Mitigation: (Action/Control)	***Responsibility***	***Timeframe***
Bird guards to be installed according to Eskom Transmission Guidelines (APPENDIX 3) on self support towers identified during the 'walk down'.	Eskom Contractor ECO	Bird guards to be installed during construction prior to commissioning.

Monitoring: Eskom Transmission to monitor network performance as per their usual procedures.

9. CONCLUSION

With the presence of river systems and numerous agricultural fields, this area is particularly attractive to many species of birds and as a result the proposed development will undoubtedly have an impact on the birdlife occurring there, as their habitat will effectively be transformed to accommodate the electrical infrastructure. However, it is believed that the key impacts (i.e. collision and habitat destruction) associated with the construction of the substation and power lines, can be minimised and mitigated with relative ease if substation **Option 1, the Corridor 8 Deviation and Corridor 6** alternatives are selected. It must be noted that the negative impacts far outweigh the positive impacts associated with a development of this nature.

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1. ASSESSMENT OF IMPACTS

Direct, indirect and cumulative impacts of the above issues, as well as all other issues identified will be assessed in terms of the following criteria:

» The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.

» The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional

» The **duration**, wherein it will be indicated whether:
  - the lifetime of the impact will be of a very short duration
  - the lifetime of the impact will be of a short duration (2-5 years)
  - medium-term (5–15 years);
  - long term (> 15 years); or
  - permanent;

» The **magnitude**, quantified as small (will have no effect on the environment), minor (will not result in an impact on processes), low (will cause a slight impact on processes), moderate (will result in processes continuing but in a modified way), high (processes are altered to the extent that they temporarily cease), and very high (results in complete destruction of patterns and permanent cessation of processes).

» The **probability** *of occurrence*, which shall describe the likelihood of the impact actually occurring and will be rated very improbable (probably will not happen), improbable (some possibility, but low likelihood), probable (distinct possibility), highly probable (most likely) and definite (impact will occur regardless of any prevention measures).

» the **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and

» the **status**, which will be described as either positive, negative or neutral.

» the degree to which the impact can be reversed (**reversibility**).

» the degree to which the impact may cause irreplaceable loss of resources.

» the *degree* to which the impact can be *mitigated.*

The potential **significance** of identified impacts will be determined using the significance rating system described below.

Significance of environmental impact = Consequence x Probability

APPENDIX 1: Assessment Criteria

The consequence of an impact can be derived from the following factors:

» Extent of impact
» Duration of impact
» Magnitude
» Reversibility

The above criteria will be rated using the criteria indicated in the table below.

Significance ranking

Magnitude	Reversibility	Duration	Spatial extent	Probability
5 – Very high / don't know	1 – Reversible (regenerates naturally)	5 – Permanent	5 – International	5 – Definite / don't know
4 – High		4 – Long term (impact ceases after operational life)	4 – National	4 – High probability
3 – Moderate	3 – Recoverable (needs human input)	3 – Medium term (5 – 15 years)	3 – Regional	3 – Medium probability
2 – Low		2 – Short term (0 – 5 years)	2 – Local	2 – Low probability
1 – Minor	5 – Irreversible	1 - Immediate	1 – Site only	1 – Improbable
0 – None				0 - None

The overall consequence of an impact must be determined by the sum of the individual scores for magnitude, reversibility, duration and extent of an impact, multiplied by the probability of the impact occurring.

Consequence (severity + reversibility + duration + spatial scale) X Probability = Significance

The significance is then characterised as follows:

» **More than 60 significance points** indicate **High** environmental significance
» **Between 30 and 60 significance points** indicate **Moderate** environmental significance
» **Less than 30 significance points** indicate **Low** environmental significance.

The impacts must be ranked according to the significance rating results obtained. The relevant mitigation measures recommended must then be considered and the significance of the impacts after mitigation determined. The impacts must then be ranked again according to the significance results after mitigation.

APPENDIX 1: Assessment Criteria

BIRD COLLISIONS

Specifications for Bird Flight Diverters installation on a Transmission line

1. Background:

Where it has been found during an EIA that there is a potential for bird collisions (specially rare or endangered species) with new overhead lines or there are actual collisions on existing lines it is advisable to install bird flappers or bird flight diverters on the earthwires.

It has been found in South Africa and overseas that the majority of collisions happen with the earth wires, as they are less visible than the conductors. The reason is that they are thinner than the conductors and also fewer of them on a line.

Typically big birds with less manoeuvrability, when flying horizontally to the ground, will see the conductors and when taking evasive action collide with the earthwires above.

The bird devices are installed either using "bicycles" along the earthwires or from a chair hanging from a helicopter.

2. Specifications - *Bird Flight Diverters*:

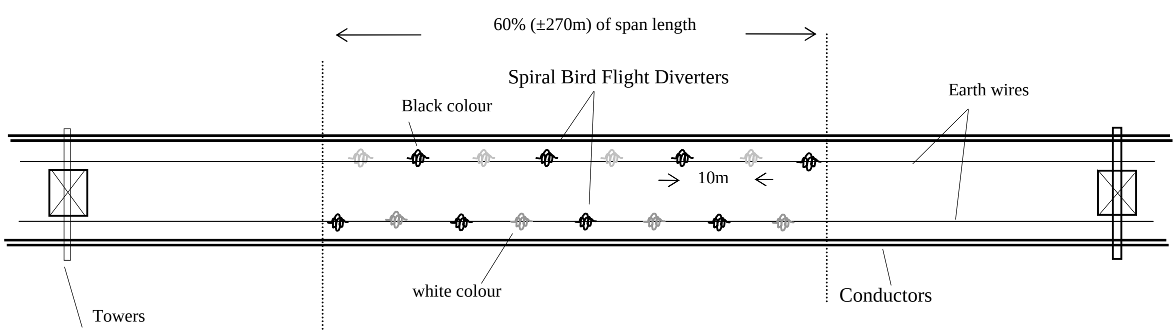
As per recommendations from Chris van Rooyen of the Endangered Wildlife Trust (EWT), Transmission should use the spiral type until all flapper types are tested by Eskom..

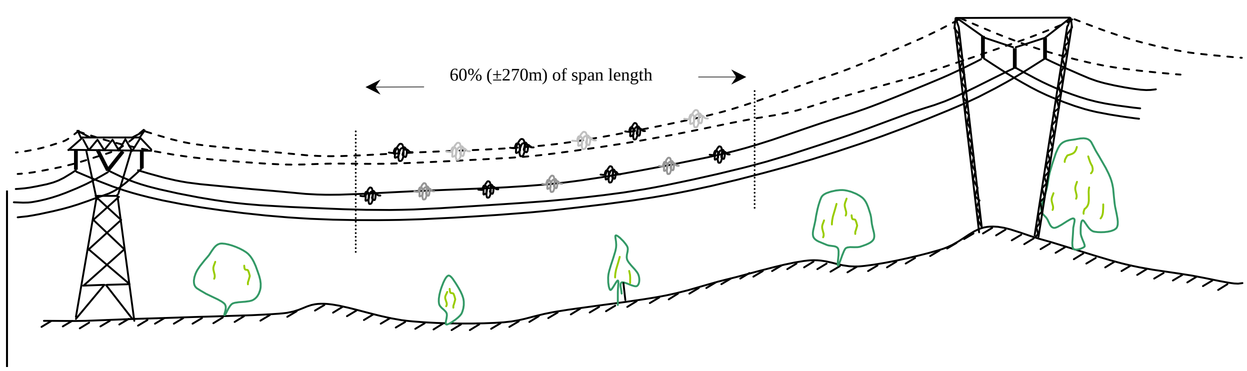
- Black and white spirals are of preformed 14mm diameter PVC UV stabilised rod.

