

	Scope of Work	Transmission
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DEVELOPMENT TEAM

This report has been sent to the following for comments and inputs; concurrence with the contents will be assumed if there are no response.

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1. INTRODUCTION

[1] The Arnot Simplon 275kV line is situated in Mpumalanga, it is mostly parallel to the Arnot Maputo line. Tower 201, on the line, was severely affected by soil erosion. Lines Engineering Services (LES) conducted a site visit on the 30 March 2023. During the site visit the following had been identified:

- Severe soil erosion has exposed Leg C of Tower 201.
- The overall area has numerous smaller scours which appear to be propagating from the main scour created, which is resulting in soil erosion.
- The depth of the scour varies along the erosion path becoming progressively deeper downslope (close to Tower 201), then shallowing after Leg C.
- The widest portion of the scour is in between Legs B and C.
- It is assumed that the scour may have been further increased by an anomalous rainfall event occurring.
- No damage to the foundation could be identified.
- The tower steel is intact and does not show any signs of stress/buckling on the bracing and main members.

The intention of this report is to develop a scope of work for the mitigation of soil erosion on the tower.

2. SUPPORTING CLAUSES

2.1 SCOPE

This scope of works outlines details of the technical details.

2.2 APPLICABILITY

Arnot Simplon 275kV – Tower 201

2.3 NORMATIVE/INFORMATIVE REFERENCES

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

2.4 NORMATIVE

- [1] SANS 1200 DK: *“Standardized Specification for Civil Engineering construction Section DK -: Gabions and pitching”*
- [2] SANS 1580: *“Hexagonal steel wire mesh gabions andrevet mattresses”*
- [3] 240-47172520: *“TRMSCAAC6, The Standard for The Construction of Overhead Powerlines”*
- [4] OHS Act and Regulations OHS Act and Regulations (latest revision)
- [5] 32-846: *“Eskom Operating Regulations for High Voltage System (ORHVS)”*

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2.5 INFORMATIVE

[1] None

3. DEFINITIONS AND ABBREVIATIONS

3.1 DEFINITIONS

- Construction work - The erection, maintenance, alteration, renovation, repair, demolition or dismantling of or addition to a building or any similar structure.
- Contractor - Contractor is a person/company responsible to sufficiently and safely conduct the construction work accordingly to applicable standards and legislature, ensuring alignment to technical specifications.
- Gabion - A cage of galvanized steel wire mesh (with or without PVC coating) that is packed with stones and is used in material retaining structures and in various situations to counter erosion.
- Geotextile -Geotextile is a synthetic fabric used for civil engineering construction practises. Geotextile applications can be used for stabilisation of loose materials for erosion prevention.

3.2 ABBREVIATIONS

Term	Definition
LES	Lines Engineering Services
NGL	Natural Ground Level
OHS Act	Occupational Health and Safety Act
PPE	Personal Protective Equipment
SOW	Scope of Work
SANS	South African National Standards

4. ROLES AND RESPONSIBILITIES

The Contractors lead are the following:

- i. provides adequate resources including provision of equipment for required Works;
- ii. manages cost and a scheduled time frame of work;
- iii. ensures the scope is carried out in full;
- iv. provides regular feedback on the status of this phase;
- v. ensures that all site work is conducted by a competent person;
- vi. an authorised individual in terms of the OSH Act is required (ORHVS).
- vii. Contractor to appoint a designer to design erosion systems highlighted below and site supervision during the construction.
- viii. ensures that prior to any fieldwork, all parties working on site familiarized themselves with the Employer's safety requirements and the Occupational Health and Safety (OSH) Regulations

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act (85 of 1993);

5. HEALTH AND SAFETY

The Contractor to submit the following:

- i. Safe Working Procedures (SWP) for all activities
- ii. Ensures that all personnel are familiar with the Employers Health and Safety induction, and PPE requirements before commencement of the Works.
- iii. Ensure that all activities do not contravene with Environmental compliances
- iv. Prevention/mitigation measures of all risks identified on site prior and during the activities.
- v. Emergency procedures
- vi. All assembly areas highlighted during emergencies.
- vii. Designated areas for smoking, eating and toilet facilities highlighted.
- viii. All work will be conducted during live conditions, contractor to ensure all work is done safely. Earthing of plant equipment, adhering to clearances need to be highlighted in the SWP and method statement.
- ix. Covid – 19 safety regulations
- x. Lay down areas and access routes are clearly identified and made secure.

