BIRD GUARD PROJECT ON THE EROS KOKSTAD 132KV LINE

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SUMMARY

The Eros Kokstad 132kV line in the Eastern Region, Eskom Distribution in South Africa experienced numerous voltage dips and breaker auto-recloser operations during January 2000. Most of these faults were due to flashovers caused by bird streamers. From the statistical analysis performed on the quality of supply data, it was found that 45% of the voltage dips could be attributed to vulture activity on the towers. Numerous line patrols were performed on the line by the local Technical Service Center staff. Bird droppings on the insulators and flash over marks were found on some of the towers. Eskom staff found that the insulator strings on strain structures were been damaged by birds pecking away at the insulator sheds. The structures where the problems were experienced were situated within 300 metres of a nearby “vulture restaurant”. The carcass of a dead cow was placed at the restaurant when the cow had died due to illness. The restaurant was frequented by Cape Vultures and Pied Crows. A project was initiated to install bird guards and bird perches on the section of the line near the vulture restaurant. The bird guards installed on the crossarms were to prevent the vultures from perching over the insulator strings and releasing their streamers and the bird perches were installed on the tower peaks to provide alternative perching spots for the vultures. This paper provides an overview of the pilot project and the results of the field investigation and statistical analysis of available data. The recent results achieved so far with the bird guard project are shown with photographs and the relevant graphs of the results discussed.

BACKGROUND

The Eros Kokstad 132kV line is 52km long and connects the Eros substation near the town of Harding and the Kokstad substation at the town of Kokstad in Kwa-Zulu Natal, South Africa.

The line consists of Wolf conductor and mainly silicone rubber insulators installed on the towers with a few towers insulated with glass insulators. Most of the structures on the line are steel lattice type and 13m concrete H-poles. The first 31 structures out of Eros substation are 13m concrete H-poles. The line has two shield wires for lightning protection.

The Eros Kokstad 132kV line is a relatively new (1999) line in the Kokstad area. A section of the line runs through the nearby Ngeli forest. The rest of the line is in open, hilly, bushveld. The Kokstad area is in a medium lightning density area with an average ground flash density of 6 to 7 flashes/km^2/year.

The Kokstad Plains 88kV line (Mink conductor) runs parallel to the Eros Kokstad 132kV line for 50km, before both lines turn into the Kokstad substation. Tower footing resistance tests were conducted on both lines and the measured values were found to be acceptable.

PROBLEM ANALYSIS

During the month of January 2000, numerous voltage dips and breaker auto-recloser operations (ARCs) were experienced on the Eros Kokstad 132kV line. For the month of January 2000, 5 ARCs and 17 voltage dips were recorded. This performance level for a 132kV network was unacceptable and a performance investigation was initiated by the Eskom Plant Department [1].

Numerous line patrols were performed by the local Kokstad Technical Service Centre (TSC). Bird droppings were found on some of the insulator strings and flashover marks were found on the tower structures.

Vultures were found to be perching on the suspension towers above the crossarms and their streamers were causing phase-to-earth faults on the line. The TSC staff also reported that they had twice found a dead (electrocuted) vulture under the towers in the same section of line.

From the discussions by the author with the local TSC staff, it was found that in the past previous attempts had been made the TSC staff. The staff had tried to counter the pollution of the insulators by placing dustbin lids above some of the insulator strings. Bird perches were also installed on the tower peaks in order to draw the birds away from critical areas on the towers.

These practical measures did not bring about an improvement in the performance of the line. Some of the existing glass insulators were replaced with composite silicone insulators to try and counter any pollution related flashovers.

However, the TSC staff soon noticed that the insulator strings on the strain towers were been damaged by birds pecking away at the insulator sheds. The damage was across the entire string including the live end. The damage was very evident and reported to the Eskom Plant Department [1].

The distance to fault locators (impedance based) at Kokstad substation indicated the source of the faults occurred about 12km from the Kokstad substation. This was in the same section of the line as where the dead vultures, flashover marks and bird droppings were found by the TSC staff [1].

FIELD INVESTIGATION

A field investigation was arranged during February 2000 with representatives from the Eskom Plant Department, Eskom Field Services Department, Eskom Transmission, Eskom Endangered Wildlife Trust (EWT) and the farm owner (Mr Bastard). At the field meeting the structures were inspected on Mr. Bastard's farm, the problems on the line discussed and various recommendations put forward for action.

