

Title: **EXISTING TOWERS :  
STRUCTURAL INSPECTION,  
ANALYSIS STRENGTHENING,  
DESIGN AND CERTIFICATION  
OF TELECOMMUNICATION  
TOWER& MAST  
INFRASTRUCTURE**

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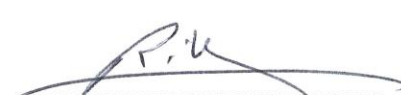
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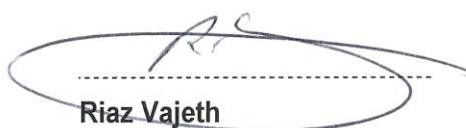
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## **1. Introduction**

ESKOM Telecommunications (ET) undertake to carry out annual routine maintenance for the radio towers/ mast to ensure that no structure or part of it is loaded in a manner that pose threat to human life as prescribed in the Construction Regulations section of the OHS Act 11(1)(a)( b) and 11(2)(a)(c). ET is further committed to the safety of employees, partners, and members of the public while conducting tower /masts maintenance.

## **2. Supporting Clauses**

### **2.1 Scope**

This document specifies the requirements for structural inspections, integrity & loading analysis, as well as the certification of ET radio tower and mast infrastructure either by ET or an appointed independent inspection authority, hereafter referred to as the Contractor.

Should ET opt conduct part or full scope of work in-house, the subject matter expert (SME) must be consulted to ensure that the persons doing the work have all the necessary requirements for the selected scope of work. Eskom in house workers shall under formal training to ensure that they are competent to conduct tower inspections

Note that any action, repairs or follow up inspections not specifically noted in this document which may be required following the outcome of this investigation, will be handled via a separate enquiry. This specification must be read and used in conjunction with all applicable national and international standards and regulations as per the normative references section 2.

#### **2.1.1 Purpose**

The purpose of this specification is to provide the technical requirements for radio tower and mast structural inspection & analysis to be used by contractors for Eskom to ensure that all telecommunication tower and mast infrastructure are structurally sound, compliant to the relevant regulations and laws and are loaded within their design limits.

**Note:** That any action, repairs or follow up inspections not specifically noted in this document which may be required following the outcome of this investigation, will be handled via a separate enquiry. This specification must be read and used in conjunction with all applicable national and international standards and regulations as per the normative references section 2.

#### **2.1.2 Applicability**

This specification is applicable to existing radio towers and masts used within ESKOM by ESKOM Telecommunications Division including all the Contractors appointed to do the work.

#### **2.1.3 Breakdown of the scope and deliverable**

The Contractor shall be appointed to perform full or part of structural inspection, analysis, design strengthening, and certification of existing telecommunication tower and mast infrastructure in accordance with the requirements outlined in this document.

##### **2.1.3.1 Structural inspection**

Where the scope of work is to conduct the inspection only, the Contractor shall provide ESKOM with an inspection report detailing the findings as guided by the requirements of this document. The report shall be shared with the SME who will advise if any further analysis will be required.

### **2.1.3.2 Analysis of the existing infrastructure and certification**

Where the scope of work is to conduct structural analysis of the tower based on the recommendations from the SME as result of the inspection carried out as mentioned on 2.1.3.1, the Contractor shall provide ESKOM with a PLS Tower back up model including a detailed report showing all the results of the analysis. The report and the PLS Tower models will be reviewed by the SME to ensure that the report aligns with the requirements of this document. If the structures in question are not part of the standard ESKOM design library, the Contractor shall collect all data to produce outline drawings, manufacturing drawings and all the other relevant information required to produce a detailed structure analysis as guided by the requirements of this document.

If the results (reviewed and accepted by the SME) from the detailed analysis conducted show that the structure complies with the latest TIA 222- G standard as described in this document, the Contractor shall issue a certificate of compliance (COC).

