

## Roodepoort Strengthening 400kv Power Line – Civil Aviation Authority Assessment report

### 1. Background:

- 1.1 This assessment report has been generated by the Civil Aviation Authority (CAA) AOG office , in response to a commission from Fourth Element Consulting (Pty) Ltd., on behalf of Escom, in relation to the proposed construction of new electrical transmission lines, in the area adjacent to Lanseria airport.
- 1.2 The assessment conducted by the CAA, focuses on the impact the various proposed transmission line routings would have on the International Civil Aviation Organisation (ICAO) Annex 14 surfaces as applied to Lanseria Airport, with the intention of ensuring aviation safety and at the same time, assisting the applicant in pursuit of the most equitable solution to that organisations plans, but with the bias towards aviation safety.
- 1.3 The terms of reference under which the assessment is applied consist of the CIVIL AVIATION ACT NO. 13 OF 2009 and the Civil Aviation Regulation 139.01.30, with emphasis on paragraph 3 and 8, which states” *(3) Buildings or other objects which will constitute an obstruction or potential hazard to aircraft moving in the navigable air space in the vicinity of an aerodrome, or navigation aid, or which will adversely affect the performance of the radio navigation or instrument landing systems, must not be erected or allowed to come into existence without the prior approval of the Director.*  
*(8) In the event of a conflict of interest between land use authorities and air space users, air safety must be regarded as predominant and not to be compromised by land development projects or other obstacles.”*
- 1.4 In support of these directives, the standards and recommended practices(SARPs), as contained in the ICAO Annex 14 are applied to practically assess the impact of any planned structure(i.e. building , crane or as in this case, pylons and transmission lines.) on the airspace into which the structure is intended to be erected.
- 1.5 The Annex 14 surfaces, in the case of the assessment concerned with this project, consist of the Approach and Departure Slopes related to both runways 06 and 24 at Lanseria. These surfaces are virtual surfaces which commence at ground level 60m from the threshold of the runway under assessment and then slope up, at a specific gradient from ground level to a distance from the runway, as determined by the category of aerodrome, together with the Inner Horizontal surface and the Conical surface. The Inner Horizontal surface, as the name implies, is a virtual horizontal surface, placed at a specific height above the elevation (height above Mean Sea Level) of the airfield using the elevation of the lowest runway threshold as reference. The Conical surface butts onto the outer boundary of the Inner Horizontal Surface, at the elevation of the Inner Horizontal and is sloped in nature, with a specific angle and terminates at a specific distance, as dictated by the criteria for this surface, depicted in Annex 14.

### 2. General:

- 2.1 The six options for the routing of transmission lines, as supplied by the applicant, in the form of Point Data Tables, depicting the planned positions of the turning points of the transmission lines, leading from the point where the new transmission line system would connect with the existing power infrastructure, to the intended substation were used to define the routing of each transmission line. As the applicant has advised that the pylons supporting the transmission lines, would be spaced between 300 and 350m apart, the more conservative figure of 300m was utilised to establish GIS station points, depicting the positions of pylons along the routes, with GIS station point one co-incident with the co - ordinate of point one of the data table.

- 2.2 The elevation of the arbitrarily placed station points was then assessed, which together with the advised maximum pylon height of 32m produced the total elevation of the station point (Pylon). Dependant on where the pylon was situated, in relation to the Annex 14 surfaces being assessed, i.e. Approach /Departure slopes or Inner Horizontal, etc., the elevation of the pylon was then compared with the elevation of the surface under which it was situated, in order to determine as to whether the pylon, as obstacle, would either be clear (below the surface) or penetrate the surface and should the surface be penetrated by the obstacle, the amount by which it penetrated.
- 2.3 The assessment has been undertaken, using Google Earth for visual representation of the various routings, as well as the boundaries of the various Annex 14 surfaces. These boundaries in turn been overlaid with the routings of the various transmission line options.

**3. Assessment comments:**

- 3.1 The comments regarding the assessment relating to the individual routings will be supported by the Google Earth .kmz file developed as the assessment progressed and is to be referenced in order to gain full benefit of the report. Each individual route will be commented on , commencing with Option 1 and will contain a comment indicating whether the CAA would approve the application for the routing should the particular routing be decided upon by the applicant, as the preferred option or options.

