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Environmental Noise Report

Proposed ESKOM Maningi Sub-Station

Final Report

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EXECUTIVE SUMMARY

A new ESKOM electrical substation is proposed on an existing stand in a boomed residential area in Sandown. The investigation's purpose was to assess the impact of the potential noise from this substation, which will be the only significant noise source in the area, on the surrounding residential dwellings. This was achieved by measuring the noise levels from existing similar units at an operating substation, making confirmatory background noise measurements at a position near the proposed site and calculating the noise level at the neighbouring dwellings and predicting the subsequent community response. All calculations and predictions were carried out in accordance with the relevant SANS Standard Codes of Practice (Refs. 1 & 2), and as required by the regulations of the DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND TOURISM.

The expected response from the community to the noise impact, i.e. the comparison of recommended noise limits with the predicted noise from the substation, is based on the relevant SANS document, (Ref. 1), and expressed in terms of the effects of impact, on a scale of 'NONE' to 'VERY HIGH'. This report is an overall assessment designed to predict the collective response of a noise-exposed population and therefore the impact the ambient noise is likely to have on them, and is based on predicted equivalent continuous noise levels according to the relevant SANS code of practice, (Ref. 1).

Noise at the neighbouring residential property boundary from all four transformers operating together at the same level is 20 dB greater than the rating level, which is a noise impact categorised as 'VERY HIGH'.

The housing of the main units in enclosures similar to those employed at the Sanpark substation in Sandton will reduce the emitted noise to acceptable levels. The fan cooling units, which will necessarily be outside these enclosures should be suitably screened and provided with low noise fans in order to achieve the required noise levels during periods of high load and temperature.

1. PURPOSE OF THE INVESTIGATION AND TERMS OF REFERENCE

A new ESKOM electrical substation is proposed on an existing stand in a boomed residential area in Sandown. The investigation's purpose was to assess the impact of the potential noise from this substation, which will be the only significant noise source in the area, on the neighbouring dwellings. This was achieved by calculating and predicting the noise levels from existing similar units and, and making confirmatory measurements at a position near the proposed site. The expected response from the community to the ambient noise of the area, is based on the relevant SANS Standard Codes of Practice (Refs. 1 & 2), and as required by the regulations of the DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND TOURISM, and expressed in terms of the effects of impact, on a scale of 'NONE' to 'VERY HIGH'.

2. INVESTIGATIVE METHODOLOGY

2.1 Introduction

A new ESKOM electrical substation is proposed on an existing stand in a boomed residential area in Sandown. In order to be able to assess both the quantitative and geographical extent of any potential impact, it is necessary to have baseline data in the form of measured existing ambient noise levels at the site and calculated or measured noise levels of the plant to be introduced. This was achieved by making confirmatory measurements at one reference position on site and of a similar installation. These can then be compared to tables of acceptability of SANS 10103. The extent of community response can then be assessed according to national and international standards which take into account sociological factors as well as the noise climate.

2.2 Ambient Noise Levels

The existing ambient noise levels were also measured of the equivalent continuous A-weighted sound pressure level, $\mathbf{L_{Aeq,I}}$ using the 'I' (Impulse) dynamic response characteristic as recommended in SANS 10103:2008 (ref. 1) and a number of other parameters, of which the $\mathbf{L_{90}}$ is reported as the generally accepted parameter for describing the background noise level in the absence of intrusive noise.

2.3 Assessing The Noise Impact

The recommended noise levels in a suburban residential area are described in Table 2 of SANS 10103 (ref. 1), and Table 5 of the same document.

Type of district	Equivalent continuous rating level ($L_{Req.T}$) for noise dB(A)					
	Outdoors			Indoors, with open windows		
	Day-night $L_{R,dn}$ [1)]	Day-time $L_{Req,d}$ [2)]	Night-time $L_{Req,n}$ [2)]	Day-night $L_{R,dn}$ [1)]	Day-time $L_{Req,d}$ [2)]	Night-time $L_{Req,n}$ [2)]
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	**50**	**50**	**40**	**40**	**40**	**30**
c) Urban districts	55	55	45	45	45	35
d) Urban districts with one or more of the following: workshops; business premises; and main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

Table 1: Acceptable rating levels for noise in districts (Ref.1)

NB: Day-time : 06:00 to 22:00, Night-time : 22:00 to 06:00

The appropriate criteria for this assessment are in **bold script** in the above table.

1	2	3
Excess $\Delta L_{Req,T}$[a] dBA	**Estimated community/group response**	
	Category	**Description**
0 – 10	Little	Sporadic complaints
5 – 15	Medium	Widespread complaints
10 – 20	Strong	Threats of community/group action
>15	Very strong	Vigorous community/group action

a $L_{Req,T}$ should be calculated from the appropriate of the following:

1) $)L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS $L_{Req,T}$ of the residual noise (determined in the absence of the specific noise under investigation).
2) $)L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS the maximum rating level for the ambient noise given in table 1.
3) $)L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS the acceptable rating level for the applicable district as determined from table 2.
4) $\Delta L_{Req,T}$ = Expected increase in $L_{Req,T}$ of ambient noise in an area because of a proposed development under investigation.