### **2.1.3.3 Strengthening Design of the existing infrastructure and certification**

Where the scope of work is to conduct a tower strengthening design based on the recommendations from the SME as a result of detailed structure analysis carried out as mentioned on 2.1.3.2, the Contractor shall provide ESKOM with a PLS Tower back up model including a detailed report showing all the results together the proposed remedial actions to be taken to get the tower to an acceptable, certified standard. The proposed solutions shall be detailed enough to allow for implementation without doing any further work. The detailed report with all the recommendations should be send to ESKOM for review and acceptance.

After all the recommendations from the strengthening design have been successfully implemented, the Contractor shall issue a COC as per the requirements of this document.

## **2.2 Normative/Informative References**

Parties using this specification shall apply the most recent edition of the documents listed below

### **2.2.1 Normative**

The following document contains provisions that, through reference in the text, constitute requirements of this specification. At the time of publication, the edition indicated was valid. All controlled documents are subject to revision, and parties to agreements based on this evaluation are encouraged to investigate the possibility of applying the most recent edition of the document(s) listed below. Information on currently valid national and international standards and specifications can be obtained from the Information Centre and Eskom Documentation Centre at Megawatt Park.

- [1] ANSI TIA 222-G Structural Standard for Antenna Supporting Structures and Antennas
- [2] ISO 9001 Quality Management Systems
- [3] SANS 10100 The structural use of concrete
- [4] SANS 10160 The general procedures and loading to be adopted in the design of buildings
- [5] SANS 10162 The structural use of steel, Part 1
- [6] SANS 1200 A General
- [7] SANS 1200 C Site clearance
- [8] SANS 1200 D Earthworks
- [9] SANS 1200 F Piling
- [10] SANS 1200 G Concrete (structural)
- [11] SANS 1200 H Structural steelwork
- [12] SANS 1200 HA Structural steelwork (sundry items)
- [13] SANS 1200 HC Corrosion protection of structural steelwork

- [14] SANS 657-1 Steel tubes for non-pressure purposes, Part 1: Steel tubes for scaffolding and for structural and general engineering purposes
- [15] SANS 10225 Design and construction of lighting masts
- [16] SANS 121 Hot dip galvanising coatings on fabricated iron and steel articles - specifications and test methods
- [17] AWS D1.1 Structural welding code - steel
- [18] 240-56872313 Radio station earthing and bonding
- [19] 240-5996738 New towers : General tower specification for new installations of ESKOM telecommunications tower& mast infrastructure
- [20] OHS Act Occupational Health and Safety Act and its regulations
- [21] CAA Civil Aviation Authority - Regulations for structures that exceeds surrounding building heights.

Any additional standards or regulations deemed necessary for the purpose of this scope or legally required to be complied with shall be indicated by the contractor.

## **2.2.2 Informative**

- [22] SANS 10160 The general procedures and loading to be adopted in the design of buildings
- [23] BS8100 Part 1 & 2 - Lattice Towers & Masts - British Standards Institution
- [24] ANSI TIA 1019A

## **2.3 Definitions**

### **2.3.1 General**

<b>Definition</b>	<b>Description</b>
<b>Radio Mast</b>	Any self-supporting structure consisting of a single element that is used to mount radio antennae for the purpose of transmission and reception of radio signals.
<b>Radio Tower</b>	Any self-supporting lattice structure that is used to mount radio antennae for the purpose of transmission and reception of radio signals.
<b>Contractor</b>	An independent structural inspection authority appointed by ESKOM for the purpose of the intended scope of work.
<b>Site Inspection Document (SID)</b>	A document available in hard copy format to be used on site for completion and capturing all relevant site specific information in a structured way during site visits.
<b>ESKOM</b>	ESKOM Holdings Limited, its divisions and wholly owned subsidiaries.
<b>Main Members</b>	Tower Leg Member
<b>2nd Tier Member</b>	Diagonal or Horizontal Bracing Members (Main Compression Members other than Legs)
<b>3rd Tier Member</b>	Redundant Bracing Members

Definition	Description
<b>Competent Person ( as per OHS ACT)</b>	a person who – a) has in respect of the work or task to be performed the required knowledge, training and experience and, where applicable, qualifications, specific to that work or task: Provided that where appropriate qualifications and training are registered in terms of the provisions of the National Qualification Framework Act, 2000 (Act No.67 of 2000), those qualifications and that training must be regarded as the required qualifications and training; and b) is familiar with the Act and with the applicable regulations made under the Act;
<b>PLS TOWER</b>	Software used for the structural analysis and design of lattice steel towers. Developed by Power Line Systems of Madison, Wisconsin, USA.
<b>PLS POLE</b>	Software used for the structural analysis and design of steel poles. Developed by Power Line Systems of Madison, Wisconsin, USA.