Half of the spirals to be of white colour and the other half to be of black colour.

Installation of the bird flight diverters to be:

- To be installed on both earth wires (19/2,65), staggered;
- To be installed only on 60% of the span and in the middle of the span (Chris van Rooyen of the Endangered Wildlife Trust). Typical 400 kV line spans length=450m- 60%=270m.
- On the lower middle lower span, spirals be installed at 10 metre intervals on each earthwire and with alternating colours on each side (as per sketch below).





Eskom Transmission	**Guideline**	**Document Classification : [TYPE CLASS]**

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Content

1. Introduction

A bird collision incident happens when a bird physically strikes either the overhead conductor or the overhead ground wire of a power line. In the case of transmission lines, the overhead ground wire is usually involved. It is generally accepted that birds can usually avoid the highly visible bundled conductors but often fail to see the thin ground wire. In South Africa, bird collisions with transmission lines are a major form of unnatural mortality among several threatened species. Research is ongoing to attempt to gauge the effect of this form of mortality on these species, especially cranes. Preliminary results indicate that the mortality could be unsustainable for regional populations of species such as Blue Cranes in the central Karoo.

2. Background and extent of the problem of bird collisions

Collisions are the biggest single threat posed by transmission lines to birds in southern Africa (van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes and various species of water birds. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (van Rooyen 2004, Anderson 2001).

Unfortunately, many of the collision sensitive species are considered threatened in southern Africa. The graph below shows the number of collisions reported per species on transmission lines from August 1996 to present (EWT unpublished data). Most of the heavily affected species are Red Data species. It should be noted that these are only the reported mortalities, it is suspected that a large number of mortalities go unreported. It is also important to note that the mortalities recorded by Anderson (2001) as discussed below are not included in the graph below.

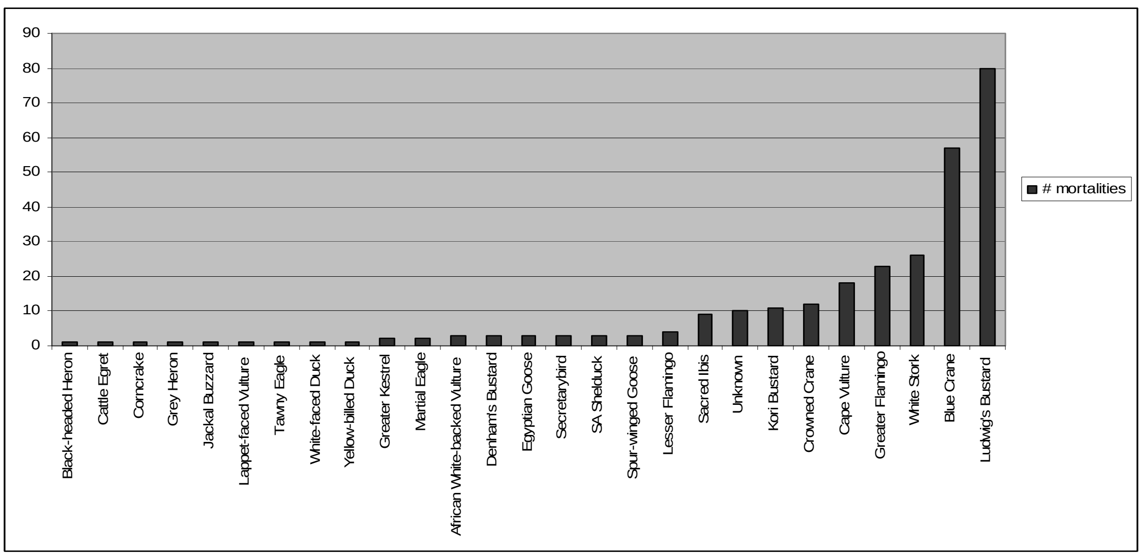

Figure 1: Number of reported collisions per species on transmission lines from August 1996 to the present (EWT unpublished data).

Although significant in itself, figure 2 is not a true reflection of the extent of the problem, because few of the collision localities were closely monitored over a substantial period of time. Where long term monitoring did happen, the picture is disturbing. In one instance, where bi-monthly monitoring did take place, a single 10 km section of 132kV distribution line killed 59 Blue Cranes, 29 Ludwig's Bustard, and 13 White Storks in a three year period (van Rooyen unpubl. data). In 2004, fifty-four Blue Crane carcasses were discovered near Graaf-Reinett in the Northern Cape province under 3.7km of distribution line.

Data collected in the Northern Cape province between 1997 and 1999 provides further evidence of the gravity of the problem. During an initial clearing of transects, a total of 194 large bird carcasses were found under 40km of Transmission line (220 and 400kV) near De Aar in the Northern Cape. Subsequent monitoring of 140 km of power lines (transects of 10km each from 22kV up to 400kV) in the same area over a period of 12 months produced another 196 carcasses (mostly cranes and bustards) the majority under transmission lines (Anderson 2001).

The Red Data species vulnerable to power line collisions are generally long-lived, slow reproducing species under natural conditions. Some require very specific conditions for breeding, resulting in very few successful breeding attempts, or breeding might be restricted to very small areas. A good example of this is the two flamingo species that occur in southern Africa, which have experienced hardly any successful breeding attempts at Etosha Pan in Namibia for several decades. Another example is the Great White Pelican that only breeds successfully at Dassen Island in the Western Cape. These species have not evolved to cope with high adult mortality, with the results that consistent high adult mortality over an extensive period could have a serious effect on a population's ability to sustain itself in the long or even medium term. Many of the anthropogenic threats to these species are non-discriminatory as far as age is concerned (e.g. habitat destruction, disturbance and power lines) and therefore contribute to adult mortality, and it is not known what the cumulative effect of these impacts could be over the long term.

Using Vortex computer modelling, the South African Crane Working Group estimated that an annual mortality rate of 150 adult Blue Cranes could reduce the eastern population of Blue Cranes (app. 2000 individuals in Mpumalanga and KwaZulu-Natal) by 90% by the end of the 21st century (McCann *et.al.* 2001). At that stage the population would be functionally extinct.

From the figures quoted above, it is clear that power lines are a major cause of avian mortality among power line sensitive species, especially Red Data species. Furthermore, the cumulative effects of power lines and other sources of unnatural mortality might only manifest itself decades later, when it might be too late to reverse the trend. It is therefore imperative to reduce any form of unnatural mortality in these species, regardless of how insignificant it might seem at the present moment in time.

3. Solutions to the problem of bird collisions.

3.1. Background

A measure that has been proved to be reasonably successful in reducing collisions is to fit the earth wire with anti-collision devices.

Figure 2: The installation of flappers on the shield wire from a helicopter.

Success rates of up to 60% reduction in mortality and even more have been documented (Ferrer and Janns, 1999). There are several devices available in southern Africa for the marking of power lines. These devices will be described below and the advantages and disadvantages discussed. The fitting of the marking devices are typically done from a helicopter, which adds considerably to the cost of any project.

