Bird Impact Assessment Study
Bravo Integration Project: Phase 5

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Executive summary

This bird impact assessment study focuses on identifying a preferred alignment for the new Bravo-Vulcan 400kV line from a bird impact perspective, and the description of associated impacts on birds. Recommendations are also provided to mitigate for potential impacts.

The following conclusions are put forward:

- A number of power line sensitive, Red Data species could potentially occur along any of the alignments, although the occurrence of these species would be the exception rather than the rule.
- The proposed power line, **unless mitigated**, will pose a limited collision risk to power line sensitive bird species in the study area. Another potential risk is the destruction of sensitive wetland habitat through the construction of access roads.
- Of the Red Data species potentially present in the area, none are particularly at risk by the power line due to the very small densities at which the species occur. The latter is a result of the extensive habitat degradation that has taken place.
- There is, however, a substantial risk of collisions for several non Red Data species which warrants the application of mitigation measures.

The following recommendations are put forward:

- A sensitivity map indicating the areas where anti-collision devices need to be applied to the proposed line is attached as APPENDIX B.
- The construction of access roads in sensitive wetland habitat should be avoided.

1 Background

1.1 Project background

The growing demand for electricity is placing increasing pressure on Eskom's existing power generation and transmission capacity. Eskom are committed to implementing a Sustainable Energy Strategy that complements the policies and strategies of National Government. Eskom aims to improve the reliability of electricity supply to the country, and in particular to provide for the growth in electricity demand in the Gauteng and Mpumalanga provinces. For this reason, Eskom obtained environmental authorisation to construct the new 400 kV Bravo (Kusile) Power Station between Bronkhorstspruit and Witbank in 2007. Construction of this power station has already commenced.

The new Bravo power station needs to be integrated with the existing Eskom electricity infrastructure. As part of this integration process, Eskom propose to construct a 400kV overhead power line, by-passing the existing Duvha substation, to form a new Bravo-Vulcan line near Middelburg, Mpumalanga. This by-pass line is planned to be approximately 10km in length. The area that was investigated for this by-pass line is a 10km radius surrounding the existing Duvha substation.

1.2 Scope of work

This bird impact assessment study focuses on identifying a preferred alignment for the new Bravo-Vulcan 400kV line from a bird impact perspective, and the description of associated impacts on birds. Recommendations are also provided to mitigate for potential impacts.

1.3 Description of typical impacts of power lines on birds

Because of their size and prominence, electrical infrastructures constitute an important interface between wildlife and man. Negative interactions between wildlife and electricity structures take many forms, but two common problems in southern Africa are electrocution of birds and other animals and birds colliding with power lines. (Ledger & Annegarn 1981; Ledger 1983; Ledger 1984; Hobbs & Ledger 1986a; Hobbs & Ledger 1986b; Ledger et al. 1992; Verdoorn 1996; Kruger & Van Rooyen 1998; Van Rooyen 1998; Kruger 1999; Van Rooyen 1999; Van Rooyen 2000, Anderson 2001). Other problems are electrical faults caused by bird excreta when roosting or breeding on electricity infrastructure (Van Rooyen *et.al*. 2002), and disturbance and habitat destruction during construction and maintenance activities.

1.3.1 Electrocutions

Large birds of prey are the most commonly electrocuted on power lines. The large transmission lines from 220 kV to the massive 765 kV structures are usually not a threat to large raptors, because the pylons are designed in such a manner that the birds do not perch in close proximity the potentially lethal conductors. In fact, these power lines have proved to be beneficial to birds such as Martial Eagles *Polemaetus bellicosus*, Tawny Eagles *Aquila rapax*, White-backed Vultures *Gyps africanus*, and even occasionally Verreaux's Eagles *Aquila verreauxii* by providing safe nesting and roosting sites in areas where suitable natural alternatives are scarce (pers.obs). Cape Vultures have also taken to roosting on power lines in certain areas in large numbers, while Lappet-faced Vultures *Torgos tracheliotis* are increasingly using power lines as roosts, especially in the Northern Cape (pers.obs.).