**4. Assessment Results:**

**4.1 Option 1.**

- 4.1.1 This routing commences to the North East of Lanseria Runway 24 threshold at 3,145. 96 meters from the threshold, with the initial routing to the South West from the point of origin. The closest point of approach to the threshold being at 2,197.95 meters from threshold (Turning point 2), before turning to the South and travelling further away from the airport. The Annex 14 surfaces assessed with regard to this option are the :
- a) Approach Slope related to Runway 24 and Departure Slope related to Runway 06 (same side of runway).
    - The elevation of the transmission line between Station 1 and Station 5 is assessed to be below and clear of both the Approach and Departure slops at this runway end.
  - b) The elevation of the transmission line commencing at Station 6 is assessed to penetrate the Inner Horizontal slope starting at 1.71meters above the surface elevation and increasing in value, due to the terrain profile. This penetration increases in height between Station 6 and Station 16 which is situated at 55. 87 meters outside of the Inner Horizontal boundary, before the route follows the fall in terrain.

Option 1; Inner Horizontal Surface Elevation: 1385.289meters

Station Position	Total Elevation of Station (m)	Penetration(m)
Turning Point (PY) 2	1387	1.71
Station/Pylon 6	1394	8.71
Station/Pylon 7	1407	21.71
Station/Pylon 8	1415	29.71
Station/Pylon9	1417	31.71
Station/Pylon 10	1423	37.71
Station/Pylon 11	1425	39.71
Station/Pylon 12	1432	46.71
Station/Pylon 13	1436	50.71
Station/Pylon 14	1424	38.71
Turning Point (PY) 3	1419	33.71
Station/Pylon 15	1411	25.71

Station/Pylon 16	1396	10.71
Station/Pylon 17	1385	At Surface
Station/Pylon 18	1371	14.29 below Inner Horiz.

**Note 1:** The terrain profile by itself penetrates the Inner Horizontal surface, with the planned for pylons increasing the amount by which the pylon (obstacle) will stand above the surface elevation.

**Note 2:** Due to the large penetration values and the proximity to the airport of the intended routing, this option will not be supported.

**Note 3:** The assessment of this option was terminated once the penetration of the Inner Horizontal had been ascertained. The evaluation of the pylons below the Conical slope has not been conducted as this exercise would have been superfluous, taking into account the penetrations already identified in the Inner Horizontal.

#### 4.2. Option 2

4.2.1. This routing commences to the North East of Lanseria Airport, further east than the Option 1 routing and is clear of the Approach slope for Runway 24 and the Departure Slope for Runway 06. The proposed path is also outside the confines of the Inner Horizontal surface, but is below the Conical surface related to runway 24. The closest point of approach to the threshold Runway 24 being turning point (PY) 3, situated at 4,085 meters from threshold.

4.2.2. A portion of the assessed routing penetrates the Conical surface, due to a rise in the terrain. However the penetration is not as severe as that which occurred with the proposed routing in Option One and may be mitigated for in the form of day and night markings as per Annex 14 SARPs.

Option 2: Elevation of Conical slope will vary according to distance obstacle is located beneath it.

Station Position	Total Elevation of Station (m)	Slope Elevation (m)	Penetration(m)
Station/Pylon 13	1450	1441.46	8.54
Turning Point (PY) 2	1447	1445.42	1.58
Station/Pylon 14	1446	1444.31	1.69
Station/Pylon 15	1442	1433.09	9.00
Station/Pylon 16	1423	1422.24	0.76
Station/Pylon 17	1408	1411.90	Below Conical
Station/Pylon 18	1392	1402.10	Below Conical
Turning Point (PY) 3	1395	1389.59	5.41

**Note 1:** The proposed routing from PY1/Station 1 to Station 12 is clear of the Approach Slope Runway 24/Departure Slope Runway 06 as well as the Inner Horizontal Surface and as such has no influence on these surfaces.

**Note 2:** An application for this routing may be supported, conditional to obstruction markings being applied to those sections which penetrate the Conical surface. The proposed routing may also be supported, as the routing from Station 1/PY1 to Turning Point (PY) 2 is positioned adjacent to an existing transmission line system, which runs to the South East into Diepkloof and as such would not present a new hazard to aviation, but rather become part of the existing, known hazard. The remainder of the route, with the exception of that portion reflected in the above table, is assessed to be clear of the conical surface and as such has no influence on the surface.

