PART B-02

TITLE: OVERHEAD DISTRIBUTION NETWORKS

SPECIFICATION NO: B-02

INCEPTION DATE: AFTER GAZETTING (WORKING DOCUMENT FOR A 2 YEAR PERIOD)

AMENDMENTS/REVISIONS

DATE	PAGE	PARAGRAPH	DESCRIPTION	ORIGINATOR	APPROVED

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1. SCOPE

This document provides a guide for the minimum maintenance requirements for overhead distribution networks.

2. GENERAL REQUIREMENTS

2.1 General

2.1.1 Inspection

Inspection frequencies may vary from area to area depending on the type and severity of the pollution involved. The recommendations indicated in **annex A** are intended as a guide to assist in the planning of maintenance intervals.

Table 1, below provides inspection frequency information.

	Inspection frequency (minimum)		
Line type	**Visual**	**Detailed**	**After handover**
Distribution (tower, steel pole, wood or concrete)	Annually*	10 yearly	±10 months
Reticulation(wood or concrete)	Annually*	10 yearly	±10 months
Low voltage 400 V/230 V	Annually*	10 yearly	±10 months
*Note * or after a close succession of faults with unidentified causes*			

2.1.2 After hand over inspection

An inspection should be carried out within the guarantee period, allowing sufficient time for repairs to be carried out. Only authorized personnel should carry out these inspections.

2.1.3 Pollution

The type of pollution found during inspections should be recorded.

2.1.4 Transport

The condition of the terrain and natural vegetation will generally prescribe the method of transport and careful consideration should be given to environmental conservation.

Transport should not cause undue damage to roads, vegetation, crops or fields prepared for planting, etc. and, where possible, servitude roads should be used unless otherwise arranged with the landowner. The Licensee should repair any damage caused by its vehicles.

2.2 Visual inspections

Visual and physical inspections of overhead lines should be carried out at the minimum frequencies given in **annex A**. All inspections are to be properly reported for further action.

These inspections should identify defects in overhead lines such as the following:

a) Broken insulators and arrestors

b) Pollution

c) Dampers and spacers adrift or faulty

d) Erosion

e) Discoloration/corrosion of conductors

f) Damaged conductors

g) Incorrect clearance from ground or trees

h) Incorrect clearance to Telecom line crossings

i) Activities under power lines, for example, buildings, etc.

j) Worn hardware and damaged structures, switchgear or transformers

k) damaged, rusted or corroded switchgear on the line

l) Insecure fibre optic cables strung on the lines

m) Insecure earthing straps on steel structures, poles and street furniture associated with the distribution network and

n) Faulty Anti-climb devices.

2.3 Detailed inspections

2.3.1 Towers

Detailed hands-on inspections should be carried out at the frequencies specified in table 1 using a predetermined checklist similar to the example in **annex A** and the inspection should cover at least the following:

a) All hardware for wear;

b) Corrosion inspection of all components (especially at the coast or in pollution areas);

c) Depending on the length of the overhead line and taking its environment into consideration, select a sample number of structures and inspect the interface between conductor and clamp/spacer/damper for damage; and

d) Depending on the number of structures, select a sample number and test the earth connections to the general mass of ground.

e) Foundation

2.3.2 Steel and concrete pole lines

Detailed, hands-on inspections should be carried out at the frequency specified table 1 using a pre-determined checklist similar to the example in **annex A** and the inspection should cover at least the following:

a) All hardware for wear;

b) Corrosion inspection of all components (especially at the coast or in pollution areas);

c) Paint work and foundation condition; and

d) Pole numbering check, if existing, and a check of all bolts, dampers, connectors, etc.

2.3.3 Wooden pole lines

A detailed hands-on line inspection should be carried out at the frequency specified in table 1 and should cover at least the following:

a) A pole by pole check of the condition of each pole (including partial excavation and a check for degradation as recommended in **annex A** or as determined by experience in suspect areas, especially the central eastern areas where there is a high occurrence of termites)

b) Visual inspections should be performed on all wooden pole lines and documented in the form of a work order.

2.3.4 Servitudes

The Licensee's rights with regard to servitudes and the approach to the control and cutting of trees and bushes within these servitudes should apply.

Servitude roads necessary for the patrol and maintenance of lines should be maintained so that they are useable at all times.

All servitude gates should be kept locked unless otherwise agreed with the landowner who should indemnify the licensee. Gates should only be installed with the permission of the landowner and the licensee should maintain them in good order. This specifically includes any earth straps bonding the gate and posts.