It was found that the structures where the problems were experienced were situated within 300 metres of a nearby "vulture restaurant". This vulture restaurant was a nearby hilltop where the carcasses of dead cows were placed. The restaurant was frequented by about to 60 Cape Vultures at a time, as well as a large number of Pied Crows.

The owner used the vulture restaurant as an integral part of his waste disposal program on the farm. The vultures had taken to perching on the several towers in the vicinity of the vulture restaurant waiting for possible food.

BIRD INTERACTION ON TRANSMISSION LINES

Vulture species

There are two main species of vultures in South Africa. The Cape vultures have a population of 12 000 and are distributed mostly in the east and north of South Africa. The White Backed vultures have a population of 40 000 and are found mainly along the northern and eastern parts of the continent of Africa.

Both these species of vultures are known to cover vast areas in search of food. These birds have been observed 250 km from nesting sites and as much as 980 km from their nesting sites in extreme cases [2].

Faults due to birds

In the past, the Engineering community determined that faults experienced on the transmission networks caused by birds were minimal and consisted of about 1% to 2% of the total number of line faults on the networks. This has however been determined by Eskom Transmission to be of a larger percentage of the total line faults [2].

Bird interactions with distribution lines are known to result in a variety of line faults. These types of network interactions consist of the following :

- Electrocutions
- Transmission line collisions
- Bird nests on structures
- Classical pollution
- Bird streamers

The interactions of vultures with distribution lines which are of importance to this project are the electrocutions and bird streamers.

Bird streamers

Faults caused by bird streamers occur when the air gap is bridged by a continuous or partial stream of bird excrement resulting in a line fault. If a streamer then encroaches the air gap clearance of the affected insulator assembly then a breakdown could result.

The arc would then propagate across a few insulator sheds and then vertically up the air gap. In this manner bird streamers could bridge air gap clearances which are much larger than the streamer. This mechanism partially explains why V-string assemblies are more susceptible to streamer breakdown than I-strings [2].

STATISTICAL ANALYSIS OF QUALITY OF SUPPLY DATA

The quality of supply data (QOS) was analysed for the period December 1999 to March 2000. It was found that 15 of the 17 voltage dips experienced on the line were single phase dips. A time-of-day-analysis was also performed to try and identify possible daily trends in the faults [1].

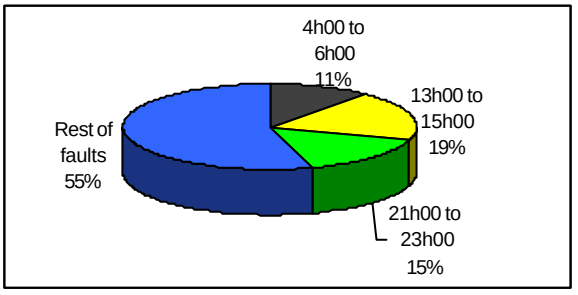

Figure 1 Time of day analysis of the faults on Eros Kokstad 132kV line

Figure 1 above shows that 45% of the faults on the line occurred during the periods of known vulture activity (4h00 to 6h00 and 21h00 to 23h00). The period 13h00 to 15h00 is less clear, but could be due to the fact that carcasses were put out during that time of day. Also often several vultures will remain on the towers throughout the day near the vicinity of food.

Figure 2 below shows that 88% of the faults were phase to earth faults which is characteristic of a bird streamer fault. Majority of the voltage dips were Y class dips as classified by the South African NRS 048 Standard.

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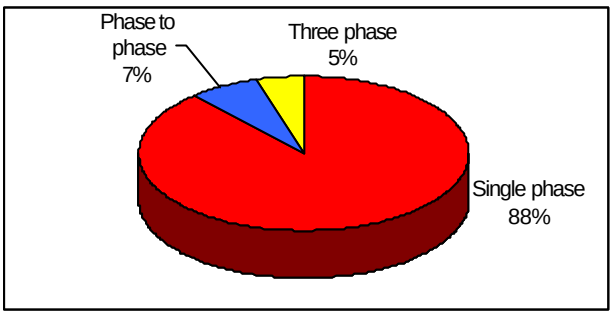

Figure 2 Phases effected by the faults on the Eros Kokstad 132kV line

FINDINGS AND RECOMMENDATIONS

From the information gathered at the site investigation meeting, personal line patrols by the author and patrols by the local TSC and from discussions with C. van Rooyen (EWT) and H. Vosloo and M. Connor (Eskom Transmission) the following was proposed : [1] [3]

The excessive number of faults on the Eros Kokstad 132kV line was most likely caused by a combination of vulture electrocutions and vulture streamers that caused flashovers when the birds used the towers in the vicinity of the vulture restaurant to perch on.