3.2. Static devices

Static devices are mechanically more durable than dynamic devices because they lack the element of wear and tear that moving parts inevitably have. However, in South Africa, static devices, particularly the so called Bird Flight Diverter (also known as the pigtail) has had limited success (Anderson 2001). The most obvious reason seems to be that they are simply less visible, especially the small ones (see figure 5). A better option would be to use the bigger pigtail (see figure 5, right), although it is still not the preferred option.

Figure 3: Example of static devices.

3.3. Dynamic devices

Dynamic devices (usually called bird flappers), have moving parts as opposed to static devices where there are none.. Dynamic devices are very effective in reducing collisions as the birds seem to see them very well (van Rooyen unp. data) probably because of the movement that attracts attention. The disadvantage of dynamic devices is that they are subject to extensive wear and tear, inevitably limiting the lifespan of the device. Wear could result on the device itself as well as on the cable to which it is attached.

Figure 4: Examples of the dynamic bird flapper devices

This has obvious cost implications if a line needs to be re-marked at intervals of a few years. No solution to that problem has been found to date and it must be accepted as a constraint. Figure 4 shows examples of bird flappers currently available on the market.

3.4. Reflective devices

A new product that shows great potential is the Inotec BFD88, a reflective stainless steel sphere of 70mm diameter. Experiments have shown the visibility of this device to be superior to coloured (red, yellow, white, black) objects especially during the low light conditions at dawn and dusk when birds may be flying from roosting areas to feeding areas and back. Due to the spherical shape, the device reflects any available light in all directions and is therefore visible from all directions including above or below the diverter. The diverter does not require direct sunlight and is effective during overcast conditions and the low light conditions before sunrise and after sunset (Van Rooyen, pers obs.) When viewed during these low light conditions the device is particularly visible against dark backgrounds such as the ground, trees or high ground. It is also particularly visible against bright cloud when viewed from below.

Figure 5: A Reflective Bird Diverter (left) installed on a line with conventional bird flappers (right).

Figure 6: An example of reflective diverters on a test line at dusk with white conventional bird flappers in between

An option could be to string the Inotec NFD88 diverters close enough to form a dotted line on each earth wire on those spans crossing the river (see figure 6). **Due to the relatively small size of the spheres, it would need to be spaced very close together to make it effective, maximum 5 metres apart on both earth wires.**

3.5. Spacing intervals

Research in the Netherlands has shown that spacing intervals have a major influence on the effectiveness of anti-collision devices. In South Africa, the same has been found. See Figure 7 for a suggested marking method with Bird Flappers. In the case of the Inotec BFD88 diverters, a similar 5 metre interval is suggested.

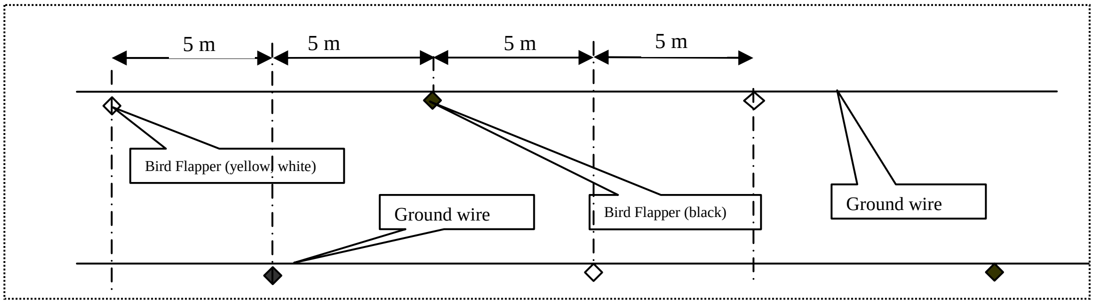

Figure 7: Marking method with Bird Flappers on overhead ground wires (viewed from above)

NB. It is important to alternate the colours (yellow-white) in order for maximum contrast.

3.6. Portion of span to be marked.

Only the middle 60% of each span needs to be marked as this is where most of the collisions occur.

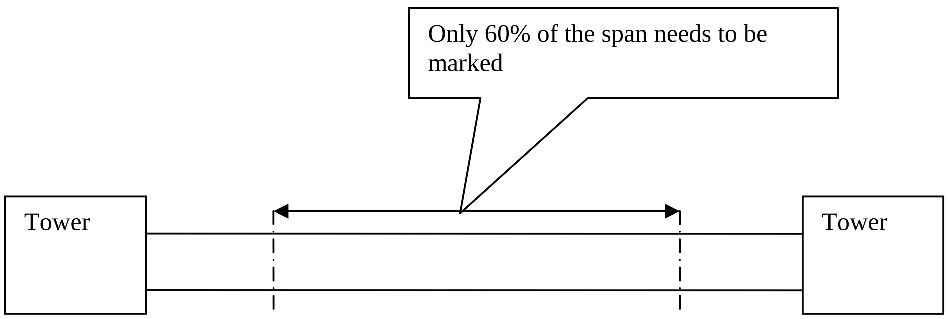

Figure 8: The section that needs to be marked

3.7. Illuminated devices.

A specific problem is posed by birds that fly at night, for example flamingos that migrate great distances at night. A device is available for this problem, namely the Mace Bird Lite, which is a Perspex tube with a fluorescent tube inside.

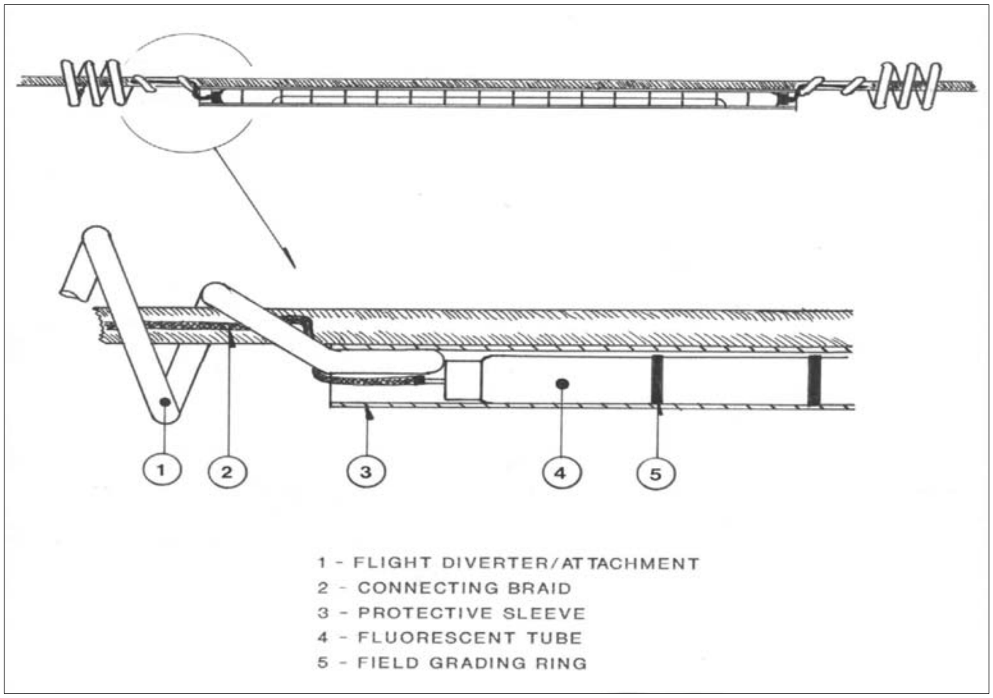

Figure 9: The Mace Bird Lite

It is mounted on the overhead ground wire and the light is energized by the ambient electrical field generated by the conductors. It has been used in South Africa and Botswana and is reported to have worked well for curbing flamingo mortality on power lines. No scientific data is available on the effectiveness but it is generally claimed to be effective.

