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DOCUMENT NUMBER	ISSUE	SYSTEM
W8377/21	1.0	Gordonia-Avondale 132kV Transmission Line
SUBJECT		
Electromagnetic Interference Risk Assessment between the Avondale 132kV Transmission Line and SKA.		
KEYWORDS		
132kV Transmission line, SKA,	mitigation, interference	
DISTRIBUTION		
Zutari (Pty) Ltd		
SUMMARY The study area is located outside of the declared Karoo Central Astronomy Advantage Area, promulgated in terms of the Astronomy Geographic Advantage Act, Act No. 21 of 2007. Due to the 200km separation distance between the Gordonia-Avondale 132kV Transmission Line area and SKA infrastructure, this infrastructure would pose a very low risk to the SKA operations and no special design techniques, or additional mitigation measures would be required.		
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1. BACKGROUND

The Karoo area is host to the Department of Science and Technology's SKA radio telescope project. Due to the sensitivity of the telescope receivers, there is a risk that unintentional emissions from electrical and electronic systems will desensitise the SKA receivers resulting in interference to celestial observations and/or data loss. Such interference is typically referred to as 'Electromagnetic Interference (EMI).

2. DEFINITIONS

electrical equipment	means any electrical machinery, electrical systems, appliances or devices, including any wireless data communication used for the operation of these facilities, used for construction, distribution and transmission power systems, exploration, farming, household, manufacturing, maintenance, or mining purposes
electrical infrastructure	means any infrastructure or facility, including any wireless data communication used for the operation of the electrical infrastructure, to be used in any way for electricity generation, electricity distribution, electricity transmission, or for a distribution or transmission power system, and electrical facilities and equipment used for these applications
Existing electrical equipment and infrastructure	Means electrical equipment and infrastructure that is in operation or in use or where construction on site has started, prior to the date on which these regulations are promulgated by publication in the Government Gazette (15 December 2017)

Table 1: Definitions

3. AIM

The aim of this document is to provide supporting information in lieu of a detailed risk assessment due to the 199km separation distance between the transmission line and the SKA infrastructure.

4. REFERENCED AND APPLICABLE DOCUMENTS

(Very) Short Note on Separation Distances from Power Infrastructure – A Tiplady December 2014
Radio Interference between the Solar 400 kV Transmission Line and the SKA - EMC and EMI Eskom supported Study N.R100017.R.01.009 by KR Hubbard

5. LOCATION



Figure 1: Area map showing the Avondale Transmission line location relative to SKA



Figure 2: Local map with Upington International airport as reference



Figure 3: Elevation Profile between the transmission line and SKA buffer zone

6. TECHNICAL CONSIDERATIONS

6.1 POTENTIAL NOISE SOURCES

In a high voltage environment, the radio frequency interference sources are generally sparking and arcing related. Corona from the lines are generally not associated with high frequency (above 30MHz) interference. Gap-type corona interference can extend to beyond 1GHz.

- Corona discharge at the surface of the conductors, insulators and fittings;
- Sparking at the insulators;
- Sparking at mounting hardware and contacts;
- Micro arcing.

Weather conditions has a 10 to 20 dB impact on the noise source with corona being worst during wet weather conditions and sparking/ arcing being worst during dry weather conditions.

6.2 CORONA DISCHARGE

Corona discharge occurs when the electrical field close to a conductor is higher than the electrical withstand capability of the air, resulting in an electrical break down. The breakdown occurs at a local level, hence no flash over will occur. The discharge energy will be fairly low and the frequency band of concern is also low.

Any equipment, fittings and insulators energised to high voltage may generate corona.

Corona is a normal effect and is worst during wet weather conditions.

6.3 SPARKING

Sparking occurs when there is sufficient voltage (> withstand capability of air) to cause electrical breakdown of the air between two metallic objects (avalanche ionisation) and the development of an arc. At least one of the metallic components is electrically floating. This is not necessarily a single event as the components can be charged again after the discharge. The discharge energy is much higher than for corona and the frequency range extends into the GHz domain.

Sparking (gap discharge) is mostly associated with bad contacts and inferior installation practises.

Sparking is worst during dry weather conditions.

6.4 ARCING

Arcing is when ionised air forms a conductive current path between an earthed component and component at line potential. Arcing is associated with a fault condition, of short duration and the arc will normally be interrupted by the protection circuits.

6.5 SWITCHING EVENTS

Switching events such as capacitor bank switching will cause voltage and current transients with frequency components into the GHz band due to steep dV/dt and dI/dt gradients.

7. PATH LOSS CALCULATION



Figure 4: Path loss calculation @ 300MHz

The total path loss calculation (free space loss of 128dB and terrain loss of 60.2dB) shows a signal reduction of 191.5dB due to the 200km separation distance and terrain profile.

8. MITIGATION REQUIREMENTS

Based on the study supported by Eskom under the research programme: EMC and EMI (N.R100017.R.01.009 [2] with inputs from SKA, a 132kV transmission line will achieve SARAS limit compliance (-245 dBW/Hz) for separation distances >8km (wet conditions).

The 8km separation distance is confirmed by the separation distances adopted by the SPDO [1].

As a result of the 199km separation distance between the Gordonia-Avondale 132kV Transmission Line and the SKA infrastructure no mitigation measures would be required.

9. CONCLUSION

The study area is located outside of the declared Karoo Central Astronomy Advantage Area, promulgated in terms of the Astronomy Geographic Advantage Act, Act No. 21 of 2007.

The 200km separation distance and resultant total path loss of 191.5dB at 300MHz results in a very low risk of interference between the Gordonia-Avondale 132kV Transmission Line and the SKA infrastructure.

No special design techniques or additional mitigation measures would be required.

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