KUDU INTEGRATION PROJECT FOR TRANSMISSION POWER-LINES AND SUBSTATIONS

AIR POLLUTION EFFECT ON POWER LINES SCOPING REPORT

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Table of Contents page

1 INTRODUCTION ... 1

1.1 Terms of Reference of the Air Pollution Scoping Report ... 1

2 AIR POLLUTION AND POWER LINES ... 1

2.1 Assessment Methodology ... 2

3 Proposed and Preferred Alignment for the Power Line ... 4

3.1 Route Alternatives ... 4

3.2 Preferred Alternative ... 5

REFERENCES ...

APPENDIX A ...

A.1 Maps ... A-1

List of Tables page

Table 2.1-1. Types and Sources of Air Pollution ... 3

Table 3.2-1. Power line Route Comparisons ... 5

1 INTRODUCTION

ESKOM is planning the construction of a 400 kV transmission power line for the provision of bulk power supply from the Kudu Combined Cycle Gas Turbine (CCGT) power station in Namibia to the Western Cape. This power station will supply power both to the Eskom and NamPower grids.

The power line is approximately 390 km long, extending from the Namibian border and Oranjemond substation in the Northern Cape to Juno substation near Vredendal in the Western Cape. Five alternatives have been identified for the possible routes of the lines.

Eskom suggested a number of possible integration options of which one has been identified as being technically the most feasible. Within this integration option, five alternative routes for the corridor of the transmission power line have been identified. These alternative alignments (Routes A-E) run through or skirt around the Namaqua National Park, extending the study area to the east and west. These various options are described in detail in the final Scoping Report and can be seen in Figure A-1 in Appendix A.

Demos Dracoulides and Associates (DDA) was appointed by P.D. Naidoo & Associates (PDNA) in association with Strategic Environmental Focus (SEF), in order to address major issues and constraints with regard to the air pollution effects on the power line insulators along the different alternative routes.

1.1 Terms of Reference of the Air Pollution Scoping Report

The Terms of Reference for this Scoping Report are:

1. Undertake a desktop study of known air pollution sites along the proposed corridor routes.
2. Assess these known sites in terms of their impact on the power line infrastructure.
3. Provide recommendations regarding the preferred alternative.

2 AIR POLLUTION AND POWER LINES

Air pollution is a major criteria for the design of transmission line insulators. Pollution has a negative effect on the insulation system of power lines and substations, which could in the shutdown of the power line. At present, there is no data available regarding the pollution level in the various regions.

Pollution falling on the insulators produces a conductive film on the surface which causes the surface leakage current to increase, eventually resulting in flashover / local arcing on insulators.

Flashovers occur mainly on transmission lines when, in combination with condensation, light rain or fog, ash or dust build-up cause arcing across insulators and dips and spikes in power supplies. This weakens the insulators, and repeated arcing can cause the shutdown of the power line.

Fires can also impact the insulators of power lines due to the generated ash particles. When these particles are combined with high humidity under foggy conditions, they form a "conductive fog" that can cause transmission network trips.

This "conductive fog" is instantaneous and not predictable. Some of the glass insulators used in substations and power lines are not able to withstand this phenomenon, thus causing widespread flashovers, which initiate tripping of lines and plant.

The sea-breeze circulations that can generate a "conductive fog" or heavy pollution on power lines have a typical extension of 20 km. Similar effects are observed with wind systems near heated mountains and in large-scale convective systems.

To avoid these problems, it is necessary to perform pollution measurements to assess whether pollution deposits are within or beyond limits.

Generally, the practice being adopted is to try and locate power line routes in low or medium pollution areas, and avoid the power line traversing an area near the coastal belts, industrial belts etc.

There are several remedial measures that can be implemented in order to overcome problems due to pollution. These may be a combination of:

- Manual cleaning of insulators.
- Washing the insulator on a regular basis to prevent build-up of pollutants.
- Corn blasting (dry cleaning).
- Use of bird guards.
- Application of silicon grease.
- Use of RTV silicon rubber coating.
- Use of semi-conducting glazed insulators
- Providing creepage extenders.