Unfortunately, the same can not be said of the smaller sub-transmission and reticulation lines of 11kV to 132kV (Van Rooyen 1998; 2000). Raptors and vultures instinctively seek out the highest vantage point as suitable perches from where they scan the surrounding area for prey or carrion. In flat, treeless habitat power pylons often provide ideal vantage points for this purpose. The vast majority of electrical structures were designed and constructed at a time when the awareness of the danger that they pose for raptors was very limited or totally absent. Depending on the design of the pole, a large raptor can potentially touch two live components or a live and earthed component simultaneously, almost inevitably resulting in instant electrocution and a concomitant disruption in the electrical supply (Van Rooyen 1998).

1.3.2 Collisions

Anderson (2001) summarizes collisions as a source of avian mortality as follows:

"The collision of large terrestrial birds with the wires of utility structures, and especially power lines, has been determined to be one of the most important mortality factors for this group of birds in South Africa (Herholdt 1988; Johnsgard 1991; Allan 1997). It is possible that the populations of two southern African endemic bird species, the Ludwig's Bustard *Neotis ludwigii* and Blue Crane *Anthropoides paradiseus*, may be in decline because of this single mortality factor (Anderson 2000; McCann 2000). The Ludwig's Bustard (Anderson 2000) and Blue Crane (McCann 2000) are both listed as "vulnerable" in The Eskom Red Data Book of Birds of South Africa, Lesotho & Swaziland (Barnes 2000) and it has been suggested that power line collisions is one of the factors which is responsible for these birds' present precarious conservation status

Collisions with power lines and especially overhead earth-wires have been documented as a source of mortality for a large number of avian species (e.g. Beaulaurier et al. 1982; Bevanger 1994, 1998). In southern Africa, this problem has until recently received only limited attention. Several studies however have identified bird collisions with power lines as a potentially important mortality factor (for example, Brown & Lawson 1989; Longridge 1989). Ledger *et al.*(1993), Ledger (1994) and Van Rooyen & Ledger (1999) have provided overviews of bird interactions with power lines in South Africa. Bird collisions in this country have been mainly limited to Greater and Lesser Flamingos, various species of waterbirds (ducks, geese, and waders), Stanley's *Neotis denhami* and Ludwig's Bustards, White Storks *Ciconia ciconia*, and Wattled *Grus carunculatus*, Grey Crowned *Balearica regulorum* and Blue Cranes (for example, Jarvis 1974; Johnson 1984; Hobbs 1987; Longridge 1989; Van Rooyen & Ledger (1999)). Certain groups of birds are more susceptible to collisions, namely the species which are slow fliers and which have limited maneuverability (as a result of high wing loading) (Bevanger 1994). Birds which regularly fly between roosting and feeding grounds, undertake regular migratory or nomadic movements, fly in flocks, or fly during low-light conditions are also vulnerable. Other factors which can influence collision frequency include the age of the bird (younger birds are less experienced fliers), weather factors (decreased visibility, strong winds, etc.), terrain characteristics and power line placement (lines that cross the flight paths of birds), power line configuration (the larger structures are more hazardous [for collisions, with electrocutions the opposite is the case]), human activity (which may cause birds to panic and fly into the overhead lines), and familiarity of the birds with the area (therefore nomadic Ludwig's Bustards would be more susceptible) (Anderson 1978; APLIC 1994).

Although collision mortality rarely affects healthy populations with good reproductive success, collisions can be biologically significant to local populations (Beer & Ogilvie 1972) and endangered species (Thompson 1978; Faanes 1987). The loss of hundreds of Northern Black Korhaans *Eupodotis afraoides* due to power line collisions would probably not affect the success of the total population of this species and would probably not be biologically significant, but if one Wattled Crane was killed due to a collision, that event could have an effect on the population that would be considered biologically significant. Biological significance is an important factor that should be considered when prioritising mitigation measures. Biological significance is the effect of collision mortality upon a bird population's ability to sustain or increase its numbers locally and throughout the range of the species.

