3. TECHNICAL DETAILS OF THE PROPOSED PROJECT

3.1 Transmission Lines

As electricity cannot be stored, power is generated and delivered over long distances at the very instance that it is needed. In South Africa, thousands of kilometres of high voltage Transmission lines (i.e. 765 kV, 400 kV or 275 kV Transmission lines) transmit electricity, which is mainly generated at the power stations located within the Mpumalanga Province coal fields, to Eskom's major substations. At these major substations, the voltage is reduced, and the electricity is distributed to smaller substations all over the country through sub-transmission lines (i.e. 132 kV, 88 kV or 66 kV Distribution lines). At the smaller substations the voltage is further reduced and the power is distributed to local users via numerous small power lines (i.e. 22 kV and 11 kV lines) referred to as Reticulation lines. The power generated by Eskom can only be utilised from those points of supply which transform the power into a usable voltage.

3.2 Technical Details of the Tower and Transmission line Design

3.2.1 Towers

Transmission line conductors are strung on in-line suspension towers and bend (strain) towers. The structures proposed to be used for the majority of the 765 kV Transmission line are the 765 kV cross-rope suspension structures (refer Figure 2.1, Chapter 2). These towers are approximately 50 m in height and a total footprint area of 80 m x 50 m is required for each tower. The average span between two towers is 400 m.

The cross-rope suspension tower is typically used along the straight section of the servitude, while the self-supporting angle towers (Figure 2.3, Chapter 2) and in-line strain towers are used where there is a bend in the powerline alignment. Angle towers are cumbersome and more steel-intensive than suspension towers, making them more visually intrusive and expensive to construct. Therefore, Transmission line routes are planned with as few bends as possible.

3.2.2 *Servitude Requirements and Clearances*

The servitude width for a 765 kV Transmission line is 80 m. The servitude is required to ensure the safe construction, maintenance and operation of the line, and thereby entitles Eskom Transmission Division certain rights (e.g. unrestricted access).

Where 765 kV Transmission power lines are constructed in parallel, a minimum separation distance of 60 m is required in order to ensure the reliable operation of

both lines. The minimum vertical clearance to buildings, poles and structures not forming part of the powerline must be 10,4 m, while the minimum vertical clearance between the conductors and the ground is 15,0 m. Any farming activities can be practised under the powerline, providing that safe working clearances and building restrictions are adhered to under all circumstances.

The minimum distance of a 765 kV Transmission line structure from a proclaimed public roads is between 60 and 120 m (according to the road type), from the centre of the structure to the centre of the road servitude. The minimum distance between any part of a tree or shrub and any bare phase conductor of a 765 kV Transmission line must be 10,0 m.

Since the final corridor for the proposed 765 kV Hydra Gamma 1 Transmission line has already been approved by the environmental authorities and the additional 80m servitude was negotiated with the affected owners during the previous EIA phase, the final definition of the centre line for the Transmission line and co-ordinates of each bend in the line will be determined by the surveyors. Optimal tower sizes and positions will be identified and verified using a ground survey (in terms of the Environmental Management Plan (EMP) requirements).

A 4-8 m wide strip is generally required to be cleared of all trees and shrubs down the centre of Transmission line servitudes, for stringing purposes only. Any tree or shrub in other areas which will interfere with the operation and/or reliability of the Transmission line must be trimmed or completely cleared. Vegetation clearance for the proposed Hydra-Gamma 765 kV Transmission line will be minimal due to the characteristic low-growing plant species within the study area. The clearing of vegetation will take place, with the aid of a surveyor and botanist specialist, along approved profiles and in accordance with an approved EMP, and in accordance with the minimum standards to be used for vegetation clearing for the construction of the proposed new Transmission line as listed in Table 3.1 (Eskom, 2000) and included within the vegetation guidelines included in Appendix B.