### 4.3. Option 3

4.3.1. As this proposed route is situated to the West of Lanseria Airport and is clear of all Annex 14 surfaces, no assessment was conducted on the proposed routing.

**Note 1:** An application for this routing may be unconditionally supported by the SACAA.

### 4.4. Option 4

4.4.1 This routing also commences to the North East of Lanseria Airport following the same profile as that of options 1 and 2, to the South East in the vicinity of the airfield, before turning South and then South West and is the closest of the three routing proposal to the airfield, which are situated to the East of Lanseria. The planned routing passes through the Approach slope for Runway 24/ Departure Slope Runway 06, but is assessed to be below and clear of these surfaces, with the closest point of approach to the threshold runway 24 being station 5, situated at 1,506.75m from threshold.

4.4.2 The rise in terrain, results in the route penetrating the Inner Horizontal Surface, commencing at Station 9, through Turning Point (PY) 2 to Station 25, at which point the assessment was terminated, due to the penetration of the Inner Horizontal Surface ascertained between the points mentioned.

Option 4; Inner Horizontal Surface Elevation: 1385.289meters

Station Position	Total Elevation of Station (m)	Penetration(m)
Station/Pylon 9	1393	7.71
Station/Pylon 10	1405	19.71
Station/Pylon 11	1397	11.71
Station/Pylon 12	1387	1.71
Turning Point (PY) 2	1396	10.71
Station/Pylon 13	1394	8.71
Station/Pylon 14	1378	Below Surface
Station/Pylon 15	1356	Below Surface
Station/Pylon 16	1352	Below Surface
Station/Pylon 17	1362	Below Surface
Station/Pylon 18	1373	Below Surface
Station/Pylon 19	1388	2.71
Station/Pylon 20	1398	12.71
Station/Pylon 21	1404	18.71
Station/Pylon 22	1414	28.71
Station/Pylon 23	1424	38.71
Station/Pylon 24	1437	51.71
Station/Pylon 25	1447	61.71

**Note 1:** Due to the multiple penetrations of the Inner Horizontal Slope this option would not be supported.

**Note 2:** In addition to the Note 1 above, this option would not be supported, due to the proximity of the proposed route to the threshold of runway 24 and the fact that it passes below the Approach and Departure Slopes associated with that runway, which would, should an event occur in which an aircraft is forced to land in the Approach/Departure area through which the transmission line is proposed, present an additional hazard to an already critical situation.

#### 4.5. Option 5

- 4.5.1. This proposed route is situated to the West of the threshold of Runway 06 and passes through the Approach slope associated with runway 06 and the Departure slope of runway 24. The closest approach to the threshold runway 06, is Station/Pylon 13, situated at 402.37m from threshold. The route commences to the North West of Lanseria airport, and proceeds in a South Easterly direction, until it is South of the airport, before turning in a South Westerly direction.
- 4.5.2 While the terrain is level within the vicinity of the approach and departure slopes, the terrain is sufficiently high enough in this area, to cause penetration of both the Approach and Departure Slopes associated with Runway 06. The rise in terrain towards the South of the runway, also contributes to multiple penetrations of the Inner Horizontal.

Option 5; Approach and Departure Slopes, assessed at 2 %. Threshold elevation 1376.93m

Station Position	Total Elevation(m)	Slope Height(m)	Penetration(m)
Station/Pylon 12	1393	1384.65	8.35
Station/Pylon 13	1393	1383.78	9.22
Station/Pylon 14	1399	1387.17	11.83

Option 5; Inner Horizontal Surface Elevation: 1385.289meters

Station Position	Total Elevation(m)	Penetration(m)
Station/Pylon 11	1389	3.17
Station/Pylon 12	1393	7.71
Station/Pylon 13	1393	7.71
Station/Pylon 14	1399	13.71
Station/Pylon 15	1402	16.71
Station/Pylon 16	1399	13.71
Station/Pylon 17	1381	Below Surface
Station/Pylon 18	1394	8.71
Station/Pylon 19	1399	13.71
Station/Pylon 20	1397	11.71
Station/Pylon 21	1407	21.71
Station/Pylon 22	1417	31.71
Station/Pylon 23	1433	47.71
Station/Pylon 24	1438	52.71
Station/Pylon 25	1440	54.71
Turning Point (PY2)	1440	54.71

**Note 1:** Due to the multiple penetrations of the Approach, Departure and Inner Horizontal Slopes, this option would not be supported.