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6. SCOPE OF WORK

This section will outline the scope of work. A conceptual design for the mitigation of erosion is included (Refer to Appendix B) for the contractor as part of the detailed design phase. The Contractor is required to review the conceptual designs contained herein, vet site conditions as necessary and provide a technically implementable and constructible detailed design for the works. The contractor's detailed design pack should be submitted to Eskom, for review and acceptance. Once the detailed design has been reviewed and accepted by the Employer (Eskom - LES), the Contractor will construct the accepted technical detailed designs (as per Eskom approved design). The Contractor also produces the necessary as-built documentations required at the end of construction works. Adequate technical oversight must be allowed for during the construction works by the person/s responsible for the technical detailed design.

6.1 Line Details

The Arnot Simplon 275kV line –

Table 7.1: Summary of Line Details

Line details	
Line name	Arnot Simplon 275kV line
Construction completion year	1976
Line length	88,55km
Voltage	275kV
Structure types	419A 19,35CAH
Conductor	Twin Zebra @ 50 degrees templating temperate
Ground wire	EW : 19/0.104" EW2 19/2.65

6.2 PROJECT SCOPE OF WORK - SOIL EROSION SYSTEMS

The erosion surrounding the Arnot Simplon Tower 201 must be mitigated by:

- I. Removal of loose soils around the foundations
- II. Placement of soil imported backfill
- III. Installation of erosion control systems (Gabions, reno-mattresses etc)

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6.2.1 Removal of loose eroded soil and backfilling procedure

1) Removal of loose eroded soil

- a) Set out positions to ensure adequate cut back of soils,
- b) Excavate for the foundations of the reno mattresses
- c) Excavation is conducted in a stepped manner to prevent sidewall destabilization
- d) Excavation and backfilling is done per tower foundation leg C and B respectively to not further compromise the tower foundation system.

2) Backfilling.

- a) The contractor shall import G4 material to backfill all excavations around the Arnot Siplon Tower 201 foundations Leg C and B.
- b) The material to be utilised for compacted backfill shall be moistened to optimum moisture content (OMC) $\pm 10\%$, and deposited in horizontal layers, having a thickness of not more than 250 mm before being compacted (Mechanically compacted).
- c) Prior to and during compaction operations, the backfill material shall have the optimum moisture content required for the purpose of compaction, impermeability and stability.
- d) The material shall be mechanically compacted to a minimum of 95% MOD AASHTO.

6.2.2 Gabion Installation

The following section covers the construction of the Gabion and stone pitching which will be used for the protection/prevention of erosion around Tower 201. The installation of Gabions will be used in front of legs B and C to retain and prevent the soil between legs of Tower 201 from potential erosion. Gabions shall be constructed in compliance with SANS 1200 DK. The material and specification required for the gabion is detailed below.

i. Material specification for Gabion Installation:

• Stone:

All Rock/Stone that will be used for filling the Gabion baskets will require to be Clean, hard, unweathered, and free from fissures and flaking with density of 2650kg/m^3 . NO stone shall exceed the maximum size given in the table 1 and at least 85% of the stones shall be of equal to or exceeding the minimum size given in table 1 (Stone sizes).

Table 1: Stone sizes

Depth of Gabion cage (m) Up to and including	Stone Size (mm)	
	Minimum	Maximum
0.23	100	120
0.3	100	150
0.5	100	200
1	100	250

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- **Gabion Cage:**

Gabion boxes and mattresses shall comply with the requirements of SABS 1580. Maximum width and length shall not exceed 1 m and 4 m respectively.

- **Steel wire and Galvanising:**

The wire used in the fabrication of the gabions - wire mesh and for lacing (binding) and bracing operations shall be galvanised in accordance with the relevant requirements of SANS 675 for class A heavy galvanised mild-steel wire. The minimum mass per unit area of the zinc coating shall be in accordance with the figures shown in the table 2 (Gabion basket wire size and zinc coating):

Table 2: Gabion basket wire size and zinc coating

Nominal Diameter of wire (mm)	Minimum Mass of Zinc coating per unit area (g/m)
2.00 – 2.20	240
2.21 – 2.40	240
2.41 – 2.50	260
2.51 – 3.50	275
3.51 – 5.00	290

- **Wire mesh:**

Wire mesh shall be hexagonal woven mesh in which the joints are formed by each pair of wires being twisted through three half turns. The tightness of the twists shall be such that a force of not less than 1.7 KN is required for pulling on one wire in order to separate it from the other wire, provided that both wires are prevented from turning and the applied forces and the wire all kept in the same plane.

