 <b>Eskom</b>	<b>Terms of Reference</b>	<b>Technology</b>
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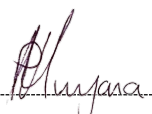

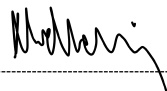
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## **Content**

1. Introduction .....	3
2. Supporting Clauses .....	3
2.1 Scope .....	3
2.1.1 Purpose .....	3
2.1.2 Applicability .....	3
2.2 Normative/informative references .....	3
2.2.1 Normative .....	3
2.2.2 Informative .....	4
2.3 Definitions .....	4
2.3.1 General .....	4
2.3.2 Disclosure Classification .....	4
2.4 Abbreviations .....	4
2.5 Roles and Responsibilities .....	5
2.6 Process for Monitoring .....	5
2.7 Related/supporting Documents .....	5
3. Scope and Specification Information .....	6
3.1 Project Overview .....	6
3.1.1 Proposed Developments .....	6
3.2 Site Description .....	7
3.2.1 Location .....	7
3.3 Information Available .....	7
3.4 Services required .....	7
3.4.1 Geotechnical consultant/Advisor .....	7
3.5 Laboratory services (including plant hire) .....	7
3.6 Health, Safety and Environment .....	9
3.7 Site Accessibility .....	10
3.8 Terms and Conditions .....	10
3.8.1 Formal Agreement .....	10
3.9 Programme .....	10
4. Authorization .....	10
5. Revisions .....	11
6. Development team .....	11
7. Acknowledgements .....	11
APPENDIX A: BILL OF QUANTITIES .....	12
APPENDIX B: TYPICAL TRFR PLINTH AND TYPICAL TRFR OUTLINE .....	13
APPENDIX C: TYPICAL MEDIUM AND LARGE FOUNDATION LAYOUT .....	14
APPENDIX D: TEST PIT PLAN LAYOUT AND LONG SECTIONS .....	15
APPENDIX E: SOIL RESISTIVITY TESTING FOR SUBSTATION APPLICATION .....	16

## **1. Introduction**

Eskom Transmission plans to put together a panel of geotechnical laboratories, who will provide laboratory services for geotechnical / dolomitic analysis investigation for new 132 to 765Kv substation developments (GIS and AIS) as well as extensions on existing substations and specialised investigations on our high voltage (HV) lines.

Laboratory services are required to obtain design data for the design of platforms and geotechnical structures.

## **2. Supporting Clauses**

### **2.1 Scope**

This document covers the scope of work, method of investigation and deliverables of the geotechnical investigations undertaken for substation developments. The content is not all exhaustive and may change from time to time.

#### **2.1.1 Purpose**

The purpose of the document is to make available the terms of reference for undertaking geotechnical investigations for Transmission geotechnical/dolomitic analysis investigations.

#### **2.1.2 Applicability**

This document shall apply to Substation Engineering Department within Transmission Engineering in Eskom.

### **2.2 Normative/informative references**

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

#### **2.2.1 Normative**

- [1] ISO 9001 Quality Management Systems.
- [2] SAICE Code of practice for the safety of persons working in small diameter Shafts and test pits for Civil Engineering Purposes (2007).
- [3] TMH1:1979. Standard methods of testing road construction materials. National Institute for Transport & Road Research C.S.I.R. Pretoria.
- [4] SANS 3001. Civil Engineering test methods
- [5] Jennings J.E., Brink A.B.A. and Williams A.A.B. (1973). Revised Guide to Soil Profiling for Civil Engineering Purposes in South Africa. The Civil Engineer in South Africa, January 1973.
- [6] Guidelines for Soil and Rock Logging in South Africa, 2nd Impression 2001, eds. A.B.A. Brink and R.M.H. Bruin, Proceedings, Geoterminology Workshop organised by AEG, SAICE and SAIEG, 1990.