### 2.3.2 Disclosure classification

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

## 2.4 Abbreviations

Abbreviation	Description
<b>COC</b>	Certificate of Compliance
<b>CAA</b>	Civil Aviation Authority
<b>ECSA</b>	Engineering Council of South Africa
<b>EDC</b>	ESKOM Documentation Centre
<b>ESK</b>	ESKOM wide document ID prefix
<b>ET</b>	ESKOM Telecommunications
<b>ID</b>	Identification
<b>(M)</b>	Mandatory
<b>SME</b>	Subject matter expert ( within ESKOM )

## 2.5 Roles and Responsibilities

The Contractor shall be responsible for the scheduling and execution of the site inspections as per section 6 in this specification. Site inspections shall be done in consultation with the relevant Eskom Enterprises field staff for support. Refer to section 8 for the required credentials for the individuals proposed for this tender.

The contractor shall be responsible to employ the services of one or more registered structural engineer (s) to perform the analysis as per section 4,5,6,7 & 8 in this specification. Refer to section 8 for the required credentials for the individuals proposed for this tender.

## 2.6 Process for Monitoring

ET will conduct internal audits to ensure that inspections are done according to the requirements of this specification.

## **2.7 Related / Supporting Documents**

This specification must be used together with the requirements of the new towers general specification, **240-5996738**

- Other applicable documents include;-
- Appointment letters
- Training records and certificates
- Certificates
- Inspection check list

## **3. Site Inspection**

- a) All sites with tower(s) and/or mast(s) identified for evaluation are required to be visited for the inspection. Each Tower/Mast shall be evaluated, documented and reported on individually. Refer to Annex A for a listing of the towers/masts to be included in this scope (M)
- b) Site inspections & analysis, incorporating the requirements of above listed standards and regulations as a reference point, shall be conducted for identification and disposition of structural non-conformances. The requirements for the structural inspection, tower loading inspection, general site information as well as verification of installation standards will be addressed in the following sections. Inspections shall include, but not be limited to the requirements of this document. (M)
- c) A comprehensive Site Inspection Document (SID) shall be compiled for completion on site. The Contractor is to ensure that all requirements are addressed in the document in a structured way so that all required information can be captured and documented on site. The Contractor shall provide a sample of the proposed SID one week after the contract has been awarded. All facets covered in this specification and Annex J of TIA 222 – G standard are to be included in the SID, including any further information required by the Contractor to produce the required analysis and outputs. The SID shall be approved by ESKOM prior to any site visits and inspections (M)

### **3.1 Structural Inspection**

The Radio tower/mast inspections in terms of Construction Regulations (section 11) shall be carried out at least once every six months for the period of two years for new structures and thereafter once a year for other structures. The inspection shall include:

- 3.1.1** Identify the tower/mast type and record the information on the tower data plate (where available) (M)
- 3.1.2** Determine the total structure vertical height to the nearest meter by means of measuring from the foundation base plate level to the highest structural member (excluding lightning rod & collinear on top). No GPS or barometric instrument shall be used to determine the tower height. (M)
- 3.1.3** The structures shall be measured sufficiently to enable the Structural Engineer to compile drawings and perform the structural modelling & analysis as per section 4 & 5. Where the original tower supplier drawings (either supplied by ESKOM or third party) are available, the Contractor shall be responsible to ensure that the drawings are accurate and complete, including any deviations, modifications or strengthening that may have been performed. (M)
- 3.1.4** Horizontal plan view shape & dimensions of the concrete base shall be provided - also see paragraph 4.2 (M)
- 3.1.5** Foundations for towers shall be assumed to be correctly designed at the time of the installation of the tower, therefore the requirement would only be to strengthen the foundation where required when the tower requires strengthening. Therefore the Contractor is required to submit a foundation strengthening design where it is applicable and signed off by an ECSA registered civil engineer. (M)
- 3.1.6** Magnetic particle testing of critical welds where cracks are suspected or likely shall be performed. The tested areas shall be coated with cold galvanising paint as per the paint manufacturers' instructions (M)