- **Geotextile:**

A geotextile blanket shall be made of fibres consisting of at least 85% (by mass) of polypropylene, polyethylene, a polyester, a polyamide, or a co-polymer of vinyl chloride and vinylidene-chloride, or any combination of these polymers, and the polymer(s) shall contain such additives as are necessary to render the filaments resistant to the effects of ultraviolet radiation and heat. Bidim (A4) geotextile membrane or similar approved shall be used. The material shall be placed, in accordance with the instructions, in strips with a minimum overlap of 300 mm at the joints and shall be properly fastened to prevent any movement or slipping while the gabions are being placed.

- **Preparation of the foundation and surface for bedding:**

The surface on which the gabion cages are to be laid before they are to be filled with rock shall be levelled as to present an even surface at the depth shown on the drawings or as directed by the engineer. Where required, a foundation trench along the toe off the revetment or wall shall be excavated to the dimensions show on the drawings or indicated by the engineer.

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- **Gabion Assembly:**

The methods of construction, placing, stretching, wiring and filling with rocks shall be done in accordance with the manufacturers specification/instructions which have been approved by the engineer. However, the following need to be ensured and covered during erection and before the start of rock placing:

- Each gabion cage shall be stretched, aligned, and wired to the adjacent cage.
- Wire braces in sufficient number to prevent the deformation of a cage as it is being filled with rock shall be connected between the vertical sides of each of the outer cells of each gabion cage.
- The lower braces shall be tensioned when the gabion cage is not more than one-third full and the upper braces when it is not more than two thirds full.
- The corners of adjacent gabion cages shall be securely wired together to provide a uniform surface. Where practicable, consecutive courses of gabion cages shall be staggered, like brickwork to avoid the coincidence of vertical joints.

- **Rock Filling:**

Care shall be exercised in filling against the faces of gabion boxes that will be exposed to view in the finished structure. Rock particles of sizes described above(Ref: Table 1) shall be so packed as to obtain a fair-faced finish. Successive gabion boxes shall be filled in stages to prevent deformation and bulging. The rock shall be filled to just below the level of the wire braces and the braces shall then be twisted, windlass-style, to provide tension, after which the filling shall be completed, the boxes being slightly overfilled to provide for settlement. Care shall be taken to ensure that the lids of each course of gabion boxes are closed and laced before the next successive course of gabion boxes is placed, and that each box is filled evenly to a level surface ready to receive the next course of boxes.

- **Final wiring of cage:**

The closing and wiring-down of lids shall proceed as soon as is practicable after the filling operations. Lids shall be stretched tightly over the filling and wired down securely through each mesh along all edges, ends and diaphragms. The ends of all tying and bracing wires shall be turned into the gabion box or mattress on completion of the lacing operations.

- **Backfilling:**

The Contractor shall backfill each excavation with stabilised G4. The material to be utilised for compacted backfill shall be moistened to optimum moisture content (OMC) $\pm 10\%$, and deposited in horizontal layers, having a thickness of not more than 300 mm before being compacted. The backfill material to be compacted shall contain no stones more than 150 mm in diameter, and be free from organic material such as trees, brush, scraps, etc. The material shall be mechanically compacted to a minimum of 95% MOD AASHTO. Backfilling to trenches shall be placed in layers of thickness not exceeding 150 mm.

7. DESIGN AND CONSTRUCTABILITY

It is the duty of the contractor to mitigate all the risks identified and execute the work safely according to the standards and specifications. The Contractor will submit the detail design for review to LES (Hold point).

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7.1 DESIGN

All designs need to be thoroughly checked and signed off by the Contractors Professional engineer prior to submitting to LES for review and implementation has final designs for construction. The contractor will need to finalise the detail design and issue as built drawings once the highlighted scope of work has been completed.

7.2 CONSTRUCTION EARTHING

It is the responsibility of the contractor to make sure that all the machinery and equipment being used are earthed at all times. An authorised ORHVS person shall be full time on site. It will be necessary to use equipotential plates in some instances. All work will be done under live conditions. All earthing work shall be done in accordance to Annex C in the latest version of TRMSCAAC 6. A safe working procedure to be submitted to LES, for acceptance, prior to any site activity.

7.3 GROUND STABILITY

Access to Tower 201 needs to be clearly marked and identified prior to the work being conducted. The work will be carried out on sloping terrain the contractor to ensure all machinery are correctly positioned for the work to be carried out. Prior to commencement of work the contractor shall visit the site to identify access routes and machinery limitations.

7.4 RISKS

The following risks have been identified:

- Powerlines are live.
- Uneven terrain
- Flooding in rainy season
- Tower stabilisation should be considered depending on the construction on the remedial designs.