Examples of vegetation clearing are represented in Figures 3.1 and 3.2 below:

Figure 3.1: Example of Bushclearing around a Transmission line tower

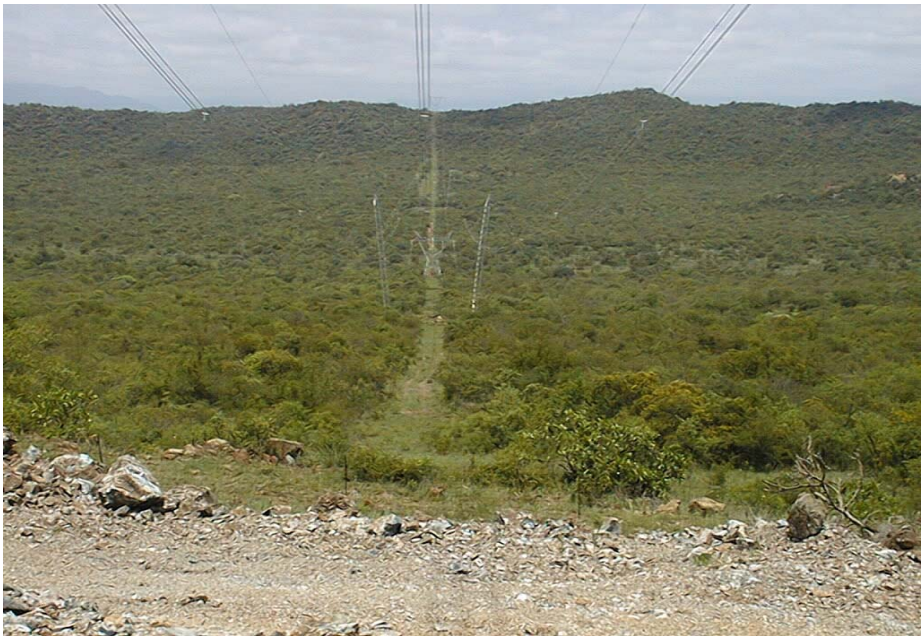

Figure 3.2: Example of vegetation clearing within the servitude

Table 3.1: Minimum standards to be used for vegetation clearing for the construction of a new Transmission line

Item	Standard	Follow up
Centre line of the proposed Transmission line	Clear to a maximum (depending on tower type and voltage) of a 4-8m wide strip of all vegetation along the centre line. Vegetation to be cut flush with the ground. Treat stumps with herbicide.	Re-growth shall be cut within 100 mm of the ground and treated with herbicide, as necessary.
Inaccessible	Clear a 1 m strip for access by foot only,	Vegetation not to be

Item	Standard	Follow up
valleys (trace line)	for the pulling of a pilot wire by hand.	disturbed after initial clearing – vegetation to be allowed to re-grow.
Access/service roads	Clear a maximum (depending on tower type) 6 m wide strip for vehicle access within the maximum 8 m width, including de-stumping/cutting stumps to ground level, treating with a herbicide and re-compaction of soil.	Re-growth to be cut at ground level and treated with herbicide as necessary.
Proposed tower position and proposed support/stay wire position	Clear all vegetation within proposed tower position in an area of 20 x 20 m (self-supporting towers) and 40 x 40 m (compact cross-rope suspension towers) around the position, including de-stumping/cutting stumps to ground level, treating with a herbicide and re-compaction of soil. Allow controlled agricultural practices, where feasible.	Re-growth to be cut at ground level and treated with herbicide as necessary.
Indigenous vegetation within servitude area (outside of maximum 8 m strip)	Area outside of the maximum 8 m strip and within the servitude area, selective trimming or cutting down of those identified plants posing a threat to the integrity of the proposed sub-transmission line.	Selective trimming
Alien species within servitude area (outside of maximum 8 m strip)	Area outside of the maximum 8 m strip and within the servitude area, remove all vegetation within servitude area and treat with appropriate herbicide.	Cut and treat with appropriate herbicide.

Once the centre line has been cleared, the contractor's surveyor will peg every tower position and marks the crossing point with existing fences for new gate installation. Where required, once the tower positions have been marked, the vegetation clearing team will return to every tower position and clear vegetation, in accordance with the specifications outlined in the Environmental Management Plan (EMP) as well as associated Eskom vegetation management guidelines to be adhered during construction activities (Refer to Appendix B).

