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Content

1. Introduction

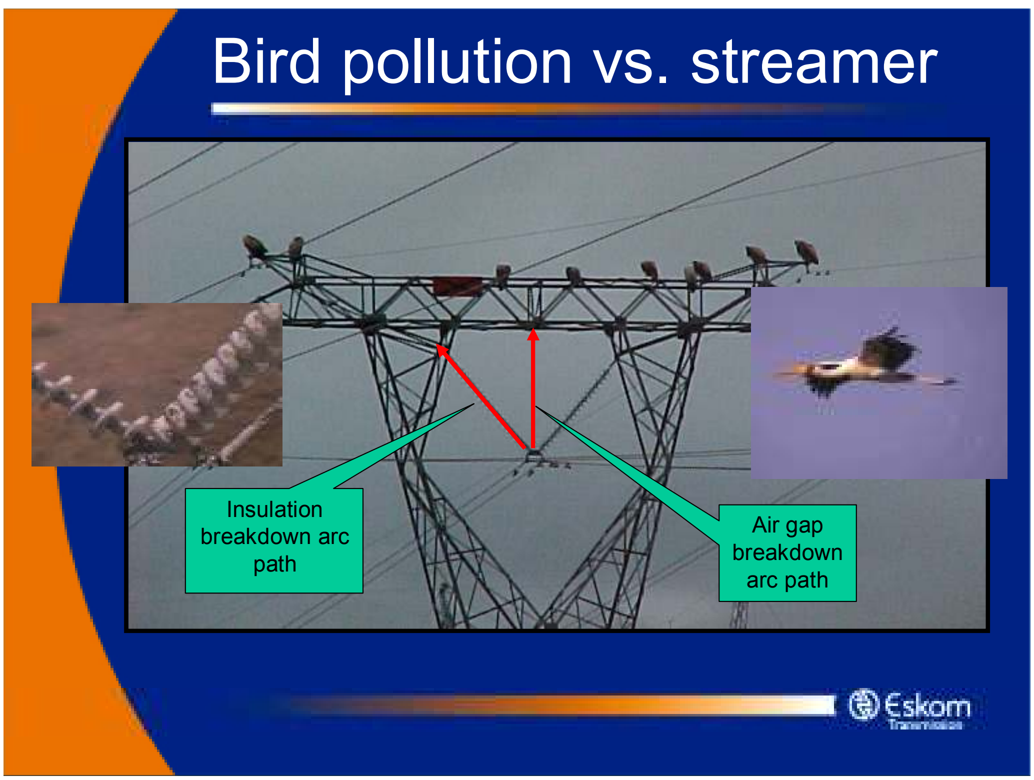
Birds of all descriptions use power line structures for perching and nesting purposes. These structures often are the only (or superior) substrate.

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 behaviour 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

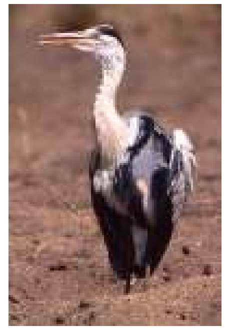
Large predatory birds tend to create the biggest risk of flashovers. Species such as ***vultures, herons, certain ibises and stork species, eagles and large hawks*** are high risk species. The presence of these birds on the towers is a strong indicator that bird streamers faults could be present.

Black Eagle

Cape Vulture

Martial Eagle

Grey Heron



3.6. Presence of dead birds under the towers

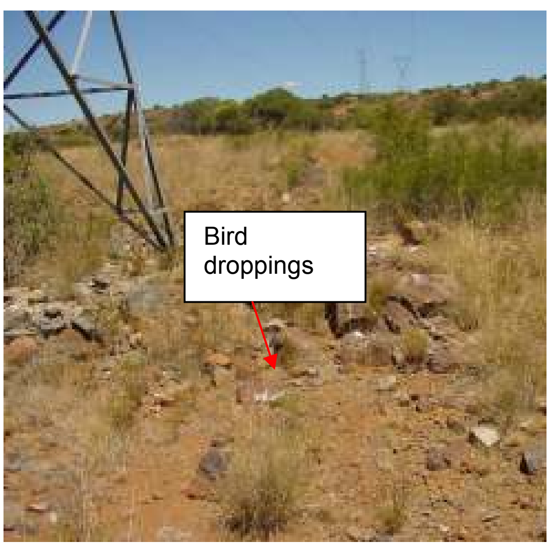
Although electrocution as a result of a bird streamer induced fault is a rare occurrence, it does occur. If dead birds with burn marks are found under structures ***with sufficient clearances to preclude any possibility of the bird having physically bridged the air gap with its body or wings***, it is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