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APPENDIX A: Bill of Materials

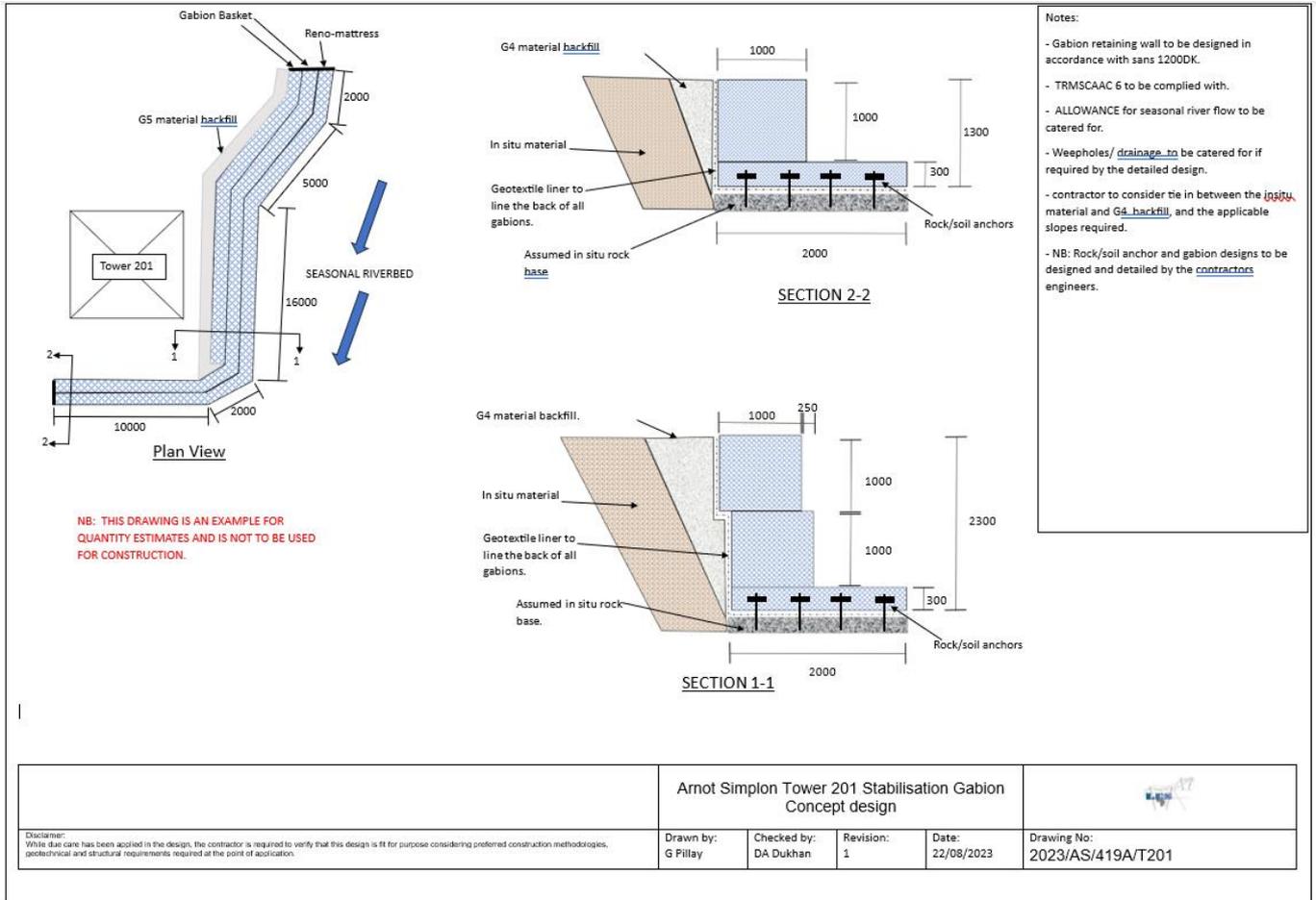
The following materials are re-measurable to suit the slope on site. These are preliminary estimates and will be developed to better accuracy in detailed design by the Contractors appointed professional engineer.

Gabion Wall		Unit
Gabion Stones	83	m ³
Gabion baskets (2 m x 1m x 1m)	18	no
Gabion baskets (2m x 1m x 1m)	13	no
Reno mattress (2m x 1m x 0.3m)	35	no
Filter Fabric m wide Geo Textile	105	m ²
G4 import backfill and compact to 95% ModAashto	70	m ³
Rock anchors installed	40	no

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APPENDIX B: GABION CONCEPT DESIGN



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