NOTE Overlapping ranges for the excess values are given because a spread in the community reaction may be anticipated

Table2: SANS 10103-2008 Table 5 – Categories of Community/Group Response

The expected response from the local community to the noise impact, i.e. the exceedance of the noise over the acceptable rating level for the appropriate district, is primarily based on Table 5 of SANS 10103 (ref. 1), but expressed in terms of the effects of impact, on a scale of 'none' to 'very high'.

INCREASE dB	RESPONSE INTENSITY	REMARKS	NOISE IMPACT
0	None	Change not discernible by a person	None
3	None to little	Change just discernible	Very low
3 ≤ 5	Little	Change easily discernible	Low
5 ≤ 7	Little	Sporadic complaints	Moderate
7	Little	Defined by National Noise Regulations as being 'disturbing'	Moderate
7 ≤ 10	Little - medium	Sporadic complaints	High
10 ≤ 15	Medium	Change of 10dB perceived as 'twice as loud' leading to widespread complaints	Very high
15 ≤ 20	Strong	Threats of community/group action	Very high

Table 3: Response intensity and noise impact for increases over the ambient noise

3. AMBIENT NOISE MEASUREMENTS AT THE SITE

3.1 Introduction

Noise measurements according to SANS Code of Practice 10103:2008 (Ref. 1) were carried out. Confirmatory ambient noise measurements were made at a point near the site. This point is defined in Section 3.5.

3.2 Equipment Used:

01dB Type SdB01+ Precision Integrating Sound Level Meter, serial number 10167, fitted with 01dB Microphone Type MCE210, serial number 001194, and windscreen. Field calibration using Bruel & Kjaer Type 4230 Sound Level Calibrator, serial number 1314348.

3.3 Calibration Certificates

All equipment with valid calibration certificates, from the testing laboratories of De Beer Calibration Services. The calibration certificates are available for viewing if required.

3.4 Procedures Used

Measurements were carried out in accordance with SOUTH AFRICAN NATIONAL STANDARD - Code of practice, SANS 10103:2008, *The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication.*

and as required by the regulations of the DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND TOURISM. NO. R. 154. *Noise Control Regulations in Terms of Section 25 of the Environmental Conservation Act, 1989 (Act No. 73 of 1989)*. Govt. Gaz. No. 13717, 10 January 1992, i.e. Gauteng province, Department of Agriculture, Conservation and Environment, Notice 5479 of 1999. *Noise control regulations, 1999*, Provincial gazette extraordinary, 20 august 1999.

3.5 Measurements at the Proposed Site

Measurements were carried out at a single location on the property as described below. This was chosen for the following reasons:

1) Easily definable and with easy future access in case of need for comparison measurements after completion of the project.

2) Representative of the important background noise regime, the road, and at the boundary of the proposed development.

Note 1: All noise levels in this report are A-weighted noise levels expressed in dB(A).

Note 2: $\mathbf{L_{Aeq,I}}$ is the A-weighted equivalent sound level using the 'I' (Impulse) dynamic response characteristic as recommended in SANS 10103:2008 (ref. 1)

Note 3: The noise level exceeded for 90% of the time ($\mathbf{L_{90}}$) is taken as an expression of the background noise in the absence of intrusive noisy events, primarily road traffic and random domestic noise events, barking dogs, pedestrians, and local traffic.

Note 4: In the Comments column of the noise tables, C - Car, Minibus or LDV, HGV – Heavy Goods Vehicle or Bus, A/c – Commercial airliner, La/c – light aircraft, H – Helicopter, cN - noise level calculated from traffic count, for the measurement period, usually (but at least) 10 Minutes.

Measurement Position 1:

At a position opposite the proposed site as shown in the following photographs. GPS position S26° 05.657′ E28° 03.886′, height 1574 ± 6.6m

View across Adolph to proposed site

View along Adolph with site to right

Measurement Table

Day/Date	Time	Temp °C	RH %	Wind m/s	$L_{Aeq,I}$ dB(A)	L_{90} dB(A)	Comment
Fri 24/04/09	16:12-16:22	20	26	Still	46.7	37	A/c=2
Fri 24/04/09	16:23-16:33	20	26	Still	44.0	36	A/c=4
Sun 28/06/09	15:45-15:55	17	13	<3.0	51.1	41	
Sun 28/06/09	15:56- 16:06	17	13	<3.0	53.8	39	H=1, a/c=1, La/c=1

Observations: These values are typical of a quiet residential area with remote trafficked roads, which dominate the noise climate.

3.6 Measurements on a Similar Transformer at the Fourways Substation

Full overall and frequency spectrum measurements were made at the boundary of the Fourways substation on 1/7/09, the measurement position as shown in the following photograph, 18m from the assumed acoustic centre of the transformer.