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- [7] Site Investigation Code of Practice, 1<sup>st</sup> Edition, South African Institution of Civil Engineering - Geotechnical Division, January, 2010.
- [8] 240-96393507: Soil Resistivity testing for Substation application
- [9] 240-84699047: Geotechnical investigations scope and specification template

### **2.2.2 Informative**

- [10] SANS 10160: Basis of structural design and actions for buildings; Part 5: Basis for geotechnical design and actions.

## **2.3 Definitions**

### **2.3.1 General**

<b>Definition</b>	<b>Description</b>
Stratigraphy	The layering of deposits, with newer remains overlaying older ones, forming a chronology of the site
Excavatability	Tractor-Loader-Backhoe
Seismic	Related to, or caused by an earthquake or other vibration of the earth
Lithology	The general composition of a rock or rock sequence
Liquefaction	Process of or state of having been made liquid
Factual report	A document that is concerned with facts or contains facts
Interpretive report	Documents which contains interpretation of analysis of results including factual and desktop reporting, ultimately reaching objective recommendations based on the interpretation of results and background information of the geotechnical field.
Consultant	A person or party who is consulted to carry out the geotechnical investigation.

### **2.3.2 Disclosure Classification**

**Controlled disclosure:** controlled disclosure to external parties (Both Discretionary and enforced by law).

## **2.4 Abbreviations**

<b>Abbreviation</b>	<b>Description</b>
TLB	Tractor-Loader-Backhoe
CBR	California Bearing Ratio
TMH	Technical Methods for Highways
SAICE	South African Institution of Civil Engineering
SAIEG	South African Institute for Engineering and Environmental Geologists

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Abbreviation	Description
SANS	South African National Standards
SHE	Safety, Health & Environment
MTS	Major transmission substation
EA	Engineer Assistant
HV	High Voltage

## **2.5 Roles and Responsibilities**

The appointed Technician/Technologist/Engineer/Geologist shall ensure that this document is compiled with the standards noted in this document or any other approved appropriate form of literature and shall also ensure that the document is issued with all required associated documentation.

## **2.6 Process for Monitoring**

Not applicable.

## **2.7 Related/supporting Documents**

A typical Bill of Quantities

### **3. Scope and Specification Information**

#### **3.1 Project Overview**

##### **3.1.1 Proposed Developments**

Eskom Transmission plans to put together a panel of geotechnical laboratories, who will provide laboratory services for geotechnical / dolomitic analysis investigation for new 132 to 765Kv substation developments (GIS and AIS) as well as extensions on existing substations and specialised investigations on our high voltage (HV) lines.

Laboratory services are required to obtain design data for the design of platforms and geotechnical structures.

The proposed developments would include the installation of the following typical equipment:

- Power Transformers
- Shunt reactors
- HV switchgear
- Instrument transformers
- Surge arrestors
- Control and ancillary buildings
- Platforms
- Steel structures and foundations
- Access roads
- GIS building

The following civil engineering structures will be constructed as part of the project:

- Soil pavement
- Steel structures and foundations
- Access roads
- Fences

Typical bearing pressures in excess of between 200 - 300kPa can be expected at foundation level. Typical foundations layouts have been included as part of this report.

The investigation should provide geotechnical parameters on which the foundation and ancillary structure designs may be based. Soil parameters of the in-situ materials, which allow for the computation (as well as the actual computation) of the following mechanical properties shall be provided as part of the report:

- Shear strength
- Lateral earth pressure
- Consolidation
- Bearing capacity
- Slope stability
- Flood analysis

## **3.2 Site Description**

### **3.2.1 Location**

The geotechnical investigations will be undertaken within various locations within the country.

## **3.3 Information Available**

The following drawings are available and are attached to this document:

- Bill of quantities and estimated quantities (Appendix A)
- 240-96393507: Soil Resistivity testing for Substation application (See Appendix E).

The above information, where applicable, is also available in electronic format.

