 All executed work shall be certified on completion.
9.1.4 All work shall conform to the latest regulations and by-laws of the Municipality.
9.1.5 All civil work shall be in accordance with the standard specification for Civil Engineering Works
9.1.6 Skilled labour shall have relevant valid trade papers.
9.1.7 There shall be a warranty/ guarantee on both the workmanship and material used.
9.1.8 All products shall comply with ISO9001, ISO 14001 and ISO 18001.
9.1.9 Any deviation from specifications shall be highlighted and the reasons for the deviation shall be clearly detailed and shall be submitted to the responsible City Power official concerned (Area Manager-Engineering Operations Department).

9.2 Access and responsibility

9.2.1 The contractor shall sign City Power's standard contractors' responsibilities form that will be provided to the successful tender.
9.2.2 On being awarded the tender, the contractor shall provide City Power with a safe working procedure for every type of work to be undertaken.
9.2.3 Before commencing any work on site, the contractor shall be required to complete a standard City Power workplace risk assessment form, which must be returned with the invoices and paperwork.
9.2.4 All materials and test equipment required to maintain City Powers lines and towers shall be supplied by the contractor.
9.2.5 Whilst every effort is made to isolate the equipment as early as possible, City Power takes no responsibility for delays in or cancellation of, the proposed isolation due to network constraints.
9.2.6 The contractor shall sign a permit to work before being allowed to work on any equipment.

9.3 Ad-hoc/ additional work

Ad-hoc spares that are required shall be provided on this tender. All spare parts shall be new and shall be purchased from the original equipment manufacturers. Where the OEM is not of existence, purchased materials shall be approved by City Power official.

A full detailed list of spares and pricing shall be provided with the tender submission.

Proof of purchase of all spare parts from the original equipment manufacturers shall be made available to City Power

9.4 24-hour emergency service

A 24-hour emergency service, to address any problems that may arise, is required.

A dedicated contact number with 24/7/365 availability shall be supplied to City Power by the Service Provider.

It is important to note that in the event of the contact number being unavailable or unreachable by City Power personnel at any time shall be viewed as non compliance and may lead to penalties or cancellation of the contract.

9.5 Reports

Preference shall be given to computerised test reports. All reports shall be confirmed in writing. These shall be submitted via email with a hard copy issued later (within one week) to the responsible City Power official concerned.

9.6 Roster

City Power shall supply the contractor with the list of equipment that needs to be overhauled with the exception of emergency work. Every effort shall be made to group this work (routine maintenance) in geographical areas.

9.7 Compulsory City Power training courses

All Service Providers staff shall attend compulsory City Power induction and Safety, Health, Environment, Risk and Quality (SHERQ) training courses before being allowed to work on the lines and towers.

Staff who have not attended these training courses shall not be permitted to enter any work site or carry out any work for, or on behalf of City Power.

9.8 Special considerations and performance measurement

9.8.1 All Service Providers shall ensure that the Occupational Health and Safety Act is strictly adhered to. Environmental legislation impacting on the work to be carried out must also be adhered to.

9.8.2 Performance shall be measured according to response to requests by City Power, quality of work and timeous submission of relevant paperwork, documents and reports.

9.8.3 A monthly meeting shall be held with the responsible City Power official at the premises of City Power at Reuven (or as otherwise agreed by both parties) to evaluate the Service Provider's performance.

9.8.4 City Power reserves the right to inspect all the aspects of performance measurements at any time, without the approval of, or informing, the Service Provider.

9.8.5 City Power shall have the right to any information as required by any City Power officials.

9.8.6 City Power reserves the right to award or split the contract in whichever way it wants, at its sole discretion.

9.9 City Power's responsibilities

9.9.1 To provide the Service Provider, to the best of its ability, with current information relevant to the execution of the required maintenance.

9.9.2 To advise the Service Provider in terms of this contract, of any changes to the working environment and/or the responsible City Power official concerned.

9.9.3 City Power shall audit the Service Provider on a regular basis to ensure that work has been executed to the high standards of the original equipment manufacturers.

9.9.4 To process legitimate invoices as early as possible.

9.9.5 Responsible for switching, earthing and the issuing of permits. Under no circumstances shall any Service Provider work on City Power's network without a valid permit.

9.10 Service provider's responsibilities

The following are deemed some of the most pertinent responsibilities of the Service Provider. The responsibilities listed below are not definitive or exhaustive and the responsibilities of the Service Provider are not limited to those listed below:

9.10.1 Conformance to and compliance with the standards and policies of City Power and to familiarize themselves with any and all such standards and policies.

9.10.2 To carry out all instructions issued by City Power, in respect of the contract, and to ensure that all deadlines and criteria are met.

9.10.3 To communicate any information gained or findings made during the execution of this contract that may be beneficial to the responsible City Power official concerned.

9.10.4 All sub-contractors' requirements remain the full responsibility of the Service Provider.

9.10.5 The contractor shall ensure that all equipment and tools are maintained and in good working conditions so as to comply with City Power's safety standards.