Unfortunately, many of the species that are collision sensitive are considered as threatened in southern Africa. Of the five species most affected by transmission line collisions (Van Rooyen 2006) namely the

Blue Crane, White Stork, Greater Flamingo *Phoenicopterus ruber*, Ludwig's Bustard and Cape Vulture, three are potentially present in this study area. It should be noted that these statistics are based on reported mortalities only, while it is suspected that a big number of mortalities go unreported. In one instance, where bi-monthly monitoring did take place, a single 10km section of 132kV distribution line killed 59 Blue Cranes, 29 Ludwig's Bustard, and 13 White Storks during a three year period. In 2004, fifty-four Blue Crane carcasses were discovered near Graaf-Reinet in the Northern Cape province under 3.7km of distribution line (Van Rooyen unpubl. data).

The Red Data species that are vulnerable to power line collisions are often 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 hardly had any successful breeding attempts at Etosha Pan in Namibia for several decades. Another example is the Great White Pelican *Pelecanus onocrotalus* that only breeds successfully at Dassen Island in the Western Cape. These types of species (which include the Blue Crane, which is potentially present in the study area) 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, poisonings, 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.

From the figures quoted above, it is clear that power lines can be 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 present, especially in the case of regionally threatened species such as the Blue Crane in the present study area.

1.3.3 Habitat destruction

During the construction phase and maintenance of power lines, some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads, and the clearing of servitudes. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line which can result in electrical flashovers. These activities could have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude, through destruction of habitat

1.3.4 Disturbance

The construction of a power line can be highly disturbing to birds breeding in the vicinity of the construction activities. Many birds are highly susceptible to disturbance, and should this disturbance take place during a critical time in the breeding cycle, for example when the eggs have not hatched or just prior to the chick fledging, it could lead to temporary or permanent abandonment of the nest or premature fledging. In both instances, the consequences are almost invariably fatal for the eggs or the fledgling. Such a sequence of events can have far reaching implications for certain large, rare species that only breed once a year or once every two years.

1.4 Bird habitats in the study area

The study area falls in the 2529CD quarter degree square. The following distinct bird habitats were identified in the study area during field visits in December 2008 (see APPENDIX A for examples of the micro-habitat):

- Wetlands and dams: This habitat is represented in the study area by man-made impoundments (dams) and watercourses. The largest and most prominent water body in the immediate vicinity of the proposed line is the Witbank Dam. There are also several additional smaller dams in the study area. The most important watercourse in the study area is the Olifants River, which is the water source for the Witbank dam. There are also a couple of smaller drainage lines that drain into the Witbank Dam. Some of these drainage lines have extensive wetlands areas adjacent to them. Several of the Red Data species that have been recorded in 2529CD could potentially make use of the dams and wetlands in the study area. These include Blue Crane, Yellow-billed Stork *Mycteria ibis*, Black Stork *Ciconia nigra*, Greater Flamingo, Lesser Flamingo *Phoenicopterus minor* and Caspian Tern *Sterna caspia*. Apart from these species, many non-Red Data species could also use this habitat, including several species of waders, herons and ducks. It must be noted though that, despite the occurrence of what seem to be suitable wetlands and exposed shoreline for the afore-mentioned Red Data species, the man-made disturbance levels and impacts of industrial infrastructure, especially power lines and roads are extensive. Furthermore, the Witbank Dam is an important recreational area and attracts large numbers of anglers that camp around the edges of the dam. This no doubt has a huge impact on the suitability of the area for the aforementioned species- the power lines are a major collision risk for cranes, storks and flamingos, and the constant presence of anglers around the dam will be a major source of disturbance for potential shoreline feeders such as Black Stork and Yellow-billed Stork. Other threats are pollution by industrial waste, sewage and fertilisers; siltation, landfill, boating, water-skiing, while recent counts of waterbirds also indicate a high number of domestic waterbird species (CWAC 2008).
- Dryland cultivation: The study area contains a few active agricultural lands. Data from the Co-ordinated Avifaunal Road Count (CAR) Project indicate that agricultural land is used to a limited by large terrestrial birds in the Mpumalanga highveld, and that they prefer natural grassland. Fallow fields are used to a limited extent by Blue Cranes in summer, and pastures are used by Southern Bald Ibis *Geronticus calvus*. Blue Cranes also use recently ploughed fields in winter (Young *et.al.* 2003).
- Grassland: A few pockets of untransformed natural grassland have remained in the study area, as well as abandoned lands that have reverted back to grassland. The CAR data indicate that natural grassland remains the preferred habitat of large terrestrial birds in the Mpumalanga highveld (Young *et.al*. 2003). The low reporting rate for grassland species such as Blue Crane and Denham's Bustard *Neotis denhami* in the Bird Atlas data for 2529CD (Harrison *et.al*.1997) could be the result of the extensive fragmentation of natural grassland by agriculture, opencast mining and associated infrastructure, particularly power lines and roads. On the other hand, several typical grassland species were recorded in 2529CD including White-bellied Korhaan *Eupodotis senegalensis*, Secretarybird *Sagittarius serpentarius* and Lesser Kestrel *Falco naumanni*. In the study area, the high levels of disturbance and the multitude of power lines make the occurrence of the larger terrestrial species such as Blue Crane, Denham's Bustard and Secretarybird unlikely, but the smaller, less conspicuous species such as White-bellied Korhaan and possibly the occasional Southern Bald Ibis might well be still present.