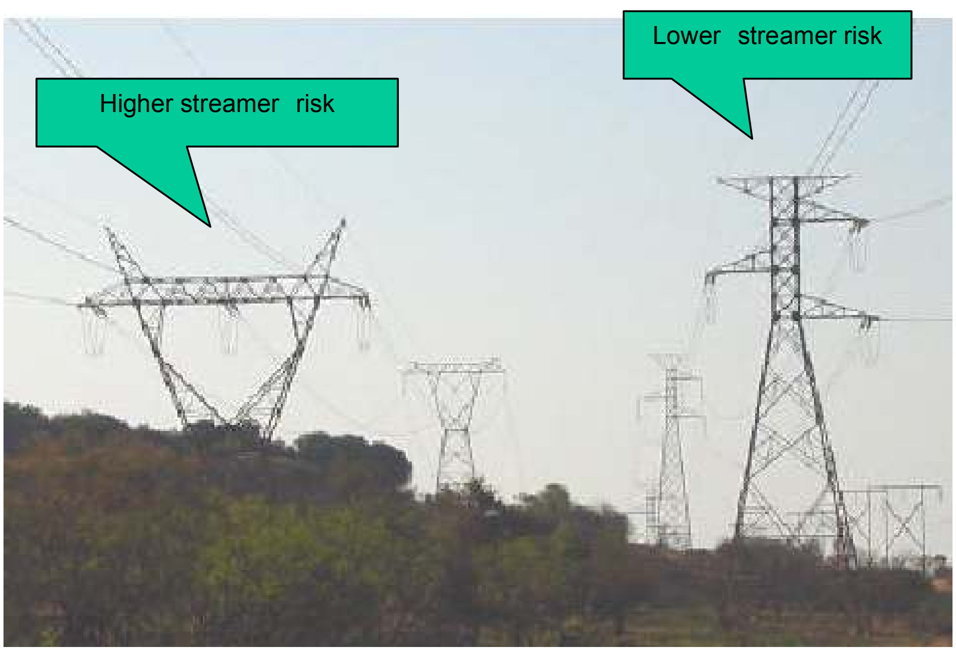
4.1. Micro fitting strategy

The tower configuration and design will determine the placement of bird guards. Care must be taken not to create new perches for birds during the installation process. Bird guards installed on near vertical tower members will result in this situation.

4.1.1. Tower design

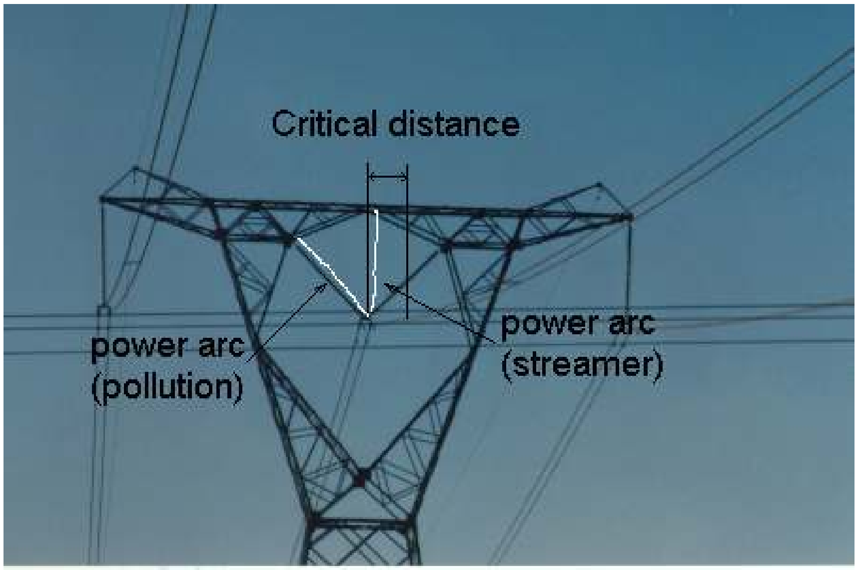
The tower design plays a major role with respect to bird streamer related faults. Vertically configured designs with ***ample perching space on top of the tower away from the cross-arms***, experience fewer faults than horizontally configured designs. The reason for this is that with the latter, the 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.