3 Supporting Clauses

Index of Supporting Clauses

3.1 Scope

This document covers the subject of bird colliding with Transmission lines.

3.1.1 Purpose

The purpose of this document is to describe the problem of bird collisions with transmission lines and to indicate which mitigation methods are available to address the problem.

.1.2 Applicability

This guideline shall apply throughout Transmission Division.

3.2 Normative/Informative References

Parties using this guideline shall apply the most recent edition of the documents listed below

3.2.1 Normative

Anderson, M.D. 2001. The effectiveness of two different marking devices to reduce large terrestrial bird collisions with overhead electricity cables in the eastern Karoo, South Africa. Draft report to Eskom Resources and Strategy Division. Johannesburg. South Africa.

Alonso J A and Alonso J C, Mitigation of bird collisions with transmission lines through groundwire marking. In: Ferrer M and Janss F E (eds), Birds and powerlines, Quercus, Madrid, 1999, pp113 – 124.

Alonso J A and Alonso J C, Collision of birds with overhead transmission lines in Spain. In: Ferrer M and Janss F E (eds), Birds and powerlines, Quercus, Madrid, 1999, pp57 - 82.

Van Rooyen, C.S. 2004. The Management of Wildlife Interactions with overhead lines. In The fundamentals and practice of Overhead Line Maintenance (132kV and above), pp217-245. Eskom Technology, Services International, Johannesburg.

3.2.2 Informative

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Koops F B J and De Jong J, Vermindering van draadslachtoffers door markering van hoogspanningsleidingen in de omgeving van Heerenveen. 1982 Electrotechniek 60 (12): pp641 – 645.

3.3 Definitions

N/A

3.4 Abbreviations

EWT: Endangered Wildlife Trust

3.5 Roles and Responsibilities

The Line and Servitude managers of each Grid shall be responsible to ensure compliance with this document.

3.6 Implementation Date

The implementation date is November 2006.

3.7 Process for monitoring

The line and Servitude managers of each grids shall monitor servitudes for evidence of bird collisions and inform the EWT accordingly.

3.8 Related/Supporting Documents

n/a

4 Authorisation

This document has been seen and accepted by:

Name	Designation
W Majola	GM (Services)
J. Machinjike	GM (Grids)

5 Revisions

Date	Rev.	Remarks
November 2006	1	Review document. Add latest equipment available

6 Development team

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DATE:………………………	DATE:………………………	DATE:………………………

Content

1. Introduction

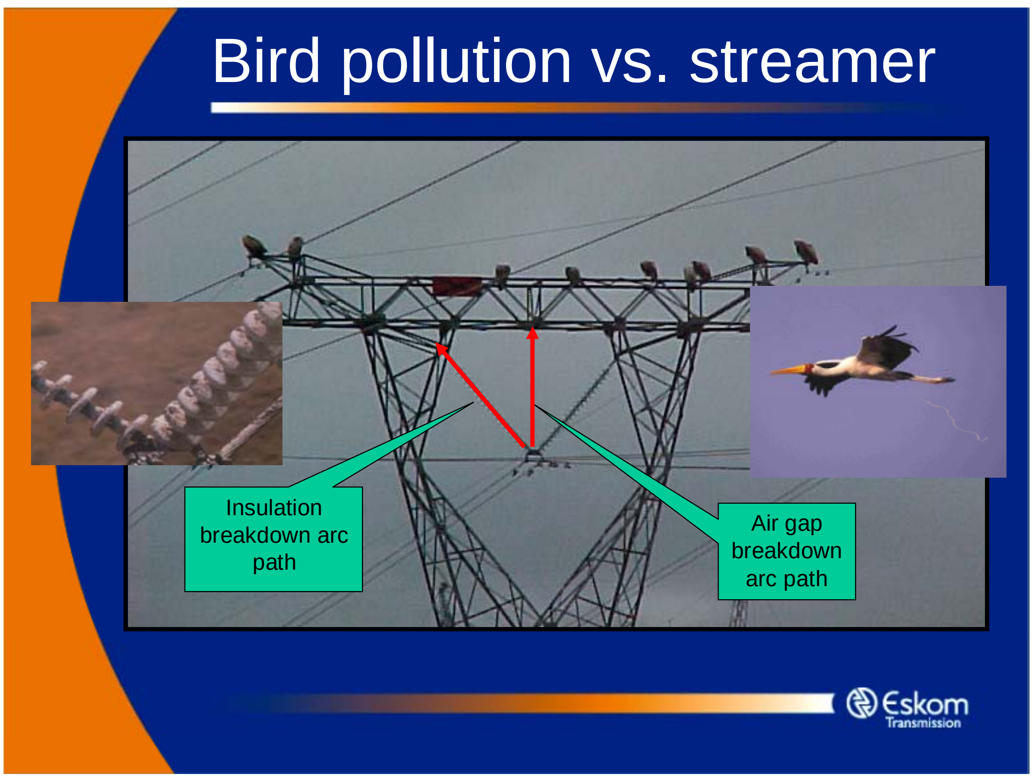
Birds of all descriptions use power line structures for perching and nesting purposes. These structures often are the only (or superior) substrate.

The principle to be followed in perch management is not to prevent birds from roosting on towers, but rather to prevent them from roosting on critical parts of the tower only. The provision of adequate alternative roosting space on the tower will enhance the success of the intervention.

2. Recognizing bird induced faulting: pollution vs. streamers

In generic terms, an electrical fault is caused by pollution, coupled with appropriate moisture, when pollutant build-up takes place on the insulator disks. The coating of pollutant (which could range from marine, agricultural or industrial pollution or to bird droppings) compromises the insulation properties of the insulator and under appropriate wet conditions, a phase-earth flashover may result ***across the insulator string.***

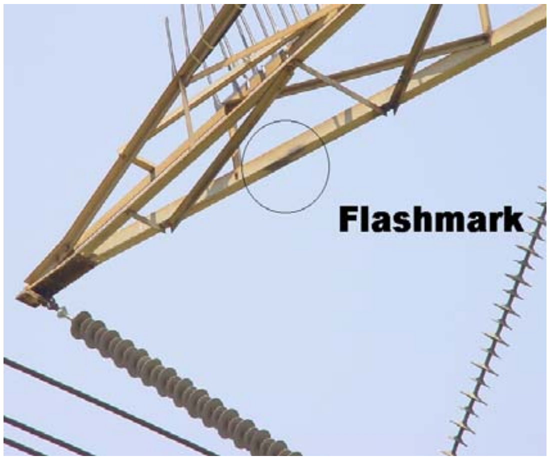
In the case of a bird streamer induced fault, the fault normally initiates on the live hardware and it propagates vertically towards the tower. The fault appears to flash across the air gap and ***does not*** follow an insulator creepage path as observed on pollution faults.