## **3.4 Services required**

### **3.4.1 Geotechnical consultant/Advisor**

Substation engineering department may require the service of a geotechnical Advisor, who has more than 5 years' experience after professional registration as a geotechnical engineer or engineering geologist (based on SANS competence levels for geo-professionals). **The advisor will be required to guide a candidate geotechnical engineer in compiling a geotechnical investigation report for a project.** The advisor will be responsible for ensuring that:

- The advisor provides all the necessary tools, equipment, and relevant literature for the candidate to be able to make the correct analysis on all project specific available data.
- Guides the candidate to full understanding on sections the candidate has no prior experience or knowledge, taking into consideration the time constraints of the task order.
- The advisor reviews, comments and provides guidance to the candidate for the correct analysis of all the sections of the report.
- The advisor signs off the geotechnical report as the approver of all the content in the document.

The advisor should be able to analyse all geotechnical lab results and in-situ tests listed in this specification

## **3.5 Laboratory services (including plant hire)**

The services of a SANAS accredited laboratory are required for testing of soil samples and to provide and operate all plant as outlined below.

### **3.5.1 Excavator/TLB services**

A TLB or an excavator (including a certified operator) with capabilities and specifications as outlined in SANS 1200D

### **3.5.2 Laboratory services**

Undisturbed, samples, Disturbed samples and bulk samples will be taken for laboratory testing and tests carried out as per SANS 3001 method. The following tests should be conducted on representative samples from site:

- Classification tests: grading & indicator (Atterberg Limits and Hydrometer).
- Compaction tests (Bulk density, MDD and OMC)
- Mod AASHTO moisture/density relationship and CBR Tests.
- Laboratory Conductivity tests (ms/cm) as per TMH-1.
- Chemical analysis of soil water extracts assessing corrosiveness (Basson index) as per TMH-1.
- Dynamic probe super heavy tests
- Swelling pressure tests
- Free swell test
- Specific gravity tests
- Heave test
- UCS tests on rocks (if necessary)
- Consolidated undrained triaxial tests on fully saturated samples and samples at natural moisture content. The test should be carried out on both undisturbed and remoulded samples (where necessary)
- Specialized testing should be conducted, such as slaking properties of rock where necessary
- Collapse potential tests (where necessary)
- Potential alkali reactivity of aggregates in areas where geology may give rise to the ASR attack on concrete
- ACV on yard stone aggregates
- 10% FACT on yard stone aggregates
- Durability Mill Index on yard stone aggregates
- Glycol test on yard stone aggregates
- XRD analysis on yard stone aggregates

Loose to medium dense soils below founding depth should be stabilized with 1-3% lime/cement. Prior to stabilising the materials, test should be done to determine if the soil contain sulfate and the concentration/quantity of the sulfate in the soil. The following test should be carried out on the specimens after stabilisation:

- ICL test as per SANS 3001
- Compaction tests (MDD and OMC)
- Mod AASHTO moisture/density relationship and CBR Tests (soaked and unsoaked).
- Unconfined compression strength test
- Indirect tensile strength test
- Atterberg limits
- Laboratory Conductivity tests (ms/cm) as per TMH-1.
- 1D oedometer heave test
- Consolidated undrained triaxial tests

**\*All materials encountered on site should be tested.**

#### **3.5.2.1 Core sampling**

200mm core diameter samples should be collected. The samples should be subjected to compressive strength tests (where surface is concrete) as well as checking the quality of the asphalt material (where asphalt is encountered).

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The cored hole should be filled as follows:

- Allow hole to fully dry
- A paint brush should be used to coat the wall with 30% dilute stable grade bitumen emulsion. Once the bitumen emulsion has broken to a uniform black colour, the core hole should be filled with fine, continuously graded asphalt, with a maximum particle size of 7.1 mm.