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**3.1.7** Tower bolts and nuts shall be spot checked with a suitable spanner for tightness, utilising the 'turn the nut' method as per SANS 10162. Bolts and nuts shall be randomly selected at various heights (at least every 3m) for the full height of the tower, as well as various sides of the tower at each level (M)

**3.1.8** All critical fastening points. e.g. foundation bolts, leg fixing bolts, etc, shall be spot checked with a suitable spanner for tightness, utilising the 'turn the nut' method as per SANS 10162 (M)

**3.1.9** An estimate of the tower exposure and topographic categories according to the TIA 222-G standard to be provided (Structural Engineer to confirm by means of suitable topographical maps, photographs & notes provided on the SID) (M)

**3.1.10** Visual inspection of the following, but not limited to, shall be reported on: (M)

- a) Loose nuts and bolts around the tower base
- b) Visible concrete base and grouting
- c) Holding down bolts / foundation bolts (double nut required)
- d) Earth connections
- e) Base rings to structure welds
- f) Gusset welding
- g) External surfaces
- h) Condition of painting
- i) Condition of galvanising
- j) Cable ladders
- k) Climbing ladder & cage
- l) Slip joints
- m) Bolting connections
- n) Longitudinal welds
- o) Circumferential welds
- p) Platforms / Landing(s)
- q) Cable connections
- r) Antenna Structures and attachments
- s) Lattice members
- t) Lightning rod
- u) Aircraft warning light(s)

## **3.2 Loading Inspection**

**3.2.1** Tower loading information shall be detailed, including all antennae as well as other structures, equipment & cables on the tower. The following information per antenna, but not limited to, shall be included: (M)

- a) Antenna Type, size, manufacturer (if available), model (if available), height on tower, mounted leg or side (define leg & side numbering on drawings)
- b) Feeder Type, Size, Quantity and Position
- c) Landing Type & Heights
- d) Cable ladder & Climbing ladder & cage/ fall arrest/ fall prevent system

### **3.3 General Site Information**

**3.3.1** Site co-ordinates shall be recorded at the base of each tower, utilising datum WGS84. Format to be in degrees, minutes & seconds (dd° mm' ss.s"), accurate to the first arc second decimal point. Ensure that at least half an hour has been allowed for the GPS to stabilise and that at least six or more satellites have been accessed before recording the co-ordinates. The instrument should be in 3D mode at the time the co-ordinates are recorded.

Please indicate if any of these conditions could not be obtained at the time the co-ordinates was taken. (M)

**3.3.2** Record height above sea level in meters. Refer to 3.3.1 for GPS conditions. (M)

**3.3.3** Tower, building/container & site boundary orientation to True North. (M)

**3.3.4** Photographs of the following shall be provided: (M)

- a) View of entire site (fenced area & full tower height fitted into one frame)
- b) Each side of the tower, full height, starting with the gantry side, going clockwise.
- c) Frame photos overlapping in the side view of the tower, starting at the base and moving to the top. The photos will be used by the structural engineer for reference and confirmation of members and connection detail.
- d) View from the tower looking: North, East South & West
- e) All critical area, incl. foundation bolts, etc
- f) All identified problem areas

All photographs to be in digital JPG format and recorded in at least 12 Mega Pixel resolution, properly named as well as referenced from the report. (M)

### **3.4 Verification of Tower Installation Standards**

The following installation standards to be verified on site. The contractor to report in writing any non-compliance: (M)