The encroachment into the licensee's servitudes of new buildings, extensions, tennis courts, swimming pools and barns, should be reported immediately, especially if underneath the lines, or inside the stipulated safety clearance.

2.3.5 Structures

No tower or pole should be climbed if it is mechanically or electrically unsafe to do so. Damaged anti-climbing devices should be repaired. All loose bolts and nuts should be re-tightened and painted with an anticorrosive paint. Damaged and faded warning, circuit and phase labels should be replaced.

2.3.6 Hardware (split pins)

All split pins should be checked to ensure that they are the correct type, that they are undamaged and correctly fitted. They should be replaced, as required, by a stainless steel split pin.

There should be a check for missing nuts and also for loose nuts that can chafe through split pins, ultimately resulting in the line coming adrift from the support structure.

2.3.7 Conductors

Armouring and ferrules should be checked and replaced with approved types where damage has been caused to the conductor. Discolouring, flash marks and any other damage should be recorded and repaired where applicable.

2.3.8 Spacers and dampers

Spacers should be checked and replaced if necessary. Loose or shifted dampers should be re-positioned and re-tightened. Damaged dampers should be replaced by approved dampers of the correct conductor diameter.

2.3.9 General

All other items of hardware should be checked for wear and replaced where necessary.

2.3.10 Insulators

2.3.10.1 Damaged insulators

If a glass or porcelain insulator has to be replaced, the remaining insulators on the string should be cleaned to the same degree of cleanliness as the 'new' disc inserted, or the whole string should be replaced. The reason for this is to prevent flashovers on the new disc inserted in the string because the voltage drop across it differs from that of the other insulators in the string because it is at a different level of cleanliness.

2.3.10.2 Live replacement of insulators

Where approved by a licensee, the replacement of insulators by live-work methods should be considered as the first option, taking all required safety precautions into consideration.

2.3.10.3 Stay wire insulators and arc gaps

Where fitted arc gaps are to be checked. Where fitted, stay wire insulators must be checked for cracks or damage.

2.3.11 Bird nests

Bird nests should not be removed from structures unless the possibility exists that a flashover can occur. All structures where bird nests are found should be identified and reported. A photo of the nest should be taken, if possible, to identify the type of bird. The trees should be trimmed back without damage to the nest if possible.

2.3.12 Earthing

2.3.12.1 Sub-transmission line

It should be ensured that earth straps are in place and examined for damage. Connections should be checked for tightness.

The tower footing earth resistance of every tenth tower should be measured after every five years and recorded using an approved system. Where the tower earth enters the ground, excavate to a depth of 150 mm, check for corrosion and rectify where necessary. The results should be compared with those of 'handover' test results and more extensive investigations should be carried out if significant variations or deterioration are found.

2.3.12.2 Medium voltage equipment

Despite carrying out physical earth lead inspections, there should be a five yearly programme for the testing of pole-mounted transformers and switchgear earthing resistances.

3. SWER NETWORKS

Transformer earthing must be reliable and of low resistance. The earthing shall be tested regularly in order to maintain the transformers reliability. Poor earthing systems reduce safety and the quality of supply.

4. RECLOSERS AND SECTIONALISERS

4.1 Oil quenching

In the absence of OEM recommendations, service yearly or after 80 to 120 operations, whichever comes first. In addition a monthly visual check and taking of counter readings is to be carried out.

4.2 Vacuum interruption

These are to be treated as maintenance free. However a monthly visual check, taking of counter readings and checking of battery voltages should be done. Service should include a major one every 5 to 10 years, which will include the replacement of all insulating oil and the measurement of contact wear on the wear indicator.

4.3 SF6 arc quenching

Maintenance should be done in accordance with OEM recommendations.

4.4 Air blast quenching

Maintenance should be done in accordance with OEM recommendations.

4.5 Fused switches

Maintenance should be done in accordance with OEM recommendations.

5. LINE CONDITION INSPECTION AND REPORTING REQUIREMENTS

4.1 Applied Conventions

4.1.1 Phase identification

Facing the load of red phase is always left.

4.1.1 The span and terminal structure

For reporting purposes the preceding span and the structure that it terminates on will be treated as a unit. For example, the span emanating from a substation gantry up and to the first structure on the line to which the conductors are secured, inclusive of the jumpers will be deemed part of the first structure.