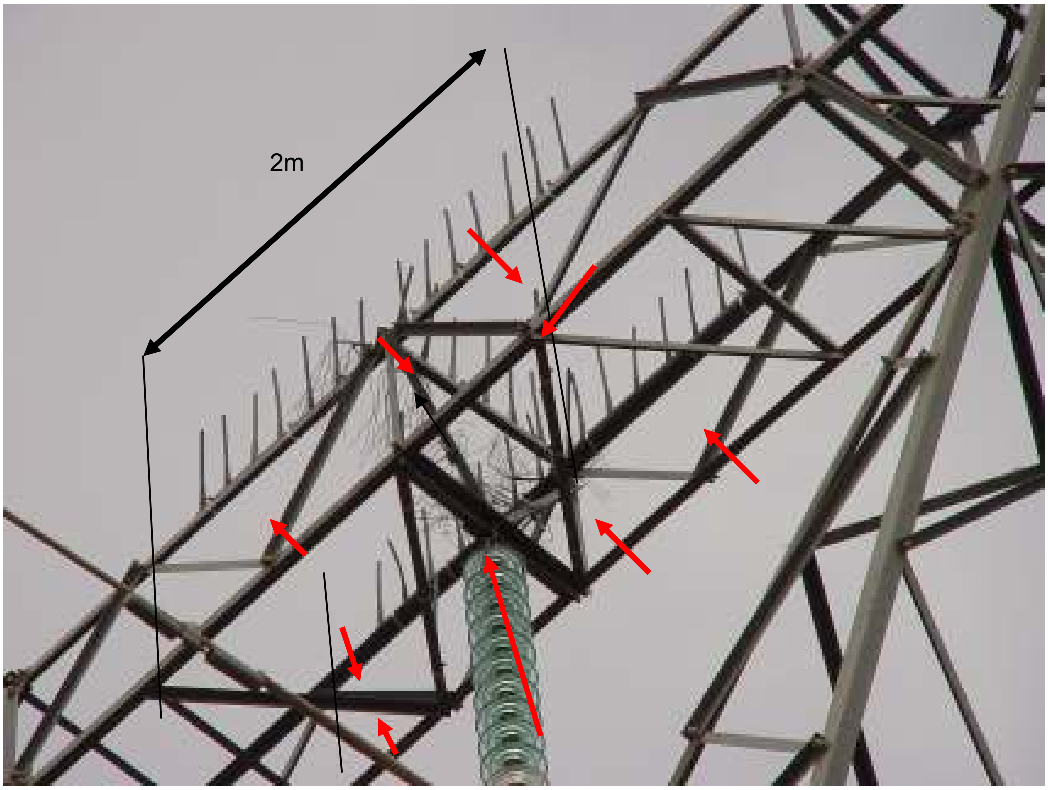
Picture of incorrect fitting leaving the landing plates exposed

4.1.3. V-strings and I-strings

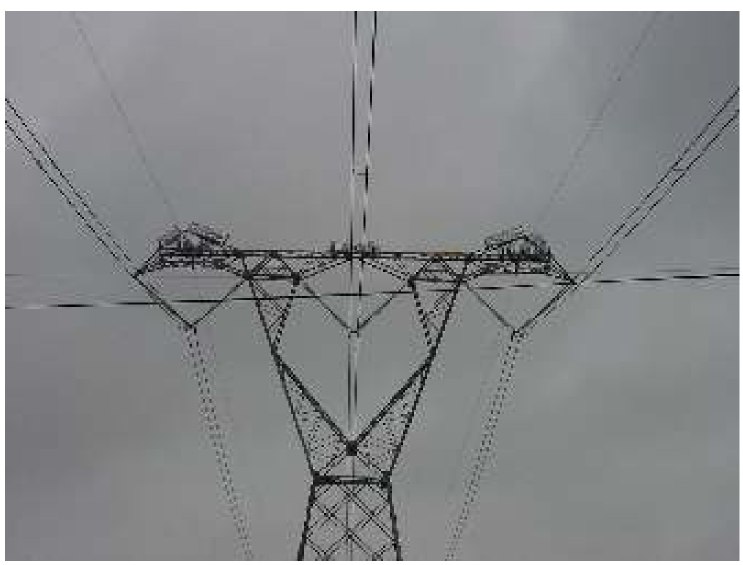
Although V-strings on centre phases were originally thought of as more vulnerable to streamer faults than the I-strings, experience has now shown that the latter are equally vulnerable and should also be protected with bird guards.

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.

4.3. Special circumstances

Results to date on lines that have been fitted with bird guards have resulted in an average of 80% reduction in bird faulting, and some lines have had a 100% reduction in bird related faulting. It is important to note though that bird guards are not a 100% solution under all circumstances. Isolated instances have been recorded where birds have managed to wedge themselves between bird guards. These incidents are always associated with extreme densities of birds on a particular tower or towers, and are often associated with super-abundance of food. To date the following examples have been recorded:

- Cape Vultures roosting in large numbers on towers at a vulture restaurant. The birds are very large and if they repeatedly force themselves between the bird guards, it will eventually result in bird guards collapsing.
- Large concentrations of Black-headed Herons have been observed on the Nyl River floodplain after the annual flooding. These birds roost in large numbers on the towers during this period, and individuals have managed to wedge themselves between the bird guards when many birds are roosting on one tower.
- One incident has been recorded where a Bald Ibis roosted in a steel bird guard. These birds habitually roost on transmission towers in large numbers and it must be assumed that that could happen, especially as the steel bird guards have bigger gaps between the rods than the plastic bird guards. It is not clear at this stage whether the same will happen with the standard plastic bird guards.

Special circumstances require special solutions, and each incident must be investigated with the help of an ornithologist to arrive at a solution. In doing so it must also be considered whether the level of faulting caused by these "special events" justifies the cost and effort to device a solution that will result in a 100% elimination of faults, especially if the faulting levels are very low and restricted to a short period of time each year."

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 Transmission power line structures.

8.2. Normative/Informative References

Parties using this 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

Refer to the latest research report publisher by ERID.

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

The implementation date is November 2006.

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:

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10. Revisions

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

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