3.2.3 Foundations

The choice of foundation is influenced by the type of terrain encountered, as well as the underlying geotechnical conditions. The actual size and type of foundation to be installed will depend on the soil bearing capacity (actual sub-soil conditions). Strain structures require more extensive foundations for support than in-line suspension structures, which contributes to the cost of the

construction of the line. The footprint area required for the construction of the foundation for the powerline is 1,5 m x 1,5 m. The minimum working area required around a structure position is 20 m × 20 m for self-supporting towers and 40 x 40 m for compact cross-rope suspension towers.

Foundations may be mechanically excavated where access to the tower position is readily available. The same usually applies to the pouring of concrete required for the setting of the foundations. Prior to erecting the towers and filling of the foundations, the excavated foundations are protected in order to safe-guard unsuspecting animals and people from injury. All foundations are back-filled, stabilised through compaction, and capped with concrete at ground level. Construction activities associated with foundations are represented in Figures 3.3 and 3.4 below.

Figure 3.3: Tower foundation construction

Figure 3.4: Example of a tower foundation

3.2.4 Stringing of Conductors

A pilot cable is used to string the conductors between towers. This can be undertaken mechanically or by hand. The line is generally strung in sections (from bend to bend). Cable drums are placed at 5 km intervals (depending on the length of the conductor) during this stringing process. In order to minimise any potential negative impacts on the surrounding area, these cable drums should be placed within the servitude.

Figure 3.5: Mechanical stringing of the conductors

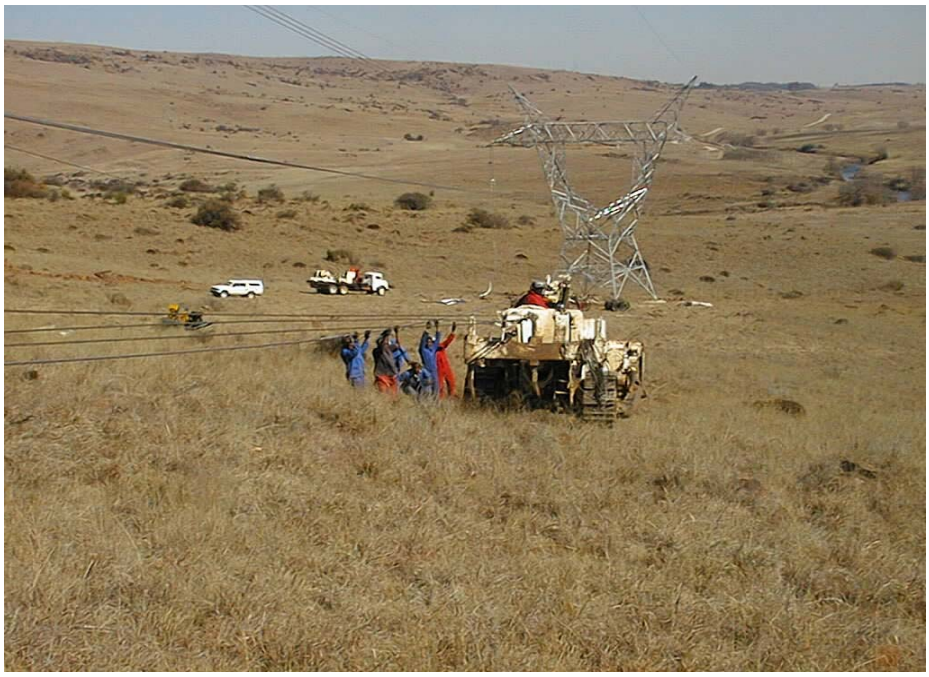

Figure 3.6: Mechanical stringing of the conductors

3.2.5 Access

A vehicle access road is usually required to be established to allow access along the entire length of the servitude. Access is required during both the construction and operation/maintenance phases of both the Transmission line and substation life-cycle. Any new access roads required will be established during the construction phase and are more established by vehicle passage than by grading or blading. The need for an access road for the Hydra Gamma 2 Transmission is low as an access road was considered as part of the scope for the Hydra Gamma 1 power line. This access road will double as the access road for the Hydra Gamma 2 line.