4.2 Inspection and Maintenance Prioritization Criteria

4.2.1 Line Section Priority

Line section priorities are intended to ensure that the critical line sections receive more attention, in the interest of bulk continuity of supply and customer satisfaction, than less critical sections. These priorities are assigned once-off and should only be changed when the line configuration changes.

Priority Rating	Line section name	Motivation
1	High Fault Level Zone	Avoid as far as possible faults on this section of the line to extend the life cycle of the substation transformers and terminal equipment like breaker contacts.
2	Backbone	Avoid as far as possible faults on this section of the line to optimize redundant supply contingencies.
3	Critical Customer Zone	Avoid, as far as possible, faults on this section of the line thereby ensuring a continuous supply to critical customers to maintain customer satisfaction.
4	T-off from Backbone to Spurs and single customers.	Avoid as far as possible faults on this section of line to high volumes of customers to maintain the bulk of the customer satisfaction
5	T-offs to single customers	The lowest line section priority is to single customers.

4.2.2 Structure Type and Location priority

Structure type and location prioritization contribute to safe network operations and mitigation of criminal and civil liability. These priorities are assigned once-off and should only be changed when the structure type and location changes.

Priority rating	Structure description	Motivation
1	**Structures in high risk locations:** • Located in built up or public areas or next to pedestrian thoroughfares and schools. • Road, telecommunication line and railway and other service crossings. • Sensitive environments (Fire hazards, risk to fauna and flora) • In or crossing agricultural operations. (Animal and crop safety) • Structures in high corrosive areas	These situations constitute high severity, high exposure risk categories and therefore increase the Licensee's liability should any line component fail.
2	**Hazardous structure designs:** Structures that do not meet critical line re-designs or designs that have been discontinued for safety reasons**.**	Structural designs discontinued for safety reasons even when installed in low risk conditions (people, animal or environment) constitute a second contingency liability**.**
3	**Structures in difficult locations:** Structures that are difficult to access for maintenance activities at day time, more so at night time	These break down incidents must be avoided to limit unplanned or emergency repairs increasing the risk of loss to the licensee.
4	**Uneconomical structure designs:** Structures that do not meet performance related revisions or designs that have been discontinued for economic reasons.	These situations are not associated with increased risk or liability while normalization during component failure is motivated by economic rationale.
5	**Live work friendly structures:** Structures in accessible locations that are live work friendly that can be repaired in day time, employing live work practices	These faults can be repaired in normal working hours with the supply uninterrupted, employing live work capability by Live Work teams. Live work may also be carried out by a qualified contractor.

4.2.3 Component Priority

Component failure severity prioritization contributes to safe network operations and mitigation of criminal and civil liability.

Priority Rating	Component Description	Motivation
1	Components which when they fail will result in unsafe conditions to the public (i.e. anti-climbing devices and low hanging exposed conductors) and or loss or injury to the Licensee, customers or the public at large and if failure is imminent	These situations constitutes high severity, high exposure risk categories and therefore increase the Licensee's liability should any line component fail.
2	Components which when they fail will result in damage to adjacent components, or will fail in due course.	Limit the cascading of faults from one component to the next
3	Components, which when they fail will result in a general power outage	Improved supply availability performance indicators by minimizing outage duration.
4	Components, which when they fail will result in transient faults and cause successful auto reclosing of supply breakers or reclosers.	Improved supply quality and performance indicators by minimizing nuisance tripping
5	Substandard components that will not result in power interruptions but contribute to good utility housekeeping.	Good housekeeping practices

4.3 Environmental factors contributing to asset deterioration

4.3.1 Operating Environmental factors

a) Excessive operating temperatures (Environmental and system generated). b) Fault levels beyond equipment ratings c) Overvoltage stressing dielectrics and transformer windings insulation. d) DC offsets caused by DC traction lines	e) Excessive duty cycles caused by network abnormality resulting in pre-mature ageing. f) Above design load factors g) Extended protection operating cycles due to mechanical failure or poor equipment rating.