Either cold mix asphalt or hot mix asphalt, with minimum temperatures of 60°C and 120°C, respectively, can be used for this purpose. A steel trowel should be used to settle the asphalt against the wall of the core hole. The hole can then be filled with the asphalt in approximately 40 mm thick layers, and compacted with a Marshall hammer. The mix should be compacted just proud of the surface of the surrounding pavement

#### **3.5.2.2 Scanning for underground services**

Underground scanning shall be undertaken to ensure that no underground services traverse the site prior to undertaking the investigation.

#### **3.5.2.3 SOIL RESISTIVITY TESTS**

Soil resistivity tests are to be carried out as per the 240-96393507: Soil Resistivity testing for Substation applications (See Appendix E).

#### **3.5.2.4 DPSH Testing**

DPSH testing should be carried out between the trial holes or next to the hole where there is no certainty of depth of bedrock and the material 3m below NGL or where the soils are predominantly of a loose-medium dense or soft-firm consistency.

#### **3.5.2.5 DRILLING OF BOREHOLES**

Rotary cored boreholes (max depth 25m or 3m into the bedrock) with SPT "N" tests, undisturbed Shelby Samples to determine collapse potential/expansiveness and/or heave of the material must be undertaken.

The drilling contractor should allow for a concrete plug to fill up the boreholes after drilling.

### **3.6 Health, Safety and Environment**

All work shall be carried out in accordance with the requirements of the Occupational Health and Safety Act (Act 85 of 1993) and the regulations accompanying this act will be adhered to where applicable and comply with Eskom's SHE specification. All employees shall be provided with adequate training for the tasks that they are required to perform including an awareness of the risks involved in the execution of their duties and the methods available for the mitigation of these risks. Safety induction and security clearance will have to be done prior to establishment of site (min 2 hours). A safety file shall be prepared for the project and medicals might have to be carried out and therefore costs thereof should be included in the quote.

### **3.7 Site Accessibility**

The following is excluded from the consultants' responsibility:

- Arranging access (ESKOM responsibility)
- Excavation permits (where necessary, ESKOM responsibility)
- Detection of buried services
- Breaking out & reinstatement of surface beds
- Compaction of backfill in test holes.

### **3.8 Terms and Conditions**

#### **3.8.1 Formal Agreement**

Professional fees will be determined from the actual number of hours spent on the job, charged at current hourly rates. Internal disbursements will be charged at cost. The technical proposal should be submitted with the attached BOM. It should be filled in with all the necessary rates.

The below table should be used to guide the consultant in calculating the professional fees (excluding expenses that will be incurred and cost of compiling health and safety file).

### **3.9 Programme**

The project should be completed within 7-9 weeks of appointment

<b>Activity</b>	<b>Duration in weeks</b>
Mobilization and sub-contracts	1
Field geotechnical investigation	1
Factual report	1
Laboratory testing	3
Final report	4
Total	± 9

*\* Factual Report and Laboratory testing could run concurrently.*

Due diligence should be exercised to ensure that the final interpretive report is delivered within the timelines proposed above.

## **4. Authorization**

This document has been seen and accepted by:

<b>Name and surname</b>	<b>Designation</b>
Subhas Maharaj	Senior Manager: Substation Engineering

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<b>Name and surname</b>	<b>Designation</b>
Andile Maneli	Middle Manager: Substation Engineering

## **5. Revisions**

<b>Date</b>	<b>Rev.</b>	<b>Compiler</b>	<b>Remarks</b>

## **6. Development team**

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

- Phenyo Mvuyana

## **7. Acknowledgements**

None

APPENDIX A: BILL OF QUANTITIES

## APPENDIX B: TYPICAL TRFR PLINTH AND TYPICAL TRFR OUTLINE

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## APPENDIX C: TYPICAL MEDIUM AND LARGE FOUNDATION LAYOUT

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## APPENDIX D: TEST PIT PLAN LAYOUT AND LONG SECTIONS

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## APPENDIX E: SOIL RESISTIVITY TESTING FOR SUBSTATION APPLICATION

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