**3.4.1** Each platform should have a waist and knee guard-rails of sufficient strength to be suitable for the attachment of a safety belt. Refer to OHS Act. (M)

**3.4.2** An earthing plate (as per 240-56872313) should be present approximately 500mm below the horizontal feed gantry at its tower end, to which the antenna feeders are earthed. This bar should be connected directly to the earth ring of the tower by a copper strap. (M)

**3.4.3** Each tower leg, as well as the down conductor should be interconnected with the site earthing ring in accordance with ESKOM specification 240-56872313. Verify (above ground level inspection only) that each tower leg has a copper strap securely connected. (M)

**3.4.4** A data plate, detailing the relevant design information, should be affixed to the tower between one and two meters above the foundation level such that it can be easily read. (M)

**3.4.5** A vertical steel rod or tube lightning conductor of no less than 15 mm in diameter should be extended 2m above the top of the structure. (M)

**3.4.6** Any aircraft warning lights and tower painting must comply with the relevant Civil Aviation Authority regulations. (M)

## **4. Structural and Loading Analysis**

**4.1** All towers shall be modelled and analysed, incorporating the requirements of above listed standards and regulations as a reference point. The tower design parameters and loading capacities shall be determined for each tower. The structural analysis and design calculations must be carried out in with the latest version of PLS Tower software (developed by Power Line systems of Madison, USA). All design calculations, computer models (PLS Tower backup files) and drawings (CAD and pdf) for the towers must be provided to ESKOM. It is preferred that the models are done using the material library that is consistent with the ESKOM library as far as possible. A copy of the ESKOM material library can be made available to the Contractor upon the commencement of the contract.

(M)

**4.2** Verification of the foundation concrete volume and anchoring shall be excluded from this exercise. The Contractor shall compare the two dimensional as build plan shape & dimensioning of the concrete base with the original design drawings (where available) and report on any anomalies.

(M)

**4.3** The mast tower analysis must be done by a Professional; Structural Engineer registered with the Engineering Council of South Africa. A copy of the registration certificate must be submitted with the tender document. The Professional Engineer must sign all relevant reports, drawings, designs and recommendations.

(M)

**4.4** All structural elements must be checked against the recognised TIA-222-G Standard. Most of the older tower structures have been designed using Part 3 of the SABS 0162 code which has since been withdrawn. This may give a slenderness problem on some of the structural elements. In this case the procedure described in Annexure B must be followed.

(M)

**4.5** For each Tower the Exposure condition, as well as Topographic condition (Artificial Base Height) shall be estimated by the engineer. Suitable topographical maps, photographs & notes provided in the SID shall be used for this purpose.

(M)

**4.6** A comprehensive report for each tower shall be provided, signed off by the structural engineer. (M)

**4.7** The structural engineer shall provide recommendations for any remedial action on structural non-conformances.

(M)

**4.8** The structural engineer shall issue a certificate of compliance for all structures that do comply (M)

**4.9** for each structure, the structural engineer shall provide a detailed analysis of the tower / mast loading, indicating the following:

(M)

- a) Loading contribution detailed for each antenna, landing, feeders, etc
- b) Total Loading for tower
- c) Design Capacity of the tower
- d) Total available capacity for future loading or overloading

**4.10** The general structural design procedures and minimum design loads to be adopted in the design of all structural members must conform to the requirements of TIA-222-G standard.

(M)

**4.11** The wind loading must be calculated using the following assumptions:

(M)

- a) Recurrence Interval of Wind = 1 in 50 years
- b) Gust Profile = 3 seconds
- c) Basic Wind speed = 40m/sec (higher wind speeds to be used in areas identified by SABS 1060)
- d) Classification of structures = as per Table 2 -1 of the TIA 222-G standard, See Annex A

**4.12** In areas where ice has occurred, it is necessary for the tower to be checked for ice loads. ESKOM SME shall be consulted to provide advice on the acceptable assumptions in such cases.