The existing access road into Hydra Substation will have to be re-aligned approximately 250 m west to accommodate the substation extension to the west. This access road will be approximately 1.5 km in length, extending off the N10 National Road.

In order to reduce potential impacts associated with the construction of new access roads, existing roads will be used as far as possible where available and new access roads will be constructed by means of 'two-tracks' over the vegetation where possible to avoid permanent removal of the existing vegetation. All access points and roads will be negotiated with landowners, and are to be established during the construction phase.

3.2.6 Construction Camps

This construction of the powerline will require the establishment of a construction camp/s at an appropriate location along the route. The construction camp is estimated to be required to house up to 300 people. The exact siting of this construction camp is required to be negotiated with the relevant landowner, and must take cognisance of any no-go and sensitive areas identified through the EIA process as well as the site-specific Environmental Management Plan (EMP). Figure 3.7 represents a typical construction camp.

Figure 3.7: Typical construction camp

3.2.7 *Timing*

In most cases, the construction will begin at one end and progress towards the other. Construction of the proposed extension of the Hydra Substation and the proposed new Transmission line will be undertaken over a period of approximately 24 months, provided construction proceeds as scheduled. It is proposed that Eskom will commence with construction in May 2007.

3.2.8 Ongoing Maintenance

During the life-span of the Transmission line, ongoing maintenance is performed. Line inspections are undertaken on an average of 1 – 2 times per year, depending on the area. During this maintenance period, the line is accessed via the access routes established during the construction phase. Maintenance is required to be undertaken in accordance with the specifications of the EMP.

3.2.9 Construction Process for Transmission lines

Transmission lines are constructed in the following simplified sequence:

Step 1: Determination of technically feasible alternative corridors
Step 2: EIA input into route selection and authority authorisation of the final route selected
Step 3: Negotiation of final route with affected landowners
Step 4: Aerial survey of the route
Step 5: Selection of best-suited structures and foundations
Step 6: Final design of line and placement of towers
Step 7: Compilation of site-specific EMP – Specialist walk-down
Step 8: Vegetation clearance and gate erection
Step 9: Issuing of tenders, and award of contract to construction companies
Step 10: Establishment of construction camp, pegging of structures, and construction of access roads (where required)
Step 11: Construction of foundations
Step 12: Assembly and erection of structures
Step 13: Stringing of conductors
Step 14: Rehabilitation of disturbed area and protection of erosion sensitive areas
Step 15: Testing and commissioning
Step 16: Continued maintenance

3.3 Technical Details regarding the Substation

3.3.1 Proposed extension of the Hydra Substation

The main aspects of the proposed substation include:

- The Hydra Substation is located on the farm Hydra No 144, approximately 5 km east of De Aar. The proposed extension will take place 200m adjacent to the existing yard.
- The proposed extension of the Hydra Substation would be approximately 250m x 200m in size.
- Installation of new equipment (transformers, reactors, etc.) for operation up to 765 kV capacity. This equipment will not contain hazardous substances (PCBs, etc.), but will contain cooling oils and similar potential pollutants necessary for the operation of the equipment. The equipment will be designed according to Eskom specifications.
- The terminal towers will be higher than the actual substation steelwork, approximately 50m high.

- Access road relocated approximately 250 m west such that the substation extension can be accessed.
- Access to the site is typically via a tar road from the N10, once past Hydra at the railway line this becomes a dirt road. The proposed extension of the Hydra Substation is 2km from the N10. After construction, traffic on this road due to substation activities will be low.
- Construction is anticipated to begin in May 2007 and is estimated to continue for approximately 24 months.

3.3.2 Construction Process

The proposed extension of the Hydra Substation would be constructed in the following simplified sequence:

Step 1: Survey of the site
Step 2: Update Generic EMP to site-specific EMP
Step 3: Design of substation
Step 4: Issuing of tenders and award of contract
Step 5: Establishment of construction camp, vegetation clearance and construction of access roads (where required)
Step 6: Construction of terrace and foundations
Step 7: Assembly and erection of equipment
Step 8: Connection of conductors to equipment
Step 9: Rehabilitation of any disturbed areas and protection of erosion sensitive areas
Step 10: Testing and commissioning
Step 11: Continued maintenance

3.3.3 Ongoing Maintenance

The standard life-span of a substation and its associated components is approximately 25 years. During this period, on-going maintenance is performed, and components are replaced, which significantly extends the life-span beyond 25 years.

