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ENVIRONMENTAL NOISE IMPACT STUDY FOR THE PROPOSED CAPACITY EXPANSION OF THE OPEN CYCLE GAS TURBINE POWER PLANT AT MOSSEL BAY

Prepared by

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for

Ninham Shand Consulting Services

January 2007

EXECUTIVE SUMMARY

A noise impact study was conducted into the potential impact of the proposed capacity expansion of the Open Cycle Gas Turbine (OCGT) power station for peaking electrical power PetroSA refinery at Mossel Bay. It is proposed to construct three additional 150 MW OCGT units in addition to an existing three units presently under construction.

The results of the study indicated that the potential intensity of impact of noise from the existing three OCGT power generation units operating under normal conditions of 5 hours during daytime would be Negligible to Low for residential dwellings at a radius of 1460m from the centre of OCGT plant. The intensity would increase to Very High on farmland adjacent to the plant boundary.

For continuous operation of the three OCGT units, large areas of land, encompassing the entire study area, would be exposed to a noise impact with an intensity at the nearest residential dwellings ranging between Medium and High and increase to Very High on farmland adjacent to the plant boundary.

For six OCGT units operating under normal conditions, the intensity of noise impact at the nearest residential dwellings would range between Low and Medium. The intensity would increase to Very High on farmland adjacent to the combined plant boundary.

For continuous operation of the six OCGT units, large areas of land, encompassing the entire study area, would be exposed to a noise impact with intensity at all residential dwellings within the study area ranging between Medium and Very High.

The only meaningful noise mitigation procedure for operation of six OCGT units would require a significant reduction in noise emission level of the exhaust stack.

The primary factor affecting the intensity of noise impact is the proximity of sources with high noise emission levels adjacent to noise sensitive land with the lowest acceptable noise levels.

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ENVIRONMENTAL NOISE IMPACT ASSESSMENT FOR THE PROPOSED OPEN CYCLE GAS TURBINE POWER PLANT AT MOSSEL BAY

1. INTRODUCTION

1.1. Background and brief

Jongens Keet Associates was commissioned to undertake a specialist study into the potential impact of noise of the proposed capacity expansion during construction and operation of the Open Cycle Gas Turbine (OCGT) Power Station for peaking electricity capacity situated at the western side of the PetroSA refinery at Mossel Bay.

At the time of this study three 150 MW OCGT units were being constructed on the PetroSA site. The noise impact assessment of the units under construction is contained in a previous report (JKA, 2005).

The present study considers the proposed expansion of peaking electricity capacity by the installation of a further three identical 150 MW OCGT units to be located West of the existing site. It considers the potential noise impact for increased hours of normal operation during daytime from 2 to 5 hours for the existing three units under construction and the impact of the three existing plus the additional three proposed units (6 in total) under normal operation and operating under a worst-case scenario of 24 hours.

2. METHODOLOGY

The study was conducted in accordance with procedures contained in Section 7 of South African National Standard (SANS) 10328, *Methods for environmental noise impact assessments* in terms of the National Environmental Management Act Nr 107 of 1998. A summary of the procedure is outlined hereunder.

1. Determine the land use zoning and identify all potential noise sensitive sites that could be impacted upon by activities relating to operation of the proposed expansion of the OCGT power plant.
2. Determine the existing ambient levels of noise at identified noise sensitive sites by conducting representative sound measurements.
3. Determine the acceptable rating level for noise at the identified noise sensitive sites.
4. Identify all noise sources relating to the activities of the plant during construction phase and operation phase that could potentially result in a noise impact at the identified noise sensitive sites.
5. Determine the sound emission, operating cycle and nature of the sound emission from each of the identified noise sources.
6. Calculate the combined sound power level due to the sound emissions of the individual noise sources.
7. Calculate the expected rating level of sound at the identified noise sensitive sites from the combined sound power level emanating from identified noise sources.
8. Calculate the noise impact at identified noise sensitive sites.
9. Assess the noise impact at identified noise sensitive sites in terms of SANS 10103, *The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication*; the Noise Control Regulations of the Province of the Western Cape; the World Health Organsation; the World Bank.
10. Investigate alternative noise mitigation procedures.
11. Prepare and submit an environmental impact report containing the procedures and findings of the investigation.

3. ASSESSMENT OF NOISE

The terminology used in South African National Standards for the measurement and assessment of noise is contained in Appendix A.

