	Report	Transmission
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Title: **Duvha – Kusile (400kV)
Tower 55 and Kusile –
Minerva (400kV) Tower 28
Refurbishment**

Unique Identifier: **240-68108065**

Alternative Reference Number:

Area of Applicability: **Engineering**

Documentation Type: **Report**

Revision: **1**

Total Pages: **9**

Next Review Date: **N/A**

Disclosure Classification: **CONTROLLED
DISCLOSURE**

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1. INTRODUCTION

Lines Engineering Services went to visit the Duvha - Kusile 400 kV tower 55 and Kusile - Minerva 400 kV tower 28 after the North East grid made us aware of the possibility of the foundations being compromised due to erosion and unauthorized excavation around the towers. Upon arriving on site, it was evident that there has been digging around tower 55, and for tower 28 the foundation caps were breaking off due to soil erosion. The aim of this report is to provide the solution for the repairs of Duvha – Kusile tower 55 and Kusile - Minerva tower 28.

1.1 References

- TRMSCAAC1 Rev 5.2 - Transmission Line Towers and Line Construction
- SANS 1200 DM - Earthworks (roads, subgrade)
- SANS 1200 C - Site Clearance

2. DUVHA – KUSILE 400KV LINE: TOWER 55

Upon arriving on site, the team noticed the excavations next to the foundations as shown on figure 1. The excavations looked neat and professional, however the grid was not aware of any tests performed on the tower. Furthermore there was no barricading around the foundations which posed a safety hazard. The grid was instructed to backfill and compact the excavations in layers of 300mm soil to a compactive effort of 93% ModAshto.



Figure 1: Digging next to the foundation

3. KUSILE – MINERVA 400KV TOWER 28

This tower is next to a stream and the water has caused erosion around the tower. The bottom of the foundations has been exposed as shown in figure 2 and the concrete has major cracks. It seems there was previous work done on the foundation but the concrete is badly cracked and falling apart seen in figures 3 & 4. Since the tower is not always submerged in water the solution will look at encasing the tower legs with concrete to protect them from corroding. The repair steps for this tower are listed below.



Figure 2: Soil erosion under the foundation



Figure 3: Broken foundation cap



Figure 4: The interaction between the new and old concrete

3.1 Dewatering (If necessary)

- Removal of water and exposing the soil around the tower footprint.
- The low water level must be maintained a minimum of two weeks to allow the area around the tower foundations to dry.

3.2 Preparing ground surface

- After dewatering the site, 10MPa blinding layer should be placed on ground to create a solid platform to work on. The blinding layer will be placed around every tower leg.

3.3 Breaking of the existing tower foundation cap

- The concrete cap will then be broken using hand tools or a hand held jack hammer. Care should be taken to make sure that the steel members are not damaged during the process.
- In a case where the concrete cap will not be totally removed it will have to be scabbled to a depth of 25mm to prepare for the bonding with the new concrete cap.
- The bonding between the existing concrete and the new concrete is of vital importance to prevent water (moisture) to penetrate and reach the steel. A cement slurry should be poured on the scabbled area and immediately cast the new concrete. The new concrete must be cast to a watershed and properly cured as per TRMSCAAC 5.2 requirements.

3.4 Excavations


- Excavate in soft material, exceeding 500mm deep but not exceeding 1000mm deep. An excavation of about 1000mm x1000mm and 500mm around each tower leg will be required to expose the existing concrete cap.

3.5 Cleaning of the tower leg members and stub

- The tower members have to be cleaned to prepare for the application of a protective coat. A steel brush will be used to clean the rust on the members and cleaned with potable water and left to dry prior to application of paint. A simple adhesive tape test can be conducted to ensure that the surfaces are dry and there is no flakes or rust particles adhering to the tape in order to apply the paint coatings

3.6 Painting of the tower leg members and stub

- When the tower cleaning is complete, two coats of bitumen protective coating (Ravenol or similar approved) shall be applied on the tower members. The stubs are to be painted from exposed surfaces up to 500mm above final concrete level. The concrete cap is to be painted at least 150mm all around the stub-to-concrete interface.

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3.7 Formwork

- Formwork should be prepared before casting of concrete for all four legs of the tower. All concrete placed against shuttering shall be free from irregularities, fins, rock pockets or other imperfections. Ensure that for caps there is a watershed.

3.8 Casting of the concrete block

- A concrete mix design must be submitted to Lines Engineering Services before casting.
- Before casting the new concrete block, apply the cement slurry. A minimum 25MPa concrete block (triangular prism shape) will be cast. The size of the block will be 1000mm by 1000mm with a height of 1000mm.
- For moderate to severe conditions the mix design shall comply with SANS10100-2 where the minimum cement content shall be 340 kg/m³ CEM II or CEM I cement with extenders.

3.9 Concrete cube test

- Four concrete cubes should be prepared per concrete truck/batch to confirm the concrete strength. One concrete cube will be tested at 7 days and three cubes at 28 days.

3.10 Concrete curing & wood floating

- Concrete will be cured using an approved curing compound
- The top surface of the new concrete encasement shall have a wood float finish, and shall be contoured to allow water to shed. There should be a difference of 50mm from the highest to the lowest point of the cap surface to ensure adequate watershed.


3.11 Backfill

- After completion of foundation construction, the Contractor shall backfill and compact each excavation with suitable engineering material such as G7 or better with backfill and compaction as per TRMSCAAC 5.2 requirements in layers as per next point and to a minimum compactive effort of 93% Mod Aashto.
- The material to be utilised for compacted backfill shall be moistened to OMC (optimum moisture content +10%), and deposited in horizontal layers, having a thickness of not more than 300 mm before being compacted

4. BILL OF MATERIALS

The bill of material is only for tower 28 of the Kusile – Minerva 400kV line.

	Activity	Quantity	
1.00	De-watering		
	Installation of rough formwork including removal (double area of excavation of concrete cap, 2.0x2.0m for each tower leg)	16.00	m ²
	Pumping out of water (for fully submerged tower legs up to 500mm, 2.0x2.0x2.0m)	32.00	m ³
	Placement of blinding layer (50mm depth over surface area of excavation, 0.05x2.0x2.0m)	0.80	m ³
2.00	Excavation for Foundation		
	Excavation of concrete cap (1.0x1.0x0.5m for each tower leg)	2.00	m ³
3.00	Cleaning of tower legs and bitumen coating (2 coats)		
	Steel brush the rusted members (0.1m ² per leg)	2.00	m ²
	Breaking of the cracked concrete		
4.00	Casting and bitumen coating (2 coats) of the unreinforced concrete cap		
	Casting of a 1X1X1m concrete cap around the tower leg	4	m ³
	Concrete cube tests	4	Samples
5.00	Backfilling		
	Imported backfill (G7 or better)	3	m ³

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5. CONCLUSION

Duvha – Kusile 400 kV tower 55 will be refurbished by backfilling the excavated material. The solution for Kusile – Minerva 400kV tower 28 Refurbishment is summarized below:

1. Dewatering if necessary
2. Preparing ground surface
3. Breaking of the existing tower foundation cap
4. Excavations around each tower leg
5. Cleaning of the tower leg members and stub
6. Painting of the tower leg members and stub
7. Installing of formwork
8. Casting of the concrete block
9. Concrete cube testing
10. Concrete curing and wood floating