3.4 ENVIRONMENTAL IMPACTS ASSOCIATED WITH CONSTRUCTION ACTIVITIES

The following generic impacts are generally associated with the construction of any 765 kV Transmission power line.

3.4.1 Impacts of power lines and Electromagnetic Fields

Impacts of Transmission power lines relate to the risks posed to avifauna, mainly pertaining to electrocution and collision risks. These impacts are discussed in detail in Chapter 8, where the results of the specialist avifaunal assessment are detailed. Detailed mitigation measures have also been provided for incorporation into the Environmental Management Plan (EMP), thus adding to the already existing mitigation measures that Eskom implement to prevent impacts on Avifauna.

Transmission Power lines may impact upon air traffic, particularly helicopters and small aeroplanes, which are relatively low-flying. However, Eskom generally attach aviation spheres to Transmission power lines which may be in the flight path of air traffic to make the Transmission power lines visible to pilots so that collisions can be avoided (Refer to Figure 3.8). Larger aeroplanes fly at a height at which Transmission power lines do not have an impact on them with regards to possible collisions.

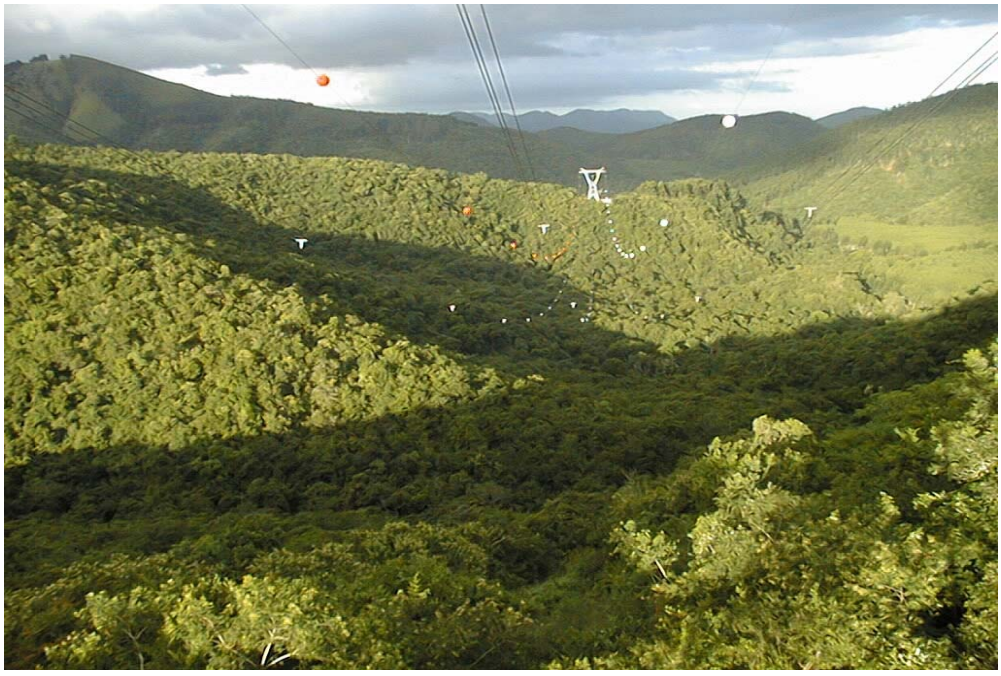

Figure 3.8: Example of Aviation spheres to make lines visible to aircrafts

The Electro-Magnetic Field (EMF) around Transmission power lines may interfere with navigational equipment used by air traffic and air traffic controls. The project team has consulted with Air Traffic Navigation Services (ATNS), who operate the navigational systems at airports throughout the country. In further consultation with ATNS, should it be necessary the proposed Transmission power line will be routed in such a manner that it will not interfere with the navigational

equipment utilised by ATNS. Please refer to Appendix C of this Addendum Report for an assessment of potential impacts of EMFs in terms of a variety of aspects.