3.1. South African National Standards

In accordance with SANS 10328, the predicted impact that noise emanating from a proposed development would have on occupants of surrounding land is assessed by determining whether the rating level of the predicted ambient noise would exceed the residual noise or exceed the acceptable rating level of noise on that land as indicated in Table 2 of SANS 10103 and relating this excess to the probable response of a community to the noise as indicated in Table 5 of SANS 10103. Tables 2 and 5 of SANS 10103 are reproduced hereunder. Refer to Appendix A for definitions of terminology.

SANS 10103, Table 2 — Acceptable rating levels for noise in districts

1	2	3	4	5	6	7
Type of district	**Equivalent continuous rating level ($L_{Req,T}$) for noise,** dBA					
	Outdoors			**Indoors, with open windows**		
	Day-night $L_{R,dn}$[a]	**Day-time $L_{Req,d}$[b]**	**Night-time $L_{Req,n}$[b]**	**Day-night $L_{R,dn}$[a]**	**Day-time $L_{Req,d}$[b]**	**Night-time $L_{Req,n}$[b]**
RESIDENTIAL DISTRICTS						
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
NON RESIDENTIAL DISTRICTS						
d) Urban districts with some workshops, with business premises, and with 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

NOTE 1 If the measurement or calculation time interval is considerably shorter than the reference time intervals, significant deviations from the values given in the table may result.

NOTE 2 If the spectrum of the sound contains significant low frequency components, or when an unbalanced spectrum towards the low frequencies is suspected, special precautions should be taken, and specialist attention is required. In this case the indoor sound levels may significantly differ from the values given in columns 5 to 7. See also annex B.

NOTE 3 Residential buildings, e.g. dormitories, hotel accommodation, residences etc. may only be allowed in non- residential districts on condition that the calculated or anticipated indoor $L_{Req,T}$ values given in column 3 of table 1 are not exceeded.

a The values given in columns 2 and 5 are equivalent continuous rating levels and include corrections for tonal character, impulsiveness of the noise and the time of day.

b The values given in columns 3, 4, 6 and 7 are equivalent continuous rating levels and include corrections for tonal character and impulsiveness of the noise.

SANS 10103, Table 5 — Categories of community/group response

1	2	3
Excess $\Delta L_{Req,T}$ [1)] 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 Calculate $)L_{Req,T}$ from the appropriate of the following:

1) $\Delta L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS $L_{Req,T}$ of the residual noise (determined in the absence of the specific noise under investigation).

2) $\Delta L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS the maximum rating level for the ambient noise given in table 1.

3) $\Delta L_{Req,T}$ = $L_{Req,T}$ 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

It is to be noted that a noise impact is assessed in terms of a district whether the land is occupied or not. In both instances noise potentially impacts on the value of the land.

3.2. World Health Organisation

SANS 10103 contains the statement that the acceptable rating levels for ambient noise are essentially in line with the recommendations of the World Health Organisation (WHO) for community exposure.

3.3. World Bank

The World Bank has adopted the WHO recommendations on maximum L_{Aeq} in residential areas and schools. These recommendations apply to all World Bank Group funded projects.

The assessments of noise impact in this study therefore embody WHO and World Bank assessments.

3.4. Impact qualifiers

The **intensity** of a predicted noise impact was determined in relation to the categories of community response contained in Table 5 of SANS 10103 and are qualified as follows:

Negligible	Predicted $L_{Req,T}$ does not exceed the residual or acceptable $L_{Req,T}$
Low	Predicted $L_{Req,T}$ exceeds the residual or acceptable $L_{Req,T}$ by between 0 & 5 dB
Medium	Predicted $L_{Req,T}$ exceeds the residual or acceptable $L_{Req,T}$ by between 5 & 10 dB
High	Predicted $L_{Req,T}$ exceeds the residual or acceptable $L_{Req,T}$ by between 10 & 15 dB
Very High	Predicted $L_{Req,T}$ exceeds the residual or acceptable $L_{Req,T}$ by more than 15 dB

For a 16-hour daytime assessment, $L_{Req,d}$ replaces $L_{Aeq,T}$.
For an 8-hour night-time assessment, $L_{Req,n}$ replaces $L_{Aeq,T}$.

3.5. Noise Control Regulations

The control of noise in the Western Cape is legislated in the form of the Noise Control Regulations of the Environment Conservation Act No. 73 of 1989 applicable to the Province of the Western Cape, Provincial Gazette Number 5309 of 20 November 1998.