2.1 Assessment Methodology

The route alignment assessment will take into consideration the:

1. Types and source of pollution along the route.
2. Distance of the power line from the different types and sources of pollution.
3. Approximate length of power line estimated to be affected by each type of pollution.

4. Any other information related to pollution, which may affect performance of the line.

The types of pollution for consideration are presented in the following table.

Table 2.1-1. Types and Sources of Air Pollution

Type of Pollution	**Source of Pollution**
Salt	Coastal areas Salt industries/farms
Cement	Cement plant Construction sites Rock quarries
Dust	
Earth	Ploughed fields Earth moving on construction projects
Fertilizers	Fertiliser plants Frequent use of fertilizers in cultivated fields
Metal	Mining handling processes Mineral handling processes
Coal	Coal mining Coal handling plants/thermal plants Coal burning/brick kiln areas
Feedlot	Earth dust stirred by animals in large feedlots
Bird Defecation	Roosts of birds areas
Chemical	Wide variety of chemical / process industries, oil refineries etc.
Smog	Automobile emissions at highway crossings Diesel engine emissions at railway crossings / yards
Cooling tower effluents	Thermal power plants Other cooling towers
Smoke	Wild fires Industrial or agriculture burning

3 Proposed and Preferred Alignment for the Power Line

Based on engineering analyses and consultation with stakeholders and interested and affected parties a proposed alignment has been determined. With this alignment, the northern section of the line will fall within the existing 220kV servitude from the Oranjemond substation to the Gromis substation in the vicinity of Kleinzee. From there, five different alternative routes have been proposed. These can be seen on the locality map in APPENDIX A. They are designated Alternative Routes A to E.

3.1 Route Alternatives

A: Direct

This option will involve an approximately straight line with a minimum number of turns from Gromis to Juno substations, crossing the Namaqua National Park.

B: West

The line will deviate to the west of the existing borders of the Namaqua National Park, but will traverse the proposed westward expansion of the park at the narrowest point, following the Hondeklipbaai Road. South of the park, the transmission power line will follow the Nuwerus-Lutzville Road to Juno.

C: N7

The line will follow the existing 220kV servitude between Gromis and Nama substations. At the southernmost point of this servitude, it will deviate to the east and follow the National Route 7 (N7) around the Namaqua National Park, all the way to Juno.

D: Boesmanland

The line will follow the existing 220kV servitude between Gromis and Nama substations, and cross over the mountains east of Springbok. From there the line will run through Boesmanland, turning west to cross the Hardeveld to Juno.

E: Combined B & A

As proposed during the authority meeting of 5 May 2006, the route Alternative B has been amended to follow a section of route Alternative A. From Gromis, the line will run to the west of the Namaqua National Park. From the Spoeg River, the line will deviate to the east and follow the first alternative. In the vicinity of the Groot Goerap River, the line will deviate to the west of Alternative A and follow the same route as Alternative B to Juno.

3.2 Preferred Alternative

The comparison of the power lines in terms of the potential to be affected by air pollution is presented in the following Table 3.2-1.

Table 3.2-1. Power line Route Comparisons

Alternatives	Recommendations	Preference
Alternative A	**Recommended,** since it avoids coastal areas, as well as areas with mine and quarry activities and industrial zones.	1
Alternative B	**Not recommended,** since it approaches the shoreline within 7 and 14 km.	4
Alternative C	**Recommended,** since it avoids coastal areas, as well as areas with mine and quarry activities and industrial zones. Maintenance of power lines could be an issue.	3
Alternative D	**Recommended,** since it avoids coastal areas, as well as areas with mine and quarry activities and industrial zones. Maintenance of power lines could be an issue but less than Alternative C.	2
Alternative E	**Not recommended,** since it approaches the shoreline as close as 3 km at Koingnaas and Hondeklipbaai. The route at Koingnaas and Hondeklipbaai also passes within less than 1 km distance from dust pollution areas such as mines and quarries.	5

The selection of the insulators used, particularly for areas with high potential for air pollution contamination is critical to minimise shutdowns.

The best method for obtaining data in order to establish a successful cleaning and maintenance programme for insulators is via on-site tests along the route(s). Several test methods for insulator performance have shown that different types of insulators have different resistance to air pollution conditions. Therefore, the types of insulators selected for areas with increased pollution levels can reduce the potential for shutdowns.