3.4.2 Impacts of anchor cables

Isolated cases have been reported of animals, whether stock or game, sustaining injuries as a result of collisions with the anchor cables that form part of suspension towers. A slight possibility exists that certain animals may be affected by the anchor cables, such as giraffe. Animals may also sustain injuries as a result of their horns getting stuck in the structures to which the anchor cables are anchored to the ground. However, measures are available to mitigate and counteract such potential injuries, and landowners are encouraged to bring any concerns about possible impacts of the anchor cables on animals to the attention of the project team. Such concerns will be passed on to Eskom, where the engineers will design mitigation measures to ameliorate potential impacts as noted by landowners. Concerns in this regard should be pointed out as early in the process as possible, in order for mitigation measures to be incorporated into the design phase of the Transmission power line and the selection of towers.

3.4.3 Impacts of tower foundations

The most significant and long-term impacts associated with Transmission power lines generally occur as a result of the tower foundations. The extent and significance of these impacts depend on the type of towers used, as the type and size of foundation required varies between the different tower types and also depends on the soil and geological characteristics of the specific sites. Foundations are generally approximately 2 m deep.

Impacts directly associated with tower foundations, include the following:

- Destruction of vegetation and habitat at site of foundation;
- Loss of agricultural soil at the sites of the towers;
- Sterilisation of minerals rights and activities at the tower sites as well as along the entire servitude, as minerals will not be able to be extracted within the registered servitude of the Transmission line;
- Risks associated with blasting and excavation, should the towers and the tower foundations need to be located on rocky substrate or on slopes;
- Potential increase in soil erosion at the sites of foundations, if the surrounding area is not properly rehabilitated subsequent to the construction of the tower foundation;
- Risk to stock and game during construction of the foundations, as a possibility (albeit slim) exists that animals may stumble into the excavated foundation before it is filled with cement (Eskom however implements stringent safety and security measures to prevent this); and

- Risk (albeit slim) exists that people, particularly children, may stumble into the excavated foundation before it is filled with cement (similarly, Eskom's strict safety measures cause this risk to be very low);

3.4.2 Indirect tower impacts

Certain indirect impacts can be associated with the construction of a Transmission power line. Such impacts include the impact of the manufacture of the steel required for the construction of the towers. These impacts are not experienced in the nominated study area where the Transmission power line is constructed and implemented but rather at factories or in industrial areas. These indirect impacts may need to be considered when selecting the type of tower to be implemented. In this regard it is favourable to use towers that require less steel, such as the cross-rope and compact cross-rope towers, which use significantly less steel than the traditional bend / self-supporting tower.

3.4.5 Impacts of access roads

Eskom's Transmission power line infrastructure needs to be easily accessible for maintenance and safety purposes and in case of emergency. If there is no existing access road available, an access road needs to be constructed. This increases the footprint area of the project, as the area impacted on by the project is then no longer restricted to the project itself (e.g. the Transmission power line servitude or the footprints of the towers), but also includes the area impacted on by the construction (where required) and maintenance of these access road. Access roads to Transmission power lines are generally dirt roads, which have less of an impact on the bio-physical environment than tarred roads. However, the access road area still has certain impacts, including the following:

- Destruction of vegetation and habitat;
- Potential increase in soil erosion rates, due to the clearance of vegetation; and
- Potential increase in road fatalities, e.g. birds, small mammals or insects killed by traffic on the access roads. This is not foreseen to be a significant impact as the volume of traffic on these roads is anticipated to be very low, and primarily for use by Eskom.

3.4.6 Impacts of construction camps

During the construction phase of the proposed Transmission power line, workers and labourers will need to be accommodated near the construction site. It is likely that some workers will be accommodated in nearby towns, whilst the majority are expected to be accommodated in temporary construction camps. The sites of these camps will be selected through consultation between Eskom,

the environmental consultant, the environmental authorities, the local authority and the particular landowners.