In terms of Clause 2 (d) of the Noise Control Regulations:

"*A local authority may, before changes are made to existing facilities or existing use of land or buildings, or before new buildings are erected, in writing require that noise impact assessments or tests be conducted to the satisfaction of the local authority by the owner, developer, tenant or occupant of the facilities, land or buildings and that reports or certificates relating to the noise impact be submitted to the local authority, to the satisfaction of the local authority, by the owner, developer, tenant or occupant."*

In terms of Schedule 3 (c) of the Noise Control Regulations:

"No person shall make changes to existing facilities or existing use of land or buildings or erect new buildings, if these will house or cause activities that will, after such changes or erection, cause a disturbing noise, unless precautionary measures to prevent the disturbing noise have been taken to the satisfaction of the local authority."

In terms of Clause 4 of the Noise Control Regulations:

"No person shall make, produce or cause a disturbing noise, or allow it to be made, produced or caused by any person, animal, machine, device or apparatus or any combination thereof."

Ambient sound level means the reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such meter was put into operation.

Disturbing noise means a noise level that exceeds the ambient sound level measured continuously at the same measuring point by 7 dB or more.

Noise level means the reading on an integrating impulse sound level meter taken at a measuring point in the presence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such meter was put into operation, and, if the alleged disturbing noise has a discernible pitch, for example, a whistle, buzz, drone or music, to which 5 dBA is added.

Certain terminology used in the Noise Control Regulations and in the SANS 10103 have similar sounding, but not equal, meanings. Thus,

Noise Control Regulations:		SANS 10103:
Ambient sound level	is similar to	Residual noise level
Noise level	is similar to	Rating level of ambient noise

Cognisance needs to be taken of the fact that the National Noise Control Regulations, upon which the Provincial Noise Control Regulations are based, have undergone major revision to bring them in line with recommendations of the World Health Organisation, WHO. South Africa is a signatory of WHO and is thereby bound by its recommendations. Although the existing Noise Control Regulations remain in force until promulgation of the revised Noise Control Regulations, the draft revision could be promulgated within the near future. Noise limits in the draft revision of the Noise Control Regulations are based on the acceptable rating levels of ambient noise contained in SANS 10103.

Thus, in terms of the revised Regulations,

Disturbing noise means a specific noise level that exceeds either the outdoor equivalent continuous day/night rating level (L_{Rdn}), the outdoor equivalent continuous day rating level (L_{Rd}) and/or the outdoor equivalent continuous night rating level (L_{Rn}) for the particular neighbourhood indicated as the Outdoor ambient noise in various districts in SANS 10103.

4. STUDY AREA

The study area is shown in Figure 1. The existing site is located approximately 1300m west of the existing PetroSA Refinery (Mossgas) with a railway line to the north. The land to the north of the railway line and west of the proposed site is zoned rural containing several farms. The land elevation increases gently towards the north. Figure 2 displays a site plan of the existing three OCGT units and the proposed three additional OCGT units.