2 Power line sensitive bird species

Generally speaking, it is unavoidable that birds get killed through interaction with electricity infrastructure, including power lines, despite the best possible mitigation measures. It is therefore important to direct risk assessments and mitigation efforts towards species that have a high biological significance, in order to achieve maximum results with the available resources at hand.

In accordance with this principle, the risk assessment is primarily aimed at assessing the potential threat to Red Data species (see the concept of biological significance under 1.3.2).

The methodology that was used to predict impacts in the current study was as follows:

- The Atlas of Southern African Birds (Harrison *et.al.* 1997) species list for the relevant quarter degree square - 2529CD - within which the study area is located was obtained from the SANBI website (http://www.birds.sanbi.org). This information was supplemented with information from the CAR Project, as well as the Co-ordinated Waterbird Counts Project (CWAC).
- The study area was inspected with a vehicle and on foot to obtain first-hand perspectives of the proposed alternatives, birdlife and bird habitats.
- High resolution Google Earth satellite imagery was used to delineate the different sensitivity zones in the study area for purposes of a sensitivity map (see APPENDIX B).
- The impacts were predicted on the basis of experience by the author in gathering and analysing data on wildlife impacts with power lines throughout southern Africa since 1996 (see van Rooyen & Ledger 1999 for an overview of methodology), supplemented with first hand data obtained during the field visit.

The Red Data bird species that was recorded by the Bird Atlas project in the relevant quarter degree square is listed in Table 1 below. The square was well surveyed during the atlas period with a total of 256 cards completed. The reporting rates are an indication of densities on the ground – the number in the reporting rate column represents the percentage of cards on which a species was recorded. Reporting rates for Red Data species were generally low, indicating that the impacts on the habitat have been extensive, reducing most of the species basically to the status of vagrants.

Table 1: Red Data species recorded in 2529CD

Species	**Reporting rate %**	**Conservation status (Barnes 2000)**	**Habitat requirements (Barnes 2000; Hockey *et al* 2005; Harrison *et al* 1997; Young et al 2003; personal observations)**
YELLOW-BILLED STORK *Mycteria ibis*	1.6	near threatened	Always associated with water – dams, wetlands, rivers, marshes, even small pools. **Vulnerable to collision with power lines**
BLACK STORK *Ciconia nigra*	0.4	Near threatened	Associated with rivers, dams and cliffs. **Vulnerable to collision with power lines**
SOUTHERN BALD IBIS *Geronticus calvus*	0.4	vulnerable	Likely to be found on recently burnt ground and unburnt, shortgrazed grassland, cultivated pastures, reaped maize fields and ploughed lands. **Vulnerable to collision with power lines.**
SECRETARYBIRD *Sagittarius serpentarius*	3.1	near threatened	Prefer open grassland, densities low in maize growing areas. **Vulnerable to collisions with power lines.**
WHITE-BELLIED KORHAAN *Eupodotis senegalensis*	0.4	vulnerable	Often in the interface between grassland and savanna. Avoids severely grazed and recently burnt sites. **Vulnerability to power line collisions** tempered by reluctance to fly long distances