3. Typical indicators of a bird streamer faulting problem

3.1. Position of flash marks

The flash marks of a bird streamer fault is highly characteristic, but difficult to spot. Typically, the flash marks will be situated on the steelwork directly above the live hardware and at the live end of the insulator string, i.e. on the yoke plate, first insulator disk or corona ring. ***There are no burn marks at the dead end of the insulator as would be the case with a pollution-induced fault*.** In the case of strain towers, the burn marks are similarly situated on the jumper cable and on the tower steelwork directly above.



3.2. Time of faults

Bird streamer faults follow a highly distinctive bimodal, temporal pattern with ***peaks usually occurring in the early evening between 18h00 and 23h00 and again in the morning, between 04h00 and 08h00*.** A possible explanation for this lies in the natural foraging behaviour of birds, in that they tend to forage away from the line during the day, returning in the early evening to roost until the next morning. It is important to note that the provision of artificial food sources, e.g. vulture feeding stations, could change the roosting behavior of the birds and result in a changed pattern of faulting.

3.3. Window size

The window size determines the ***size of the air gap, which in turn influences the probability of a streamer induced flashover***. In one instance, excessive faulting was experienced on of two parallel 400kV lines of similar design, with the only difference being that of 3.2m vs. 4.2m window size. Despite vultures utilizing both lines, faulting happened only on the line with the smaller air gap. The most likely explanation for this is that the streamer could not bridge the larger air gap.

3.4. Faulting phase

A dominant faulting phase is a strong indication of bird streamer related faulting. **Bird streamer related faults tend to be prevalent on the phase which is situated below the *highest and/or most convenient perching* space on the tower.** On vertically configured designs, this usually results in the top phase (or phases in the case of double circuit towers) faulting disproportionately to the other phases , as the birds tend to roost on the highest cross-arm. With horizontally configured designs, the middle phase is usually the dominant faulting phase. In South Africa, the middle phase on 275kV self-supporting towers is the dominant bird streamer related faulting phase due to the tower design which makes is difficult for birds to roost above the outside phases.

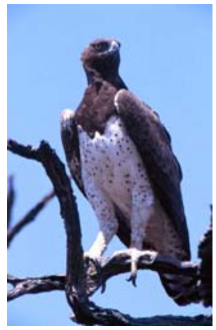
3.5. Presence of certain bird species

Large predatory birds tend to create the biggest risk of flashovers. Species such as ***vultures, herons, certain ibises and stork species, eagles and large hawks*** are high risk species. The presence of these birds on the towers is a strong indicator that bird streamers faults could be present.

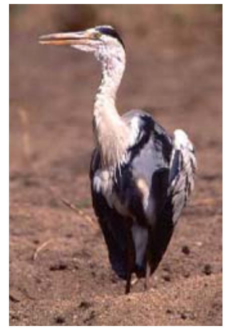
Black Eagle

Cape Vulture

Martial Eagle



Grey Heron



3.6. Presence of dead birds under the towers

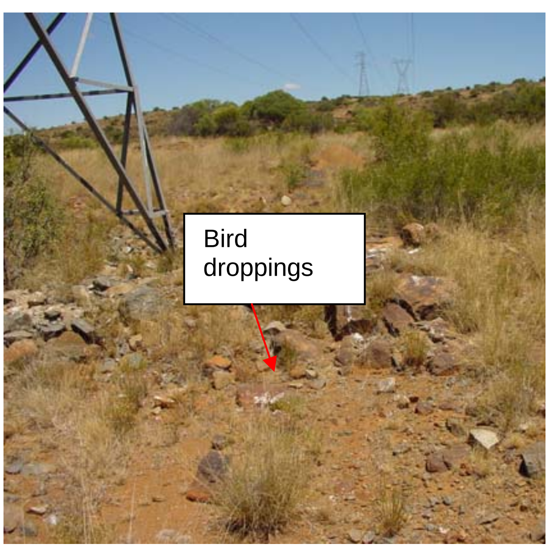
Although electrocution as a result of a bird streamer induced fault is a rare occurrence, it does occur. If dead birds with burn marks are found under structures ***with sufficient clearances to preclude any possibility of the bird having physically bridged the air gap with its body or wings***, it is a strong indication that it was electrocuted via a bird streamer flashover.

3.7. Clustering of faults in certain areas

The clustering of streamer faults in certain areas could point to birds being attracted to certain sections of the line. This could be related to ***food*** e.g. vulture feeding stations or recently burnt veld (herons), ***wetlands*** and/or ***agricultural activity*** or irruptions of insects or rodents. It could also be related to ***nesting*** activity on the towers e.g. heronries or large raptor nests or ***topography*** – vultures prefer to roost on towers that are situated on high topographical features such as hills and mountain ridges.

3.8. Bird droppings and pellets

The presence of ***bird droppings*** on electrical infrastructure is an indication that it is being used by birds for roosting purposes. Careful examination of the locality of the heaviest pollution could give an indication of where the favourite roosting spots are. The presence of ***regurgitated pellets and prey remains*** under transmission towers is also evidence that the structure is used by large birds for roosting. Analysis of the pellets can aid in the identification of the species.



3.9. Seasonality of faults

Seasonal upsurges in faults are often related to an influx of migratory or nomadic birds into an area. In South Africa, with a temperate climate, the ***onset of summer (the rainy season for most of the country) is associated with a significant increase in bird numbers and bird streamer faults.*** As a result of the highly dynamic nature of the presence of bird in the vicinity of power lines, it is recommended that a stock of bird guards be kept by the Region to permit fast response when bird faults present themselves on lines not fitted with bird guards.

4. Fitting strategies

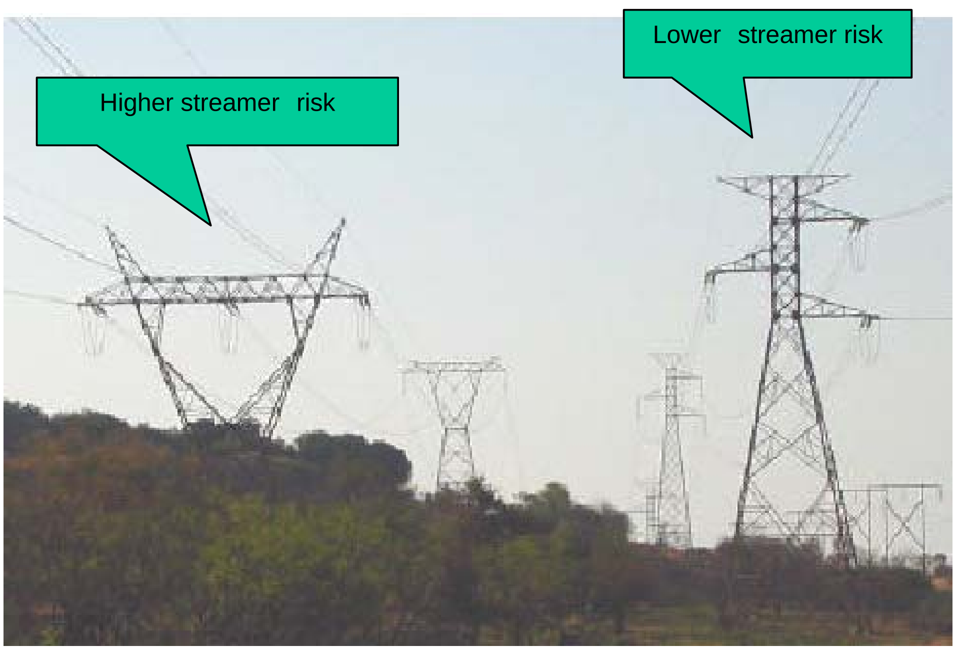
4.1. Micro fitting strategy

The tower configuration and design will determine the placement of bird guards.