The vultures were electrocuted when they attempted to perch on the bottom crossarm and in that manner bridged the air gap between the earthed steel structure and live jumper conductor. A flashover happened when a vulture perched on a crossarm and produced a streamer that passed within the limit of a jumper conductor or I-string to cause an air gap breakdown and hence a flashover.

The damage on the strain insulators was likely caused by the Pied Crows and possibly the Cape Vultures pecking away at the silicone sheds.

Both species of birds are inquisitive and intelligent creatures and are prone to ‘investigating” by pecking any strange object that is within their reach, especially while perching on the crossarm. The damage at the extreme ends of the insulator strings suggested that the crows were the most likely culprits.

Vultures would not be able to reach that far across a 132kV insulator from a perched position on the crossarm. Crows are light and nimble and probably perched on the insulator string and therefore could reach all the sheds.

Re-locating the vulture restaurant will not improve the current situation on the line. The towers that the birds perched on are situated against a slope that provides ideal lift for the vultures when taking off or landing. Vultures are creatures of habit and will continue perching on those towers even, if the restaurant is shifted several kilometres away. The problem might be shifted to a new set of towers like the nearby, parallel running Kokstad Plains 88kV line.

Terminating the feeding by stopping the vulture restaurant would be undesirable from the landowner's point of view as it forms an integral part of his farming operations and his waste management system.

It is suggested that the best method would be to discourage the birds to perch in those areas of the tower where they could cause a flashover. These areas should be within one metre or less from the end of the cross-arms. The best way to produce this result would be to install suitable bird guards on the crossarms of identified problem towers [1] [3].

PROJECT IMPLEMENTATION

The pilot project was completed by the end of July 2000. A section of line consisting of 31 towers on the Eros Kokstad 132kV line and 38 towers on the Kokstad Plains 88kV line had bird guards installed on them. Each tower peak had a bird perch installed on them to provide alternate perching sites for the vultures [1].

Ten towers on Mr. Bastard's farm were identified and then approximately ten towers on either side were also chosen to ensure that the birds did not move down the line and perch on other towers.

The bird guard is a black, PVC comb-like object that is mounted vertically on the crossarm. Figure 5 below shows how the practical methods have been installed on a tower. The bird perch consists of 3m angle iron.

PROJECT RESULTS

The project results are shown in Figure 3 and Figure 4 below for each line. The "before and after statistics" are for the period January 2000 to February 2001. The number of single phase faults and number ARCs for the entire line are shown.

The large number of ARCs experienced in January and February 2001 are due to the numerous storms experienced during that period. The statistics show the impact that the bird guards have had on the performance of both lines.

Figure 5 below demonstrates how the bird perches on the tower peaks have had the desired effect.

The vultures have been re-located on the towers away from the crossarms and are perching on the bird perches on the tower peaks.

CONCLUSIONS

A pilot bird guard project was implemented in the Eastern Region on two networks. The results so far are promising and the lines are still been monitored.

REFERENCES

[1] BG Chatterton : *"Investigation into the faults on the Eros Kokstad 132kV line in the Kokstad Area"*, Performance Report, March 2000.

[2] PV Taylor et al : *" Unknown Category of MTS Line Faults; Bird Streamers as a cause of Transient Earth Faults"*, Transmission Progress Report, July 1999.

[3] C van Rooyen : *"Investigation into suspected bird faults on distribution lines in the Kokstad area of Kwa-Zulu Natal"*, EWT Investigation Report, February 2000.