LESSER FLAMINGO *Phoenicopterus minor*	1.6	near threatened	Moves extensively between waterbodies. May be found in small numbers on any suitable dam. **Vulnerable to power line collisions**.
GREATER FLAMINGO *Phoenicopterus ruber*	7.0	near threatened	Moves extensively between waterbodies. May be found in small numbers on any suitable dam. **Vulnerable to power line collisions**.
LESSER KESTREL *Falco naumanni*	5.1	vulnerable	**No negative impacts expected from power line.** Small and nimble species, likely to use the power line as hunting perch.
AFRICAN GRASS-OWL *Tyto capensis*	0.4	vulnerable	Likely to be found in rank grass. **Could be vulnerable to collisions with power line** as potentially suitable habitat could exist in wetlands.
DENHAM'S BUSTARD *Neotis denhami*		vulnerable	Prefer open grassland, densities low in maize growing areas. **Vulnerable to collisions with power lines.**
BLUE CRANE *Anthropoides paradiseus*	0.8	vulnerable	Low reporting rate but occasional presence cannot be discounted in the pockets of remaining grassland and wetlands. **Vulnerable to collisions with power lines.**

3 Discussion

3.1 Electrocutions

Fortunately, the electrocution risk on the future 400kV power line is non-existent, due to the large clearances between the phases and the earthed components on the structures. No bird is able to bridge those clearances with its body parts; therefore no electrocution risk is present.

3.2 Collisions

The most likely impact that the proposed line will have is bird collisions with the overhead earth wire. This impact is most likely to occur close to wetlands, where the line skirts a dam or where it is positioned across a drainage line. Species at risk are water birds of several species, including flamingos where it skirts larger dams, particularly the Witbank Dam. Collision hazards also exist where the line will cross pockets of natural grassland, as this is the preferred habitat of most of the remaining large terrestrial Red Data species, including the Blue Crane, Southern Bald Ibis and Secretarybird in the Mpumalanga highveld. The first two species also use stubble fields to a limited extent. As mentioned earlier, the impacts that are evident in the study area have been severe, reducing most Red Data, large terrestrial species to vagrants. However, there are substantial numbers of Non Red Data power line sensitive species in the study area that have managed to survive and even thrive in some instances despite the habitat degradation that have occurred. In some instances, man-made developments such as the proliferation of artificial water bodies, including the Witbank Dam, have benefited certain species. Examples of those are Red-knobbed Coot *Fulica cristata*, Reed Cormorant *Phalacrocorax africanus*, Egyptian Goose *Alopochen aegyptiaca*, White-breasted Cormorant *Phalacrocorax lucidus*, Black-headed Heron *Ardea melanocephala*, Grey Heron *Ardea cinerea* and Yellow-billed Duck *Anas undulata*. These species (and many other non Red Data ducks, herons and waders) also run the risk of collision with the proposed power lines.

3.3 Habitat destruction

A limited degree of habitat destruction always takes place when a power line is constructed. In this instance large sections of the study area have been intensively transformed through agriculture and industrial development, which has destroyed a significant portion of the original habitat. However, there are wetlands in the study area that could be damaged in the course of construction activities, which could in turn impact on birds using in the wetlands. Generally speaking though, habitat destruction is not foreseen as a major impact.

3.4 Disturbance

No significant disturbance of birds is foreseen. Such disturbance as would take place is likely to be temporary and should cease after the construction of the line.