4.1.1. Tower design

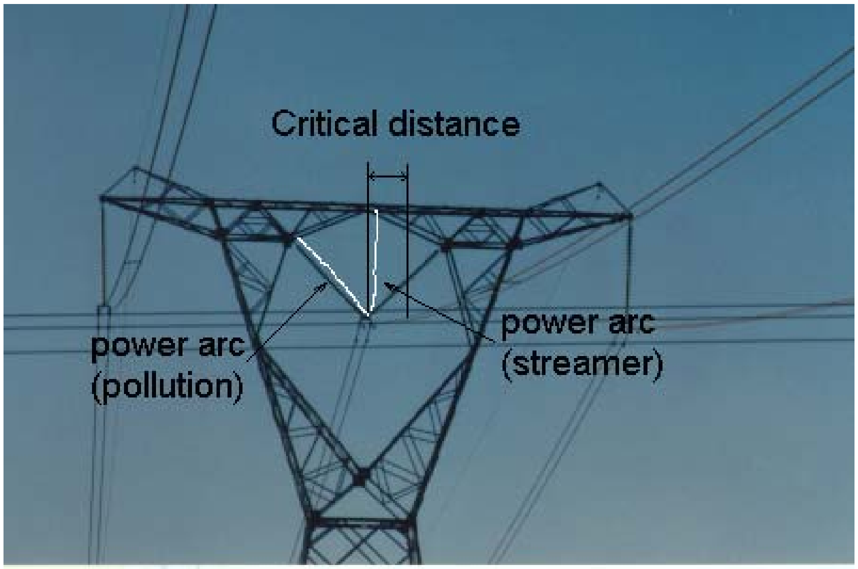
The tower design plays a major role with respect to bird streamer related faults. Vertically configured designs with ***ample perching space on top of the tower away from the cross-arms***, experience fewer faults than horizontally configured designs. The reason for this is that with the latter, the birds roost relatively closer to the conductors, therefore increasing the risk of flashovers. With the former, depending on the design, the birds first utilize the available space on top of the tower, thereby reducing the risk of flashovers. Similarly, almost ***no bird streamer faulting is experienced on the cross-rope suspension type towers***, presumably due to the unavailability of convenient perching space for birds above the conductors.

Transmission uses a variety of tower designs, with each design having as much as ten variations. As a result, broad guidelines will be given in this document. Final fitting strategies will have to be confirmed with subject specialist for final vetting.



Horizontal strain towers are the most vulnerable to streamer faults, followed by horizontal suspension towers. Delta towers are generally much less vulnerable with suspension towers being the least vulnerable.

Initial research showed that air gaps of just under one-meter, on either side of the conductor would need to be protected from potential bird streamers. Because bird guards are made in lengths of 500mm, 750mm and 1000mm for practical reasons, fitting them **one meter** on both sides of the centerline of the conductor has become the standard at all voltages. (Refer to **critical distance** in picture below). No gap of greater than 150mm should be left between two adjacent bird guards.



A distance of one meter either side of the conductor is regarded as critical in protection against streamer faults.

4.1.2. Fitting on Outer Phases

Experience revealed that faults occurred on the outer phases where the landing plates were not fully protected, which left roosting space for birds. Care must be taken not to leave any roosting space at the outer phase extremes of towers.

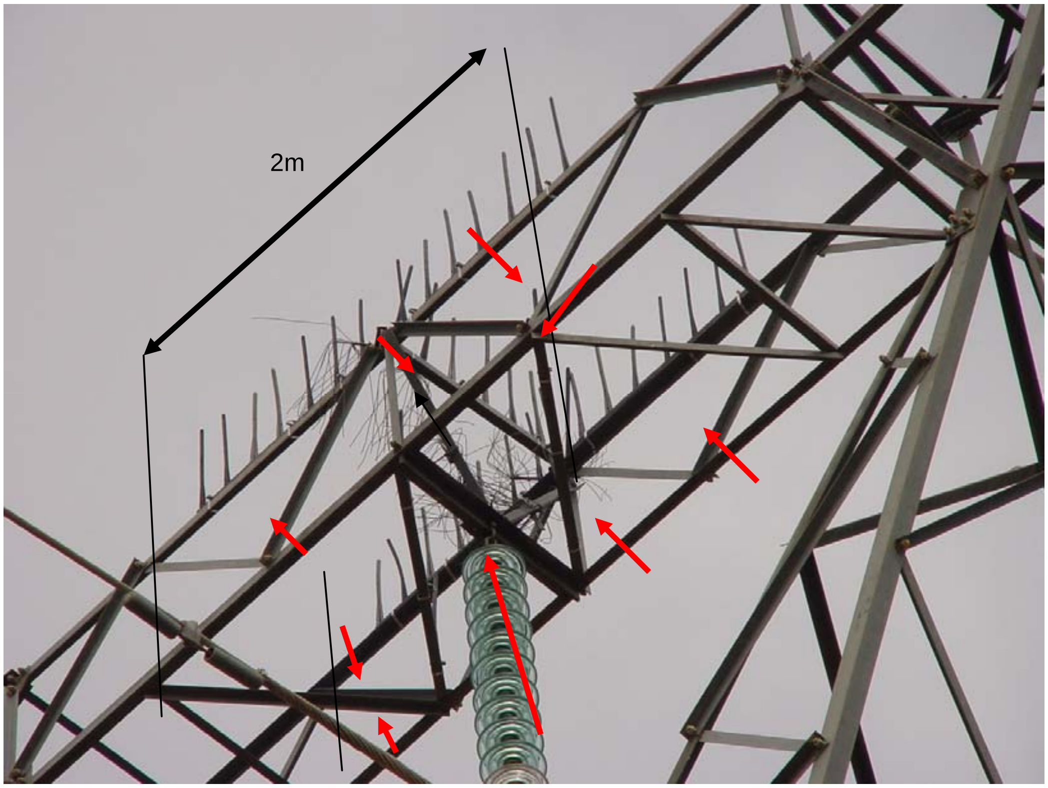
Picture of incorrect fitting leaving the landing plates exposed

4.1.3. V-strings and I-strings

Although V-strings on centre phases were originally thought of as more vulnerable to streamer faults than the I-strings, experience has now shown that the latter are equally vulnerable and should also be protected with bird guards.

4.1.4. Protecting the inside of the boat

Faults have also occurred where birds had entered and roosted inside the boat of the tower. Hadeda Ibis and Black Eagle in particular have been observed exploiting the inside of the boat or lattice member within the critical area, which was not fitted with bird guards.



Picture of an example of insufficient fitting on inside of boat indicated by the red arrows

Comprehensive fitting strategy as implemented on the Hendrina-Kriel 400kV line

4.2. Macro fitting strategy

Whilst a comprehensive fitting strategy is the safest, it also carries a high cost. Results from partial fitting were generally good when comparing risk of streamer fault with cost of installation. It must be pointed out that dependable knowledge of the habitat through which the line runs is critical when partial fitting of a line is contemplated.