A number of construction camps will be required, as construction will take place over a distance of approximately 130 km (the length of the proposed Transmission power line). It is not known at this stage how many camps will be required; this information will be detailed in the EIA phase of the project.

The EMP to be compiled by the environmental consultant and reviewed by the environmental authorities will specify detailed guidelines pertaining to construction camps, including criteria for selection of appropriate sites and guidelines to be adhered to for the day to day operation of the camp during the construction period. Potential impacts that construction camps may have, include the following:

- Degradation of vegetation and habitat at the site of the construction camp;
- Littering by construction workers;
- Pollution of water bodies through washing in surface water sources (though this is prohibited by the requirements to be specified in the EMP);
- The use of the veld and open spaces or surface water sources for ablution purposes (though this is prohibited by the requirements to be specified in the EMP);
- Collection of firewood from the surrounding environment, for heating and cooking purposes (though this is prohibited by the requirements to be specified in the EMP);
- Workers may possibly poach stock, game or wildlife from surrounding farms and areas surrounding the construction camps;
- Introduction and possible increase of crime in the areas along the servitude or in close proximity to construction camps. This aspect has been considered within the social assessment in the ESS and will be further explored during the EIA and EMP phases of the project;
- Risk of veld fires through indiscriminate tossing of cigarette butts that have not been properly extinguished or through lighting of fires for cooking or heating purposes (though this is prohibited by the requirements to be specified in the EMP);
- Noise impacts associated with the number of people temporarily being accommodated in the construction camps;
- Visual impacts associated with the camps;
- Disturbance of community activities, e.g. young workers may become rowdy during social activities at local venues such as taverns and this may in certain instances lead to vandalism, littering and even petty crime; and
- Potential health risks through the temporary introduction of a group of workers who are not local to the host community – risks may include the following:

- Potential spread of communicable diseases such as tuberculosis (TB) – this risk would be higher if the construction camp is situated in close proximity to a town or other permanent settlement;
- Potential increase in HIV/Aids transmission rates due to the presence of workers who may make use of local sex workers due to the following risk factors generally associated with these workers:
  - workers are usually mainly young males;
  - they are mainly employed on a contract basis (not permanent) and receive a relatively low income;
  - they are away from their homes for extended periods of time, which may result in feelings of loneliness;
  - they generally do not have a high level of schooling / education; and
  - in cases where the host community is poor, as is the case in sections of certain of the villages in the nominated study area, sex workers may not be in a position to negotiate condom usage.

  As in the case of diseases such as TB, the risk would be higher where the construction camps are situated in close proximity to towns or permanent settlements.
- If care is not taken to supply construction workers with adequate sanitation facilities and clean water, diseases such as cholera may emerge in the construction camps.

3.4.7 Impacts of maintenance activities

Eskom performs regular but in infrequent maintenance activities – the Transmission power lines are generally inspected once a year and as needed. Eskom has guidelines in place to prescribe the actions of maintenance officers; however, concerns have been received by the project team from landowners who are not satisfied with the conduct of maintenance workers on the existing Transmission power lines in the area.

Maintenance-related impacts relate mainly to social aspects and very few bio-physical impacts. Impacts associated with maintenance activities include the following:

- Farm gates being left open by maintenance workers, potentially leading to stock or game moving out of a camp or farm area where they need to be kept at a certain stage, for instance for breeding purposes. This may also lead to stock or game escaping off the property, resulting in financial losses for the farmer;
- Potential poaching or injuring of stock or game on farms by workers or labourers;

- Potential disturbance of stock or game, particularly if helicopters are used in the maintenance work. This is a particularly significant impact during the mating and calving seasons;
- Fears of security breaches and the possibility of a criminal element posing as Eskom representatives;
- Littering by maintenance workers (mitigation measures will be developed during the EMP phase of the project and implemented by the Environmental Control Officer (ECO) onsite during construction activities); and
- Destruction or degradation of the natural vegetation through overnight camps that are sometimes erected by maintenance teams. This may be due to removal of trees for firewood, use of the veld and / or streams for ablution activities due to a lack of or a disregard for sanitation facilities.