(M)

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**4.13** The tower or mast shall allow a maximum twist at the antennae positions of less than  $1^\circ$  (one degree). The allowable horizontal deflection at the top of the tower should be restricted as far as possible to the height of the tower or mast divided by 250 with a maximum of 0.3m at any point. (M)

**4.14** The wind loading on the tower must take into account the additional wind loading of the antenna, outdoor unit equipment, antennae mounting brackets, the caged ladder, cable ladder(s), feeder cables, platforms, etc. (M)

**4.15** The following drawings shall be compiled for each tower (M)

- a) Tower design drawings shall include all design load parameters (Site conditions)
- b) Tower loading drawings, indicating the positioning of all antennae (height, leg and azimuth)
- c) Tower member sizes and connection details

**4.16** All PLS-Tower models, reports, designs, photographs and drawings must be provided to ESKOM in hard copy as well as in soft copy format (M)

## **5. Strengthening Design**

Structural strengthening design required in cases where the tower is not in compliance with the specification or in cases where the loading of the tower is being increased and the tower is deemed not adequate for the new loading requirements.

**5.1** Build a structural computer model using PLS Tower of the mast where not available already (M)

**5.2** Calculate the loads for the antennae, cables, landings, etc. and input into the model. Refer to the loading details as per section 4. Future loading, as well as 3rd party antennae should be allowed for. Identify any changes where this tower was analysed previously. (M)

**5.3** Run the model to identify members that are over-stressed and too slender. (M)

**5.4** Calculate the strength of the connections to identify any over-stressed areas (M)

**5.5** Develop solutions to adequately accommodate the existing tower loading, as well as anticipated future loading. Staying of the tower to be investigated as a last option where other solutions are likely to be very costly or impractical. See Annex A for anticipated loading. (M)

**5.6** Tower concrete foundation to be proportionally enlarged where applicable. Since in most cases the as-built drawings will not be available, assumptions regarding the foundation design shall be stated (M)

**5.7** Provide an updated graph indicating the available antennae area to mast height. This graph should provide the picture prior to adding the anticipated future loading. (M)

**5.8** Indicate which antennae (if any) are likely to be affected during the construction which would consequently interrupt traffic. (M)

**5.9** The final design drawings must be detailed enough such that it can be issued as-is to a third party company to do the repairs without any additional information required. (M)

**5.10** Provide a construction/erection procedure for the enhancements to the tower if it is necessary to undertake the enhancements in a specific order (M)

**5.11** ECSA registered engineer to sign-off the full design (M)

**5.12** Prepare a drawing of the mast where not available already (M)

**5.13** Modify the drawing of the mast to indicate members and connections that are to receive attention (M)

**5.14** Where additional members are required, further revise the drawing to indicate the size and position of these members. (M)

**5.15** Provide information on the connection of new members to the mast either on a drawing or by description. These drawings and description should be sufficient for ESKOM to issue an open tender for implementation. (M)

**5.16** Prepare a Tower Strengthening Report, detailing the design code, criteria and assumptions used. Stipulate the current state of the mast as well as the options offered to ESKOM for correction. The report should also include graph(s), indicating the available antenna flat plate area available at various tower heights after the solution(s) proposed have been implemented. This report shall include all drawings required for the strengthening of towers and a budget cost estimation for the proposed strengthening solutions (s). (M)

## **6. Certification of New/Replacement Towers (Upgrade Contract)**

**6.1** The Contractor shall submit acceptance and supervise documentation during each phase of the construction of the tower (M)

- a) Tower Foundation Phases check sheet and Civil Engineer certificate. (M)
- b) Tower Installation and commissioning check sheet (M)
- c) Tower Structural Engineer Certificate after completion (M)
- d) The Contractor shall develop check sheets for each phase of the construction (M)

**6.2** Process for Certification:

- a) ESKOM shall Liaise with the Contractor for the date of inspection (M)
- b) Travel to and from site using own transportation (M)
- c) Inspect the strengthening with Contractor, including climbing the mast to inspect all areas that have been strengthened. (M)
- d) Indicate areas of non-compliance and specify remedial measures. (M)
- e) Provide remedial measures that can be undertaken within an hour, wait to inspect the implemented measures. (M)
- f) Issue a certificate to verify that the strengthening is acceptable and meets with the design intent. (M)

## **7. Certification for Strengthening of old Towers**

**7.1** The Contractor shall submit the following documentation during each phase of the strengthening construction of the towers.