9.10.6 All staff shall be employed by the Service Provider and shall not be staff of City Power.

9.10.7 City Power customers shall be treated with respect whilst contractors are engaged in performing duties in and around their premises.

9.10.8 The contractor shall ensure that all staff wear the correct Personal Protective Equipment (PPE) at all times, so as to comply with City Power's safety standards. Safety of staff and public cannot be compromised at any time and should there be safety concerns, the Service Provider shall inform the City Power responsible official

9.10.9 The Service Provider in conjunction with responsible City Power official shall engage with stakeholder department where required.

9.10.10 The Service Provider shall provide a security for the duration of the execution of work.

9.10.11 The Service Provider shall provide for the removal, rigging and transporting of obsolete materials from site back to Reuven Salvage yard with City power escort services.

9.10.12 The Service Provider shall provide for the optional storage of conductor and hardware per identified line if not stored at City Power Stores.

10. TESTS

All routine tests as required in terms of this specification and any additional recommended original equipment manufacturer shall be performed.

11. MARKING, LABELING AND PACKAGING

Where no proper designation labels exist on towers being maintained, they shall be replaced by the Service Provider in conjunction with approval from the responsible City Power official.

12. TRAINING

Training shall be given to City Power personnel during maintenance intervals for the duration of the contract and the cost shall be built into the pricing structure. No extra costs in this respect shall be entertained.

13. DOCUMENTATION

13.1 Documentation as detailed in this specification shall be submitted with the original tender submission.

13.2 The onus is on the tenderer to ensure that they meet the requirements and is conversant therewith.

14. QUALITY ASSURANCE

A quality management plan/system shall be set up to assure the proper quality management of the for standard for Refurbishment and maintenance of metal structured transmission lines and towers during design, development, production, installation and servicing phases. Guidance on the requirements for a quality management certificate may be found in the ISO 9001:2015. The details shall be subject to agreement between City Power and the Supplier.

15. ENVIRONMENTAL MANAGEMENT

An environmental management plan/system shall be set up in order to assure the proper environmental management of the standard for refurbishment and maintenance of metal structured transmission lines and towers throughout its entire life cycle (i.e. during design, development,

production, installation, operation and maintenance, decommissioning and disposal phases). Guidance on the requirements for an environmental management system may be found in ISO 14001:2015 standards. The details shall be subject to agreement between City Power and the Supplier. This is to ensure that the asset created conforms to environmental standards and City Power SHERQ Policy

16. HEALTH AND SAFETY

A health and safety plan/system shall be set up to ensure proper management and compliance of the standard for refurbishment and maintenance of metal structured transmission lines and towers during installation operation, maintenance, and decommissioning phases. Guidance on the requirements of a health and safety certificate may be found in ISO 45001:2018 standards. This is to ensure that the asset conforms to standard operating procedures and City Power SHERQ Policy. The details shall be subject to agreement between City Power and the Supplier.

17. SCHEDULE A: ACTIVITY & MATERIAL RATES

ITEM NO.	DESCRIPTION	UNIT	QUANTITY		
	SUPPLY AND INSTALL				
17.1	**Transmission tower repair**				
	Bracing main of towers	each			
	Main members of towers	each			
	Base plates	each			
	Anti-climb device barbed wire	metre			
17.2	**Anti-Vandalism nuts and bolts**				
	16mm	each			
	20mm	each			
	24mm	each			
17.3	**New anti-climb device and wire**				
	Barbed wire	metre			
	Coiled razor wire (500mm wide)	metre			
	Straight razor wire	metre			
17.4	**Repair broken/damaged conductors**				
	Wolf: Mid span joint	each			
	Wolf: Repair sleeve	each			
	Wolf: Dead end	each			

ITEM NO.	DESCRIPTION	UNIT	QUANTITY		
	Wolf: (other)	each			
	Upas: Mid span joint	each			
	Upas: Repair sleeve	each			
	Upas: Dead end	each			
	Upas: (other)	each			
	Goat: Mid span joint	each			
	Goat: Repair sleeve	each			
	Goat: Dead end	each			
	Goat: (other)	each			
	HTLS: Mid span joint	each			
	HTLS: Repair sleeve	each			
	HTLS: Dead end	each			
	HTLS: (other)	each			
17.5	**Restringing of Conductors**				
	Upas	Per span (200m)			
	Wolf	Per span (200m)			
	Goat	Per span (200m)			
	HTLS	Per span (200m)			
	Upas jumper (3m per jumper)	each			
	Wolf jumper (3m per jumper)	each			
	Goat jumper (3m per jumper)	each			
	Vibration damper - Upas	each			
	Vibration damper - Wolf	each			
	Vibration damper - Goat	each			
	HTLS jumper (3m per jumper)	each			
	Vibration damper - HTLS	each			