4 Identifying a preferred alignment

One of the objectives of this study is to arrive at a preferred corridor for the proposed power line in terms of impacts on avifauna. The following factors were incorporated in the formula to arrive at a preferred corridor, using high resolution Google Earth satellite imagery as the main source of data:

- Wetlands and dams: Wetlands and dams are always of particular importance for birds. The presence of wetlands and dams are an indicator of a higher collision risk.
- Drainage lines: The study area contains a few small drainage lines. These drainage lines are obviously important for birds and many water bird species occur along these drainage lines. Drainage lines are therefore an indication of a higher collision risk.
- Transmission lines: It is a proven fact that placing a new line next to an existing line reduces the risk of collisions to birds. The reasons for that are two-fold namely it creates a more visible obstacle to birds and the resident birds, particularly breeding adults, are used to an obstacle in that geographic location and have learnt to avoid it (APLIC 1994; Sundar & Choudhury 2005). Other transmission lines running parallel to the proposed alignments were therefore treated as a risk reducing factor.
- Roads: These were taken as an indication of human activity and particularly vehicle and pedestrian traffic. It was assumed that the birds will avoid the immediate vicinity of roads due to the presence of traffic and pedestrians, and therefore it will reduce the risk of collision with lines running next to roads.
- Urbanisation and industry: Urban areas and industry are centres of human activity and are generally avoided by large power line sensitive species. Towns and industry are therefore risk reducing factors.
- Natural grassland: According to Young *et.al*. (2003) the large terrestrial species on the Mpumalanga highveld favour natural grassland habitat in contrast to agricultural landscapes. Natural grassland was therefore taken as a higher collision risk. Old lands that have reverted back to grassland were included in this category.

The factors mentioned above were incorporated into a formula to arrive at a risk rating for each potential alignment. The formula was designed as follows:

- Wetlands and dams: The length of alignment running within 500m of a dam or wetland was measured.

- The number of drainage lines crossed by each alignment was counted.
- The distance that the proposed alignments are running parallel to existing roads within a 500m zone was measured.
- The length of line running through or within 1km of industrial/urban activity was measured.
- The distance that the proposed alignments are running directly next to existing transmission lines was measured.
- The length of alignment skirting or running across natural grassland was measured.

Table 2: The results of the measurements for each option

Factor	Option 1	Option 2	Option 3
Drainage lines	1	0	0
Dams and wetlands	0.41	4.36	3.04
TX lines	0	0	0
Roads	0	0	0
Suburban/industry	3.35	0	1.57
Grassland	2.09	5.96	5.95

Obviously all these factors do not have an equal impact on the size of the risk, therefore a weighting was assigned to each factor, based on the author's judgment on how important the factor is within the total equation.

The following weights were assigned. Risk reducing factors were assigned a negative weight:

Table 3: Weighting of risk reducing factors

Factor	Weighting
Drainage lines	5
Dams and wetlands	3
TX lines	-1
Roads	-2
Sub-urban/industrial	-5
Grassland	4

The final risk score for a **factor** was calculated as follows: measurements/counts x weighting. The final risk rating for an **alignment** was calculated as the sum the risk scores of the individual factors:

Table 4: The final scores for the respective options

Factor	Option 1	Option 2	Option 3
Drainage lines	5	0	0
Dams and wetlands	1.23	13.08	9.12
TX lines	0	0	0
Roads	0	0	0
Suburban/industrial	-16.75	0	-7.85
Grassland	8.36	23.84	23.8
Total	**-2.16**	**36.92**	**25.07**

From the analysis above it is clear that **Option 1** is the **preferred alignment** from a bird interaction perspective. **Option 2** is the **least preferred** option.

5 Conclusions

- A number of power line sensitive, Red Data species could potentially occur along any of the alignments, although the occurrence of these species would be the exception rather than the rule.
- The proposed power line, **unless mitigated**, will pose a limited collision risk to power line sensitive bird species in the study area. Another potential risk is the destruction of sensitive wetland habitat through the construction of access roads.
- Of the Red Data species potentially present in the area, none are particularly at risk by the power line due to the very small densities at which the species occur. The latter is a result of the extensive habitat degradation that has taken place.
- There is, however, a substantial risk of collisions for several non Red Data species which warrants the application of mitigation measures.

6 Recommendations

- A sensitivity map indicating the areas where anti-collision devices need to be applied to the proposed line is attached as APPENDIX B.
- The construction of access roads in sensitive wetland habitat should be avoided.

7 References

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