The decision to fit bird guards to a line is in the first instance an economical one. It is based on

- the dip sensitive load that the line carries and the effect that these faults are having on the customers and
- the number of bird faults that it experiences (determined from its fault history) ,

Secondly, the habitat through which the line passes and the bird species present in that habitat, and more specifically their behaviour, influences the macro fitting strategy. Bird behaviour refers to aspects such as migration, feeding and roosting habits. Habitat refers to topography, land use, and type and availability of food sources. The help of subject specialist should be used in this regard.

4.2.1. Consideration of adjacent lines

It has been reported that where bird guards resulted in a decrease of roosting space, birds have moved to adjacent lines and streamer faults have occurred there. The increase in bird (and streamer faults) must however also be seen against the influence of wet weather cycles or other phenomena and the general increase in bird population numbers for an area. It is recommended that these factors be considered where unfitted lines run adjacent to the targeted line.

5. Bird guard Specifications

5.1. Types of bird guard

The types of devices to be used will prevent birds from perching on transmission structures by forming a barrier to birds on the affected parts of the structure. The device will consist of a base with upright shafts as described below and will have no moving parts or anything else that will harm birds.
Three devices have been used successfully as part of the National bird guard project and are recommended for future use. These are:

- BeeTee bird guard.
- Mission Bird guard
- Naledi Bird guard

The latter company no longer manufactures bird guards.

5.2. General aspects

The device required is intended to prevent birds from perching on designated areas of power pylons. It should consist of a square base with upright prongs and should be made from a long life, non-conductive material and should not pose any danger to live line workers or birds. An organic polymer such as high-density polyethylene should be used. These polymers should be treated to enable it to withstand typical environmental conditions found in South Africa for a period in excess of 15 years.

5.3. Dimensions

The device should come in three lengths: 500mm, 750mm and 1000mm. The vertical rods should be about 500mm high, with a spacing of between 125-190mm and an outside diameter of about 20mm. The base should have dimensions of 40mmx40mm.

5.4. Materials to be used

The raw materials used by the manufacturer of bird guards should be sourced from a reputable supplier who shall issue a guarantee with regards to:

- the chemical composition of the materials (DOW HDPE M5010 or similar)
- the additives for ensuring suitable life of the product and estimated life. (The Ciba stabilizing system consisting of 2% minimum level of pigment type carbon black, Irganox B225 @ 0,1% and Tinuvin T783 @ 0,4% or similar system should be used. Eskom will have to approve the stabilizing system before production starts.)
- the proper blending of the raw material with UV inhibitors and other additives, that they supply.
- the manufacturing process that is followed must be sanctioned by the Supplier and Eskom to ensure quality of the product. This includes the adding of any non-virgin material. Not more than 10% of own reground material will be permitted.

5.5. Quality assurance.

All devices shall carry a batch number and date. Eskom must be able to determine the materials used for the manufacture of the particular batch.

Unannounced, random samples of the materials may be taken during the processing for testing. Contracts will be terminated with any manufacturer that does not comply with the quality standards, and costs will be recovered for the removal and refitting of bird guards of a suitable quality. Ciba can do analysis of samples.

Rapid aging and other tests will be required that will indicate the specific properties of the device. Refer to details below. The device should be mechanically sound.

An ongoing programme should be followed to observe and track any deterioration of bird guards

6. Attachment Methods

The preferred method of fitting bird guards is by means of stainless steel straps 12,74mm x 0,7mm. This method is effective but has the disadvantage that the guards can only be removed during live line work by cutting the strap. This results in a situation where in some instances bird guards are removed and not replaced by live line teams (damage to bird guards caused during the installation of optical fibre cables have been reported). Poor attachment has been observed as the single biggest reason for failure of bird guards.

In order to facilitating live-line work, quick release straps were designed and manufactured by a number of suppliers.

The number of straps per bird guard varies depending on the specific tower, size of the member and the position on the tower. Installers should ensure that the bird guard is securely attached to the tower member. As a general rule the following guidelines may be used:

Length	Number of straps
One meter	3
750 mm	2
500mm	2

One example of a quick release strap

These straps permit the partial removal of the bird guard by relaxing the tension on the strap and by pushing the guard out of the way but without causing it to fall from the tower. Upon completion of the work, the bird guard is returned into position and the strap is re-tensioned.

Bird guards may selectively be attached by means of a quick release mechanism in areas where live line work is anticipated. This mechanism should enable live line workers to move the bird guard out of the way but without the device being able to drop from the top of the tower or onto the conductors.

Alternative UV protected polymer straps are also used by overseas companies.

7. Supporting Clauses

NOT APPLICABLE.

8. Index of Supporting Clauses

8.1. Scope

This document serves as a guideline with regards to the management of perching and roosting behaviour of large birds on Transmission lines. The presence of large birds and the associated streamer activity has a profound impact on quality of supply.

8.1.1. Purpose

The document helps the reader to identify streamer problems and suggests mitigation measures. It also specifies dimensions, materials and the attachment methods of bird guards.

8.1.2. Applicability

This document shall apply to all Tranmission power line structures.

8.2. Normative/Informative References

Parties using this ~~document~~guideline shall apply the most recent edition of the documents listed below :

8.2.1. Normative

ISO 9001:2000 Quality Management Systems

8.2.2. Informative

Give sources of further information referenced in your document e.g. laws, standards, codes, procedures, etc Research docs, Derek Hoch and Streve Piper.

8.3. Definitions

Perch management
This term refers to the method of managing the roosting and perching behaviour of large birds on transmission and other structures. It is applied to prevent streamer faults and electrocutions on smaller lines. It is also used in conjunction with the management of nests on power lines. Whilst not intended, perch management also results in reduced pollution of insulators. Perch management is also used to prevent birds such as vultures from causing damage to fibre optic cables.

Micro fitting strategy
This term refers to the positioning of bird guards on specific parts of the tower.
This decision will be based on the particular design of the tower as well as the bird species that are targeted.

Macro fitting strategy
This term refers to the determination of which towers to fit with bird guards on a particular transmission line. During the National Bird guard project, both comprehensive as well as partial fitting strategies were followed.

8.4. Abbreviations

none

8.5. Roles and Responsibilities

The Line and Servitude Managers for each Grid shall be responsible for the installation of any bird guards in their respective Grids.

8.6. Implementation date

~~8.7.~~

The implementation date is November 2006.

~~8.8.~~8.7. Process for monitoring

The Line and Servitude Managers for each Grid shall be responsible for the monitoring of the adherence to this guideline.

9. Authorisation

This document has been seen and accepted by:

Name	Designation
W Majola	GM (Services)
J Machinjike	GM (Grids)

10. Revisions

Date	Rev.	Remarks
November 2006	1	Review document as per review period .