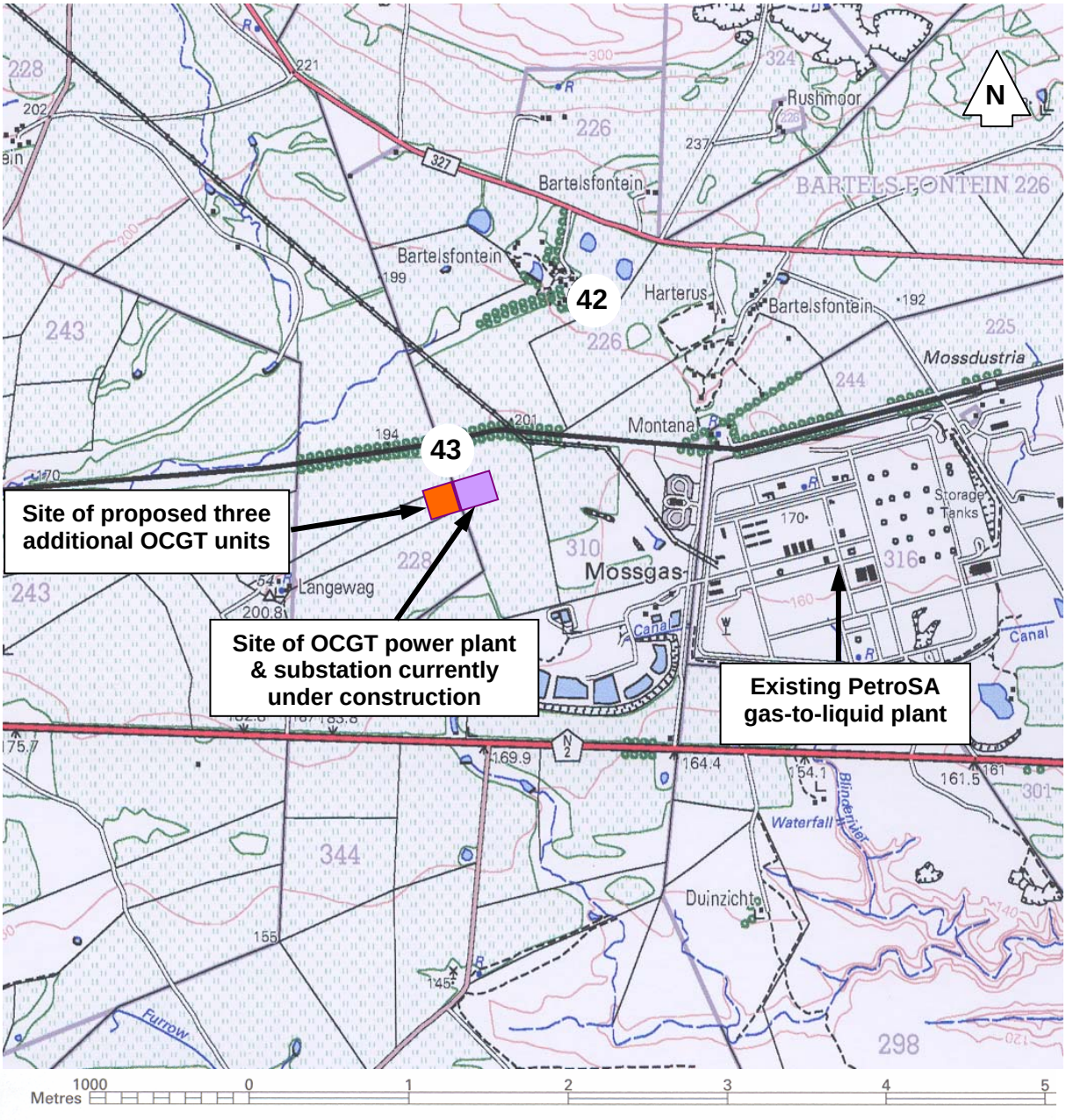

Figure 1 **Study area showing the Site of OCGT power plant & substation currently under construction and the site for the proposed three additional OCGT units**