ITEM NO.	DESCRIPTION	UNIT	QUANTITY		
17.6	**Stringing of fibre optic**				
	Stringing of new fibre optics wire including jointing with insulator, complete with fibre box.	Per span (200m)			
	Testing of fibres from substation to substation	Per cable			
	Tensioning of fibre optics wire.	Per span (200m)			
17.7	**Install/Replace insulators and assemblies** (Including corona rings and arcing horns)				
	Heavy duty assembly fitting	set			
	Light duty strain and suspension assembly fitting	set			
	Single insulator assembly strain for twin Upas conductor	set			
	Single insulator assembly strain for twin wolf conductor	set			
	Single insulator assembly strain for twin Goat conductor	set			
	Single insulator assembly strain for twin HTLS conductor	each			
	Single insulator assembly with suspension bolt-type clamp for twin Upas conductor	set			
	Single insulator assembly with suspension bolt-type clamp for twin Wolf conductor	set			
	Single insulator assembly with suspension bolt-type clamp for twin Goat conductor	set			
	Single insulator assembly with suspension bolt-type clamp for twin HTLS conductor	set			
	Dismantle and repair of cross arm	each			
17.8	**Earthing of a towers**				
	Steel earth wire 7 core	Per span			
	Measure tower footing earth resistance	per tower			
	Counterpoise earthing strap/rod	each			

ITEM NO.	DESCRIPTION	UNIT	QUANTITY		
	Repair/replace tower earthing	per tower			
	Earth resistance enhancement compound	Kg			
17.9	**Arcing horns**				
	For single upper arcing horn	each			
	For double upper arcing horn	each			
17.10	**Replacement of tower structure**				
	Mono pole for double circuits including the removal of the damaged tower.	each			
	Mono pole for single circuits including the removal of the damaged tower.	each			
	Removal of damaged structure	each			
	Supply of power crane	Per hour			
	Signage-Fit new or replace	each			
	Tower numbering (UV resistant)	Per tower			
	Warning signs (UV resistant)	Per tower			
	Repainting of tower with galvanize paint	Litres			
	Power line inspection	Per span (200m)			
	Servitude inspection	Per span (200m)			
17.11	**Civil work**				
	Excavation	m^3			
	Backfilling	m^3			
	Installation of gabions	m^3			
	Ready mix concrete	m^3			
	Foundation - cement	m^3			
	Fixing of stays	each			

ITEM NO.	DESCRIPTION	UNIT	QUANTITY		
17.12	**Miscellaneous material**				
	Shackle straight	each			
	Adjustable extension link	each			
	Fixed extension link	each			
	Equilateral triangle	each			
	Long twisted bolt clevis	each			
	Long twisted socket tongue	each			
	Compression dead end with jumper flag	each			
	Jumper flag only for compression dead end	each			
	Ball oval eye long	each			
	Socket clevis long twisted	each			
	York plate	each			
	Suspension clamp for phase conductor	each			
	U-bolts for suspension clamp	each			
	Shackle twisted	each			
	Chain link	each			
	Multi frequency vibration damper - Upas	each			
	Multi frequency vibration damper - Wolf	each			
	Multi frequency vibration damper - Goat	each			
	Multi frequency vibration damper – Goat- HTLS	each			
17.13	**Stringing of conductor (Installation Only)**				
	Upas	Per span (200m)			
	Wolf	Per span (200m)			
	Goat	Per span (200m)			

ITEM NO.	DESCRIPTION	UNIT	QUANTITY		
	HTLS	Per span (200m)			
	Upas jumper (3 m per jumper)	each			
	HTLS jumper (3 m per jumper)	each			
	Wolf jumper (3 m per jumper)	each			
	Goat jumper (3 m per jumper)	each			
	Wrapping of all tower legs with razor wire after repairs	metre			
	Repair anti climb barbed	metre			
	Repair anti climb device	Per tower			
	Tensioning of all conductors	Per span (200m)			

17.14	**Preliminary and General (Typical 22/33/88/275kV single or more circuits)**				
		Unit	**Quantity**		
	Site Establishment and P&G (Provision for staff, equipment, site offices, traveling. Etc.)	per m line length, single circuit, all phases			
	Audit / Design / Line Profiles / drawings	per m line length, single circuit, all phases			
	All temporary works required on a line	per m line length, double circuit, all phases			
	Health & Safety, training and induction requirements	per m line length, single circuit, all phases			
	Community Liaison Officer	per month			
	Security 24hrs	Per line per m, single circuit, all phases			
	Optional storage of conductor and hardware per identified line if not stored at City Power stores	Lot per month			
	Transport of obsolete materials from site back to Reuven Salvage yard	Per kg			

18	**Any other additional items not listed but required:**				
		Unit	**Quantity**		

ANNEXURE A - BIBLIOGRAPHY

240-82421511, Maintenance Standard for Metal Structured Power Lines (Eskom)

DATE	REV. NO.	NOTES
April 2019	0	First issue
February 2025	1	General editing Add new study work group committee Change the document's title