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APPENDIX A

A.1 Maps

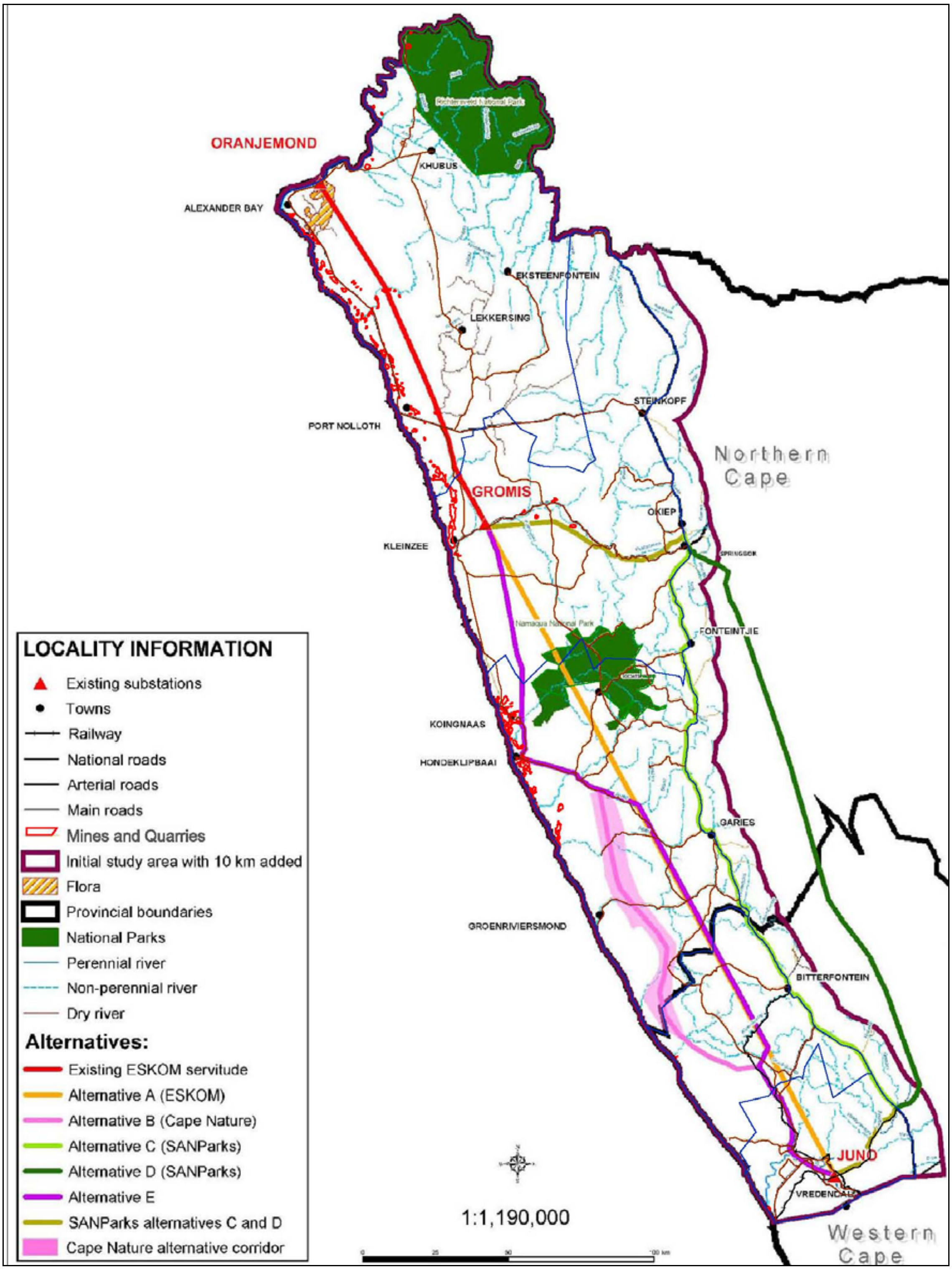

Figure A-1. Power Line Proposed Alignments