- a) Supervision of tower strengthening. (M)
- b) Tower Structural Engineering Certificate indicating the tower is compliant to the current structural code. (M)

## **8. Reporting**

**8.1** The Contractor shall have sufficient experience in performance of radio tower inspections and structural analysis and shall be currently performing such services. References of recent inspections shall be provided as part of the tender submission. (M)

**8.2** The Contractor shall have the full-time support of one or more Structural Engineer(s), sufficiently experienced in the analysis of radio towers and masts. Each Engineer's verifiable experience in analysis of above structures, name and professional; registration number shall be provided as part of the tender submission. (M)

**8.3** The Structural Engineer shall be professionally registered with the Engineering Council of South Africa (ECSA) (M)

**8.4** It is preferred, although not mandatory, for the independent inspection authority to be accredited to ISO 17020 (competency of Inspection Authorities to perform inspection activities). Proof hereof shall be provided as part of the tender submission. (M)

**8.5** The Contractor shall preferably be an approved governmental inspection authority. Proof hereof shall be provided as part of the tender submission. (M)

**8.6** The Contractor must be fully independent and any possible conflict of interest (e.g. design or manufacturing company of towers) must be declared as part of the tender submission. (M)

**8.7** The Contractor shall have adequate personnel to perform the on-site inspections. Staff details and qualifications shall be provided to ESKOM as part of the tender submission. (M)

**8.8** The Contractor shall have adequate liability insurance for cover against misjudgements or errors. Proof of Insurance to be provided to ESKOM as part of the tender submission. (M)

**8.9** The Contractor shall comply with requirements of the OHS Act, particularly the construction regulations, and shall provide proof of compliance as part of the tender submission. (M)

**8.10** The inspectors shall have undergone internal training on structural inspection and shall have at a minimum level II Magnetic Particle Inspection Qualification. Proof of compliance shall be submitted as part of the tender submission. (M)

**8.11** All the inspection and measurement work shall be under the supervision of an experienced and suitably qualified supervisor. Proof of this competency shall be provided to ESKOM as part of the tender submission. (M)

## **9. Access to Radio Sites / Substations**

**9.1** ESKOM shall accompany the appointed Contractor for the first visit to each site. Subsequent site visits by the Contractor shall be allowed. Contractors shall not be allowed, under any circumstances, to enter substations without an ESKOM representative qualified in HV regulations. (M)

**9.2** The Contractor shall provide for own transport to the sites. (M)

**9.3** No keys shall be issued The Contractor for the purposes of this contract. (M)

The Contractor shall plan the routing between the various site in conjunction with the relevant ESKOM section of responsibility. The Contractor shall provide a preliminary routing plan and time schedule as part of the tender submission. (M)

## **10. Authorization**

This procedure has been seen and accepted by:

<b>Name and surname</b>	<b>Designation</b>
J Manyisa	ESKOM Telecommunications Manager
B Nala	Group Manager – National Planning
C Naidoo	Technology & Services Manager
K Cornwall	Regional Manager ( Central)
M Ganesan	SHEQ Manager
Riaz Vajeth	Senior Manager Line Engineering

## **11. Revisions**

<b>Date</b>	<b>Rev</b>	<b>Compiler</b>	<b>Remarks</b>
Nov 2018	1	N Muthadi	First issue

## 12. Development Team

The following persons were involved in the compilation of this document

- S Natesan Chief Engineer – Lines
- R Page Senior Consultant
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- P Kgole ESKOM Telecommunications
- T Qika ESKOM Telecommunications
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## 13. Acknowledgements

Not applicable.

## **Annex A –**

Annex A - List of Towers and Masts.

Annex B - Method of Structural Analysis in case of a Slenderness Problem

Annex C - Compliance Schedule: Fully Comply, Partial Comply and Non- Comply.