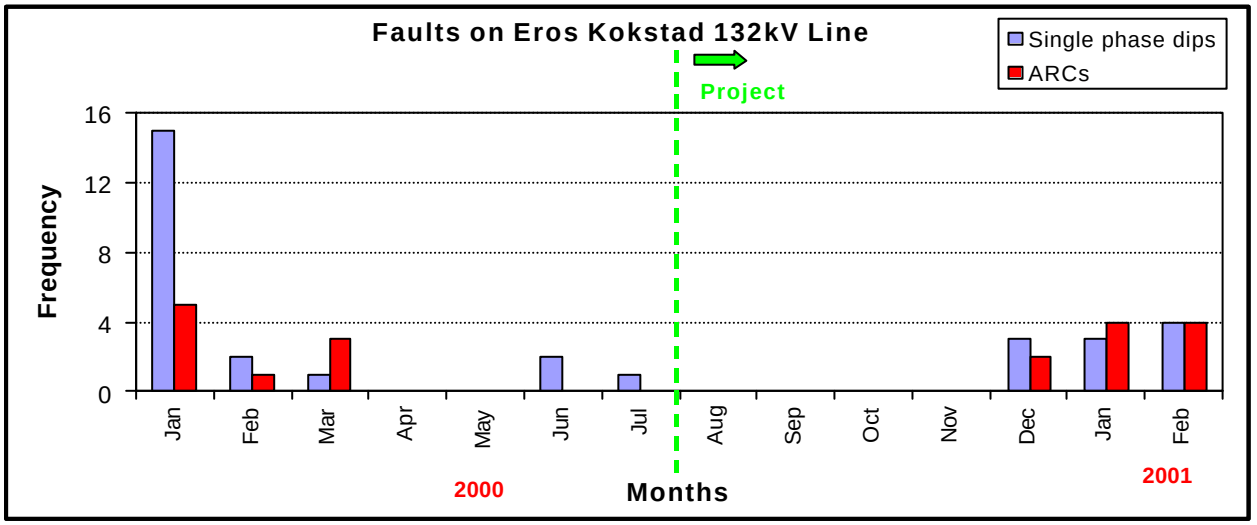

Figure 3 Results of Eros Kokstad 132kV line

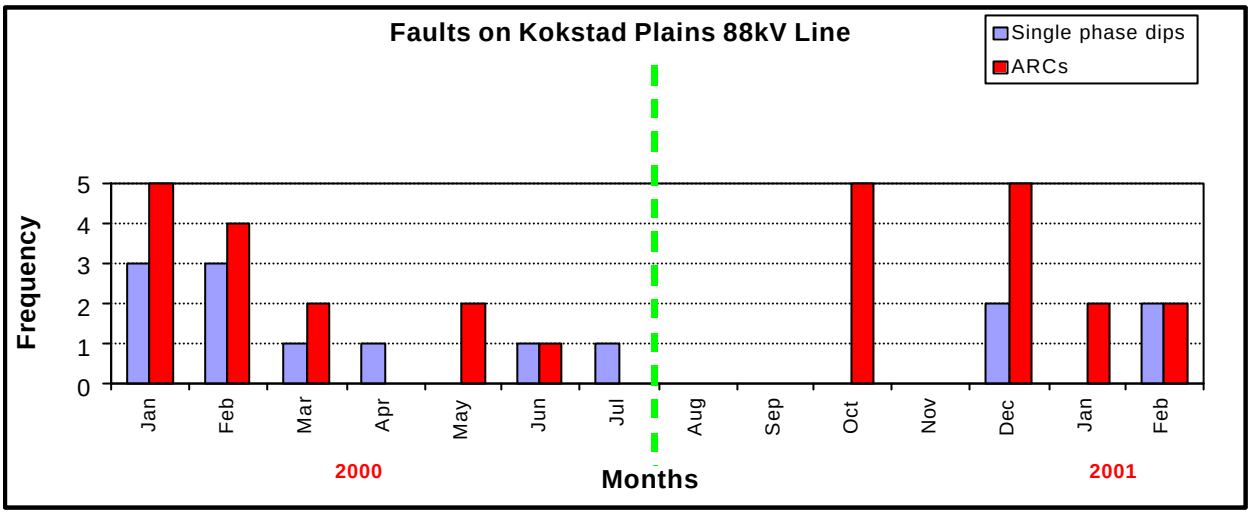

Figure 4 Results of Kokstad Plains 88kV line

Figure 5 Vultures perching on a tower on the Eros Kokstad 132kV line

Short Curriculum Vitae

Baden Chatterton is an Electrical Engineer who is employed as a Network and Plant Performance Enhancer for Eskom Distribution, Eastern Region (Kwa-Zulu Natal) in South Africa. He graduated from the University of Natal in 1997 with a BSc(Eng.) and is busy completing his MSc(Eng.) studies part time at the University of Natal. Baden Chatterton is also a member of Eskom national Work Groups looking at performance and insulation co-ordination issues of networks and equipment on a national level in the Distribution business. Baden Chatterton is a member of the South African Institute of Electrical Engineers (SAIEE) and an associate member of the Institute for Electrical Engineers (IEE). He can be contacted at +27 31 710 5058 or at chatteBG@eskom.co.za.