Freq.	A-wt	31.5	63	125	250	500	1k	2k	4k	8k
dB	48.9	51.3	53.5	61.6	54.3	45.4	45.5	33.5	<20	<20

It should be noted that the spectrum has a maximum in the 125 Hz. frequency band. This is in agreement with the well-known fact that transformer noise has a maximum spectrum level at 100Hz, twice the mains frequency.

These values were used in the following calculations, comparisons and assessments. In particular, a value of 49 dB(A) at 18m from the unit has been taken as the noise level to be assessed.

4. IMPACT ASSESSMENT

4.1 General

The noise impact on the area is significant. The unmitigated transformer noise at the nearest dwellings is calculated to be 49 dB(A). This is an impact rated in the category 'VERY HIGH' as stated in Table 3 above. In addition, the background noise in the area is unusually quiet for a suburban area as the stands are large, the population density low, and as a boomed area, no through traffic is present.

4.2 Continuous Equivalent Noise Levels And Individual Noise Events

This report is an overall assessment designed to predict the collective response of a noise-exposed population and therefore the impact the increased environmental noise is likely to have on them, and is based on measured and predicted equivalent continuous noise levels according to SANS 10103. It will be possible to detect and distinguish individual noise events, even if the noise impact is assessed as NONE, or VERY LOW, i.e. where a person with normal hearing will not be able to detect the predicted increase in ambient noise level over the acceptable rating value for the applicable district, or the actual measured pre-development noise level, but where an individual intrusive noise may nevertheless be audible to that person.

4.3. Predicted General Impact of Noise on The Community

A value of 49 dB(A) at 18m from a single unit has been taken as the noise level to be assessed. The worst case scenario of all four transformers operating together at the same noise level will increase this noise level to approximately 55 dB(A), and this will be the case at some point on the property boundary regardless of the layout configuration. Reference is made to the above table 2, (table 5 of SANS 10103-2008), criterion 3, and table 3 to determine the impact on the community of the increase in ambient noise level over the acceptability criterion due to the installation of the transformers. The strictest criterion in a suburban area is the night-time maximum acceptable noise level of 40 dB(A). To this must be subtracted an allowance of 5 dB to account for the tonal characteristics of the transformer noise (at 100Hz.) giving a rating level of 35 dB(A). This is because a 100Hz. tone is highly intrusive and attenuated to a lesser degree than higher frequencies by any neighbouring residential building façade, accentuating this effect.

Noise at the neighbouring residential property boundary from all four transformers operating together at the same level is 20 dB greater than the rating level, which is a noise impact categorised as 'VERY HIGH'.

4.4. Possible Design Mitigation Options

The noise levels are considered high enough to require specific noise barrier construction or other specific measures.

Boundary or enclosing wall:

The presence of a traditional 2m boundary wall will not be sufficient in this situation as the height of the units and the sloping terrain means that line of sight to them from surrounding buildings will still exist. Furthermore, the primary frequency of the transformer noise is too low for a barrier wall to be really effective due to the propagation/attenuation characteristics which are seriously influenced by refraction at these low frequencies. Higher walls to eliminate line of sight to the transformers are likely to be too high to be acceptable and will in any case not be able to provide the 20 dB attenuation deemed necessary.

Enclosing Building:

As the site is currently completely surrounded by existing dwellings and these dwellings are very close, a partial building is unlikely to protect all neighbouring dwellings to the extent required. A fully enclosed and roofed building with at least a 20 dB (at 100Hz.) façade sound attenuation is required, as per the current architect's design, similar to the Sanpark substation solution. In addition, measures will be taken to provide suitably attenuated cooling and screening of the transformer cooling banks, which need to be located outside the building. These will be operating primarily under coincident conditions of high ambient temperature and solar gain at periods of peak electricity consumption. This conditions will normally occur during daytime periods (06:00 – 22:00) as defined by SANS noise recommendations, and not normally during nighttime (22:00 – 06:00) when solar gain is zero, ambient temperatures are lower, and electricity consumption is at a minimum.

5. REFERENCES

1. SOUTH AFRICAN NATIONAL STANDARD - Code of practice, SANS 10103:2008, *The measurement and rating of environ-mental noise with respect to land use, health, annoyance and to speech communication.*
2. SOUTH AFRICAN STANDARD - Code of practice, SABS 10210:2004, *Calculating and predicting road traffic noise.*
3. SOUTH AFRICAN STANDARD - Code of practice, SABS 10328:2008, *Methods for environmental nose impact assessments.*
4. SOUTH AFRICAN STANDARD - Code of practice, SABS 10357: 2008, *The calculation of sound propagation by the Concawe method.*
5. DEPARTMENT OF ENVIRONMENTAL AFFAIRS. NO. R. 154. *Noise Control Regulations in Terms of Section 25 of the Environmental Conservation Act, 1989 (Act No. 73 of 1989)*. Govt. Gazette. No. 13717, 10 January 1992.
6. Fuggle, R. F. and Rabie, M. A. et al., *Environmental Management in South Africa.* Juta & Co, Ltd., 1992
7. Gauteng province, Department of Agriculture, Conservation and Environment, Notice 5479 of 1999. *Noise control regulations, 1999*, Provincial gazette extraordinary, 20 august 1999