**Annex B – List of Towers and Masts (normative)**  
(normative)

The following information has been extracted from the existing site records and knowledge from the field staff. Although the information has been verified as

Site Name ( Tower or Mast)	Area	Perceived Risk Profile	Classification of structures According to TIA 222 – G Table 2-1	Tower / Mast Type	ESKOM standard design (Y/N)	Tower / Mast Height (m)	Tower Supplier	Anticipated future loading ( m <sup>2</sup> @ req. height)	Approximate Age ( years)	Access to Site	Notes

far as possible, the Contractor shall not consider as 100 % accurate and should be verified on site as part of the tender. The information contained in the list below shall be used as the basis for the tender response

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Notes:

**Perceived Risk Profile 1**

Towers considered to comply with one or more of the following conditions:

- Perceived excessive tower loading
- Tower in Substation
- Stayed Mast
- High corrosion are (e.g. coastal site)
- Exposure (e.g. extreme wind profile, snow)
- Known structural problem

These towers to be inspected urgently

**Perceived Risk Profile 2**

Towers not complying to Profile 1, but still perceived as medium to high risk.

These towers to be prioritised for inspection after profile 1

**Perceived Risk Profile 3**

Towers perceived as low risk, e.g. newly constructed, well maintained.

These towers to be prioritised for inspection after profile 2

## **Annex C – Method for Structural Analysis in case of a Slenderness Problem**

Should there a problem with the slenderness ratios while analysing existing towers, Eskom shall be consulted in order to give direction.

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## Annex D – Compliance Schedule: Fully Comply, Partial Comply and Non-Comply

For Partial and fully compliant a description is required.

Response to Specification – 240-119380820			
Clause	Compliance Statement	Company Description	Score
3	Site Inspection		
3 a			
3 b			
3 c			
3.1	Structural Inspection		
3.1.1			
3.1.2			
3.1.3			
3.1.4			
3.1.5			
3.1.6			
3.1.7			
3.1.8			
3.1.9			
3.1.10.a			
3.1.10.b			
3.1.10.c			
3.1.10.d			
3.1.10.e			
3.1.10.f			
3.1.10.h			
3.1.10.i			
3.1.10.j			
3.1.10.k			
3.1.10.l			
3.1.10.m			
3.1.10.n			

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3.1.10.o			
3.1.10.p			
3.1.10.q			
3.1.10.r			
3.1.10.s			
3.1.10.t			
3.1.10.u			
3.1.10.v			
3.2.1	Loading Inspection		
a			
b			
c			
d			
3.3	General Site		
	Information		
3.3.1			
3.3.2			
3.3.3			
3.3.4			
Clause	Compliance Statement	Company Description	Score
3.3.4.a			
3.3.4.b			
3.3.4.c			
3.3.4.d			
3.3.4.e			
3.4	Verification of Tower Installation Standards		

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3.4.1			
3.4.2			
3.4.3			
3.4.4			
3.4.5			
3.4.6			
4	Structural and Loading Analysis		
4.1			
4.2			
4.3			
4.4			
4.5			
4.6			
4.7			
4.8			
4.9			
4.10			
4.11			
4.12			
4.13			
4.14			
4.15			
4.16			
5	Strengthening Design		
5.1			
5.2			
5.3			
5.4			
5.5			
5.6			
5.7			

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5.8			
5.9			
5.10			
5.11			
5.12			
5.13			
5.14			
5.15			
5.16			
6	Certification of New Towers		
6.1.a			
6.1.b			
6.1.c			
6	Process of Certification		
6.2.a			
6.2.b			
6.2.c			
6.2.d			
6.2.e			
6.2.f			
7	Certification of Strengthening of Towers		
7.1.a			
7.1.b			
8	Reporting		
8.1			
8.2			
8.3			
8.4			
8.5			
8.6			

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8.7			
8.8			
8.9			
8.10			
8.11			
9	Access to Radio Sites / Substations		
9.1			
9.2			
9.3			
		Total score	