4.3.2 Physical environment

a) Pollution (Industrial and/or marine) b) Insect and bird nesting and feeding activity c) Altitude (derating) d) Carbonization e) Bird droppings f) Wind conditions g) High water tables and standing water h) Seismic activity	i) Vegetation encroachment j) Soil types (compaction and PH) k) Heat as a result of field fires (and root from field fires) l) Fungal growth m) Ultra violet n) Lightning o) Precipitation p) Extreme temperatures (outside equipment rated temperatures) q) Ice

Annex A

(Informative)

Recommended inspection intervals for Overhead Distribution Lines

The following are guidelines and recommended intervals for the various maintenance inspections to be carried out on overhead distribution networks

Item/Equipment	Intervals	Activity
Auto reclose switches	In accordance with OEM and/or Quarterly	Test R.E.F. batteries and replace if necessary
Conductors	Annually (Visual)	Condition. Regulation. Debris etc. on line.
Insulators	Annually	Chipping. Damage. Pin Fixing. Conductor bending. Rust on hardware
Poles	Annually	Alignment. Damage. Numbering.
Cross arms	Annually	Position on pole. Condition. Mounting bracket condition. Rust on hardware. Support straps.
Swan necks (If installed)	Annually	Rust. Position and/or damage.
Stays	Annually	Condition. Tension. Insulators where fitted
Vibration dampers (where Fitted) Expulsion fuses Surge arrestors	Annually	Position Condition Insulation condition Signs of tracking or symptoms of electrical damage Loose connections Insulators Connections Mounting Brackets

Air break switches	Annually	Insulator condition. Contact leads. Loose connections. Mechanism stability. Rust on hardware. Operating handle mechanism for Damage or lack of lubrication. Condition of padlock, i.e. ease of operation and/or damage.
Auto-reclose switches	Annually	Insulators. Jumper condition and/or clearance. Paintwork. Oil leaks.
Sectionalizers	Annually	Insulators. Jumper condition and/or clearance. Paintwork. Oil leaks.
Transformers	Annually	Insulators. Jumper condition and/or clearance Paintwork Oil leaks
Line accessibility	Annually	Tree and shrub growth. Servitude condition
Air break switches	Two Yearly (line to be de-energised)	Insulators All connections Jumper connections and/or clearance. Contact condition Contact alignment Operating mechanism for ease of operation Lubrication if necessary Padlock condition and ease of Operation Unit operation
Connections	Five yearly (as annual but with following physical checks)	Corrosion Security clamps Grease if necessary

Wooden poles	Five yearly	Pole base for rot. Damage to pole. Pole top for rot. Wire binding intact. Earth down leads intact (if installed)
Cross arms	Five yearly	Rot. Earth bonding is sound. Pole mountings are secure. Support straps for stability.
Transformers	Five yearly	All connections are tight. Insulators for damage. Pole mountings. Rust on tank and hardware. LV circuit breaker for safe operation.
Transformers	Annually	Earth bonding is complete Oil leaks
A sample. (The recommendation is every 5th pole for)	Five yearly	Pole base for rot. Damage to pole. Pole top for rot. Wire binding intact. Earth down leads intact (if installed)
Insulators	Five yearly	Damage. Condition of ties or binding. Rust and/or damage on hardware
Cross arms	Five yearly	Mounting secure on pole. Rust and/or damage on hardware. Rot. Earth bonding for soundness. Support straps for stability
Swan necks (where installed)	Five yearly	Rust and/or damage. Earth bonding for soundness
Conductors	Five yearly	Condition

Tower / mast structural steel	Annually	Check for: Corrosion on: Legs, Beams, Crossarm(s), Footings Plates/Bolts Loose or damaged components
Earthing	Annually	Check if test results are satisfactory Earth straps in place
Stay/guys	Annually	Check for: Corrosion Tension Guy grip/ pre-formed end Stranding Stay guard, if required Stay insulator
Insulators	Annually	Check for : Clean lines Damaged insulators Missing clips Rust
SWER Transformer Earthing	Annually	Check for: Earth strap is in place Check if earthing resistance test results are satisfactory

Annex B

(Informative)

Conductor repairs

The following paragraphs apply to work on overhead line conductors:

B.1 Pre-formed repair rods should be installed if no more than one strand is broken or nicked deeper than one third of the strand diameter, or when a number of strands are reduced in area not exceeding the area of one strand. Not more than two sets of pre-formed repair rods should be installed on any one conductor in any given span.

B.2 A compression-type repair sleeve should be installed if not more than one third of the outer strands of the conductor are damaged over a length of not more than 100 mm or not more than two strands are broken in the outer layer of conductor and the area of any other damaged strands is not reduced by more than 25%.

B.3 Compression-type repair sleeves should not be installed on one conductor in a given span if it already contains a conductor splice, conductor dead-end or another compression-type repair sleeve.

B.4 Damage to the steel strands or aluminium strands exceeding the stated limits for repair sleeves should be cut out and spliced by means of a mid-span joint.