**Note 2:** In addition to the Note 1 above, this option would not be supported, due to the proximity of the proposed route to the threshold of runway 06 and the fact that it passes above the Approach and Departure Slopes associated with that runway, which would, should an event occur in which an aircraft is forced to land in the Approach/Departure area through which the transmission line is proposed, present an additional hazard to an already critical situation.

**4.6. Option 6**

- 4.6.1. This proposed route is situated to the West of Lanseria Airport, with the closest approach to the threshold runway 06 being Station/Pylon 6, situated at 3,785.84m from threshold. The proposed route tracks to the South West, increasing in distance from the threshold of runway 06, as it proceeds to the South West, until the route clears the Annex 14 surface, relating to Runway 06, before turning South.
- 4.6.2. While the proposed route is clear of the Approach and Departure Slopes associated with Runway 06, a portion of the path is situated below the Inner Horizontal surface, with multiple penetrations of the Inner Horizontal surface, to the North West of Lanseria, along with penetrations of the Conical surface, due to the rise and fall of the terrain the route would follow.

Option 6; Inner Horizontal Surface Elevation: 1385.289meters

Station Position	Total Elevation(m)	Penetration(m)
Station/Pylon 2	1404	18.71
Station/Pylon 3	1418	32.71
Station/Pylon 4	1430	44.71
Station/Pylon 5	1426	40.71
Station/Pylon 6	1410	24.71
Station/Pylon 7	1398	12.71
Station/Pylon 8	1371	Below Surface
Station/Pylon 9	1359	Below Surface
Station/Pylon 10	1350	Below Surface
Station/Pylon 11	1365	Below Surface

Option 6: Elevation of Conical slope will vary according to distance obstacle is located beneath it.

Station Position	Total Elevation of Station (m)	Slope Elevation (m)	Penetration(m)
Station/Pylon 13	1404	1398.63	5.37
Station/Pylon 16	1425	1424.20	0.80

**Note 1.** As the path of this proposed route increases in distance from the threshold of Runway 06, while it tracks to the South West, this route proposal may be consider for approval, but with a reduced priority and would require that the penetrations of the surfaces noted, be mitigated for in the form of day and night markings as per Annex 14 SARPs.

**5. Assessment Conclusion**

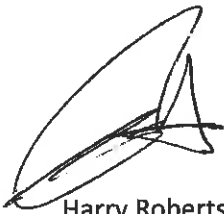
- 5.1. The above assessment results and conclusions have been reached as a result of the application of the SARPs as contained in the ICAO Annex 14 document. South Africa as sovereign State subscribes to the application of the mentioned SARPs, by way of being member of the International Civil Aviation Organisation.
- 5.2. In this context, in order to ensure aviation safety, applications submitted for the proposed transmission line routings identified in descending priority as (1) Option 3, (2) Option 2 and (3) Option 6, (with mitigation for options 2 and 6 as discussed in the assessment comments), may be supported by the CAA, conditional to the proposed routes retaining profiles similar to that which was assessed, when submitted by the applicant.

## 6. Supplementary Comment

6.1 While not part of the assessment brief, the CAA would be remiss in not advising the applicant of the fact that the routing of both Option 3 and Option 6 pass in the vicinity of two positions, which while not licenced are included on the CAA data bases as airfields. The erection of transmission lines in the vicinity of these two airfields may impact on operations to /from the facilities and it behoves the applicant to ensure that the operators of these airfields are made aware of the intended erections of transmission lines within the area, should the applicant elect to do so via either Option 3 or Option 6.

6.2 The airfields identified are:

- Oakfield positioned at S 26 02 4.00, E 027 52 21.70
- Rietfontein Micro positioned at S26 01 54.60, E027 52 60.00



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