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APPENDIX 4: IMPACTS ASSESSMENT TABLE

Nature of the Impact: Electrocutions on the 400kV power lines

	Corridor 1		Corridor 2		Corridor 4		Corridor 5		Corridor 6		Corridor 8		Corridor 8 Deviation	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Spatial Extent	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)
Duration	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)
Magnitude	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)
Reversability	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)
Probability	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)	0 (none)
Significance	**0 (none)**	**0 (none)**	**0 (none)**	**0 (none)**	**0 (none)**	**0 (none)**	**0 (none)**	**0 (none)**	**0 (none)**	**0 (none)**	**0 (none)**	**0 (none)**	**0 (none)**	**0 (none)**
Status (positive or negative)	N/A owing to the voltage size of the power line													
Irreplaceable loss of resources	N/A owing to the voltage size of the power line													
Can impacts be mitigated?	N/A owing to the voltage size of the power line													
Mitigation:	N/A owing to the voltage size of the power line													
Cumulative impacts:	N/A owing to the voltage size of the power line													
Residual impacts:	N/A owing to the voltage size of the power line													

Nature of the Impact: Collisions with the 400kV power lines and turn ins (vulnerable Red Data species include Blue Crane, Secretarybird, Kori Bustard, Denham's Bustard and the various stork species)

	Corridor 1		Corridor 2		Corridor 4		Corridor 5		Corridor 6		Corridor 8		Corridor 8 Deviation	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Spatial Extent	3 (Regional)	2 (Local)	3 (Regional)	2 (Local)	3 (Regional)	2 (Local)	3 (Regional)	2 (Local)	3 (Regional)	2 (Local)	3 (Regional)	2 (Local)	3 (Regional)	2 (Local)
Duration	5 (Permanent)	4 (Long Term)	5 (Permanent)	4 (Long Term)	5 (Permanent)	4 (Long Term)	5 (Permanent)	4 (Long Term)	5 (Permanent)	4 (Long Term)	5 (Permanent)	4 (Long Term)	5 (Permanent)	4 (Long Term)
Magnitude	3 (Moderate)	2 (Low)	4 (High)	3 (Moderate)	4 (High)	3 (Moderate)	3 (Moderate)	2 (Low)	3 (Moderate)	2 (Low)	3 (Moderate)	2 (Low)	4 (High)	3 (Moderate)
Reversability	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)
Probability	3 (Medium)	2 (Low)	4 (High)	3 (Medium)	4 (High)	3 (Medium)	2 (Low)	1 (Improbable)	2 (Low)	1 (Improbable)	3 (Medium)	2 (Low)	4 (High)	3 (Medium)
Significance	**42**	**22**	**60**	**36**	**60**	**36**	**28**	**11**	**28**	**11**	**42**	**22**	**60**	**36**
Status (positive or negative)	Negative													
Irreplaceable loss of resources	Yes													
Can impacts be mitigated?	Yes													
Mitigation:	Bird Fight Diverters to be installed on the earth wires of high risk sections of power line identified during the walk down													
Cumulative impacts:	Corridor 2, 5, 6, 8 and the corridor 8 deviation – cumulative impact is high with the presence of agricultural activities i.e. irrigated lands, subsistence and commercial farming Corridor 1 & 4 - cumulative impact is low, limited existing impacts													
Residual impacts:	High – impact remains until power lines are decommissioned and removed													

Nature of the Impact: Habitat destruction associated power line developments (vulnerable species include those Red Data species that utilise woodland and riparian habitats)

	Corridor 1		Corridor 2		Corridor 4		Corridor 5		Corridor 6		Corridor 8		Corridor 8 Deviation	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Spatial Extent	3 (Regional)	N/A	3 (Regional)	N/A	3 (Regional)	N/A	2 (Local)	N/A	2 (Local)	N/A	3 (Regional)	N/A	3 (Regional)	N/A
Duration	4 (Long Term)	N/A	4 (Long Term)	N/A	4 (Long Term)	N/A	4 (Long Term)	N/A	4 (Long Term)	N/A	4 (Long Term)	N/A	4 (Long Term)	N/A
Magnitude	4 (High)	N/A	3 (Moderate)	N/A	4 (High)	N/A	2 (Low)	N/A	2 (Low)	N/A	3 (Moderate)	N/A	3 (Moderate)	N/A

Reversability	5 (Irreversible)	N/A	3 (Recoverable)	N/A	5 (Irreversible)	N/A	3 (Recoverable)	N/A	3 (Recoverable)	N/A	3 (Recoverable)	N/A	3 (Recoverable)	N/A
Probability	5 (Definite)	N/A	4 (High)	N/A	5 (Definite)	N/A	3 (Medium)	N/A	3 (Medium)	N/A	3 (Medium)	N/A	3 (Medium)	N/A
Significance	**80**	**N/A**	**52**	**N/A**	**80**	**N/A**	**33**	**N/A**	**33**	**N/A**	**39**	**N/A**	**39**	**N/A**
Status (positive or negative)	Negative													
Irreplaceable loss of resources	Yes, particularly woodland vegetation													
Can impacts be mitigated?	No													
Mitigation:	No mitigation available to negate the imapct of habiatat destruction in woodland and riparian areas													
Cumulative impacts:	Corridor 2, 5, 6, 8 and the corridor 8 deviation – cumulative impact is high (other impacts include an existing transmission power line, irrigated lands, road networks, housing and mining). Corridor 1 & 4 - cumulative impact is low, limited exisitng impacts													
Residual impacts:	High in pristine woodland and riparian areas (Corridors 1 & 4)													

Nature of the Impact: Disturbance (vulnerable breeding Red Data species include Martial Eagle, Tawny Eagle, White-backed Vulture, Cape Griffon and the various stork species)

	Corridor 1		Corridor 2		Corridor 4		Corridor 5		Corridor 6		Corridor 8		Corridor 8 Deviation	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Spatial Extent	3 (Regional)	2 (Local)	3 (Regional)	2 (Local)	3 (Regional)	2 (Local)	3 (Regional)	2 (Local)	3 (Regional)	2 (Local)	3 (Regional)	2 (Local)	3 (Regional)	2 (Local)
Duration	3 (Mid Term)	2 (Short Term)	3 (Mid Term)	2 (Short Term)	3 (Mid Term)	2 (Short Term)	3 (Mid Term)	2 (Short Term)	3 (Mid Term)	2 (Short Term)	3 (Mid Term)	2 (Short Term)	3 (Mid Term)	2 (Short Term)
Magnitude	4 (High)	3 (Moderate)	3 (Moderate)	2 (Low)	4 (High)	3 (Moderate)	3 (Moderate)	2 (Low)	3 (Moderate)	2 (Low)	3 (Moderate)	2 (Low)	3 (Moderate)	2 (Low)
Reversability	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)	3 (Recoverable)
Probability	4 (High)	3 (Medium)	3 (Medium)	3 (Medium)	4 (High)	3 (Medium)	2 (Low)	2 (Low)	2 (Low)	2 (Low)	3 (Medium)	3 (Medium)	3 (Medium)	3 (Medium)
Significance	**52**	**30**	**36**	**27**	**52**	**30**	**24**	**18**	**24**	**18**	**36**	**27**	**36**	**27**
Status (positive or negative)	Negative													
Irreplaceable loss of resources	Yes													
Can impacts be mitigated?	Yes													
Mitigation:	Identify active nests during walk down and limit contruction and unnecessary driving past nests during breeding times													
Cumulative impacts:	Corridor 2 - High (exisiting disturbance levels emanating from the settlements and agricultural practices) Corridor 5, 6, 8 and parts of the corridor 8 deviation - Medium (existing disturbance associated with maintenance of the existing power lines) Corridors 1 & 4 - Low													
Residual impacts:	Corridors 2, 5, 6 and 8 - Low Corridors 1 & 4 - Medium													