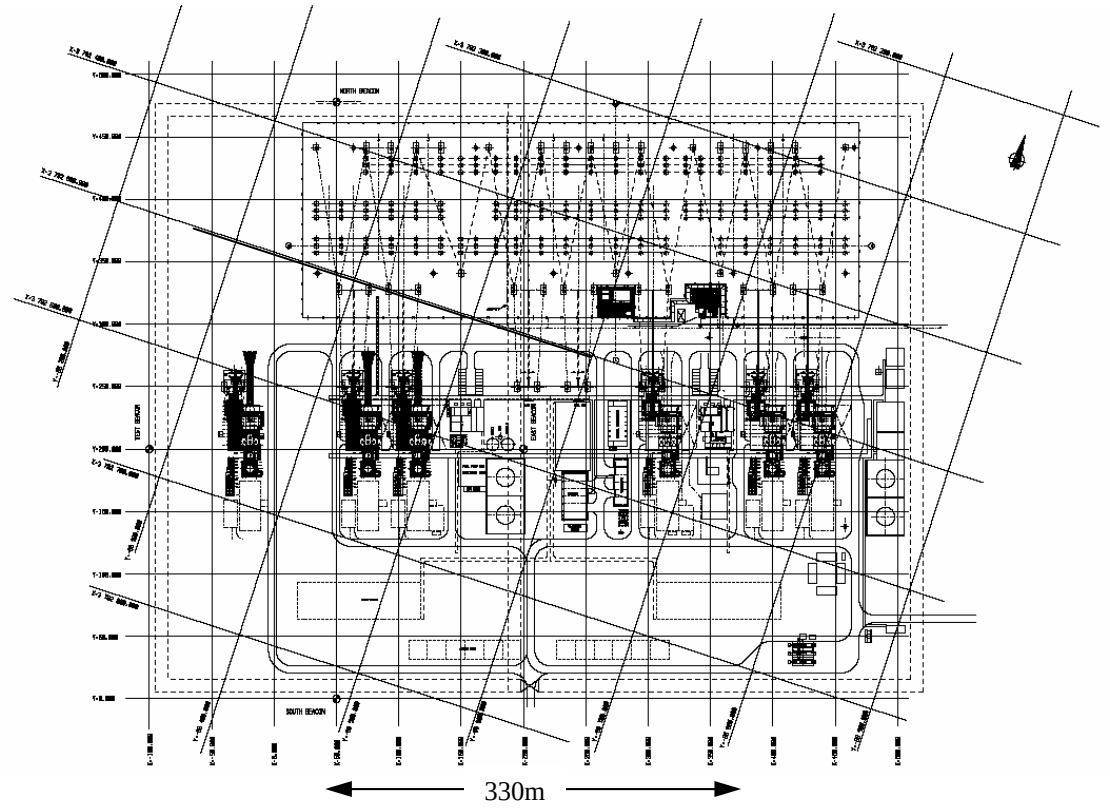

FIGURE 2 Site plan showing three OCGT under construction to the right and the proposed three additional OCGT units to the left

4.1. Measured ambient and acceptable rating levels for noise

Equivalent continuous A-weighted sound levels, L_{Aeq}, were measured on Wednesday 28 September 2005 between 11h00 and 12h00 at the NW corner of the proposed OCGT site. This was within a few metres of the boundary of the farm located west of the proposed site. Further measurements were conducted at a group of houses on Bartelfontein approximately 1100m WNW from the proposed site. The sky was partly overcast with a westerly wind of between 9 and 15km/hr blowing. Mr. J. Joubert of PetroSA was in attendance.

The L_{Aeq} recorded at the NW of the proposed OCGT site was 43dBA. Noise within the frequency band of 500Hz and 2000Hz originating from the safety flare blow-off stacks of the PetroSA plant was audible.

The L_{Aeq} recorded at the group of houses on Bartelfontein was 42dBA.

According to Mr Joubert the noise during the measurement periods was representative of that emanating from the PetroSA plant during normal operation. The PetroSA plant

operated continuously for 24-hours a day. The measured $L_{Aeq,}$ were therefore representative of that occurring during daytime and night time.

In terms of SANS 10103 the measured 43dBA and 42dBA, respectively, were slightly lower than the acceptable daytime rating level of 45dBA for a rural residential district but 7 and 8dB higher than the acceptable night time rating level of 35dBA.

Analysis of the recorded sound spectra (not included in this report) showed that wind noise at frequencies below 500Hz contributed to the recorded L_{Aeq} values. It was estimated that, in the absence of wind noise, the L_{Aeq} values would be 2dB less than those recorded at the two sites.

The measured L_{Aeq} are displayed in black on a white background in Figure 1.

5. SOURCES OF NOISE RELATING TO THE PROPOSED OCGT PLANT

It is proposed to install an additional three Siemens type SGT5-2000 150MW OCGT power generation units on the new site. An example of two typical generation units, received from Siemens, is displayed in the photograph of Figure 3. Each unit comprises several major sources of noise. The photograph includes labels of some of the sources. A plan and section of an OCGT power generation unit is displayed in Figure 4.

The linear-weighted sound power levels, in dB, in each octave frequency band from 31,5Hz to 8000Hz emitted by each noise source and the mean elevation of the source above ground level are recorded in Table 1. These apply to the existing units as well as the proposed additional units and were obtained from Section 7 of a report provided by Siemens (Siemens, 2005).

TABLE 1 Elevation & octave frequency band sound power levels of each source

Noise sources for each power generation unit	Source height, m	Octave frequency band, Hz								
		31.5	63	125	250	500	1000	2000	4000	8000
		Sound power levels, dB								
Gas turbine package UMB	6	123	121	112	107	100	95	92	87	83
Gas turbine filter house UMB	14	113	104	97	87	84	92	95	94	89
Gas turbine diffuser extension duct UHN	6	109	115	110	105	104	99	99	93	87
Exhaust stack	30	130	124	114	103	101	99	98	98	104
Lube oil coolers URC	4	96	98	100	101	96	92	90	88	87
Forced cooling water cooler URB	4	100	102	104	106	100	96	94	92	91
Transformers BAT/BBT/BFT	6	79	89	103	103	99	94	87	83	73
Unidentified noise source	6	121	121	116	112	103	97	91	85	81
Single noise source for all units:										
Fuel oil pump station UEL	3	82	95	103	101	99	98	96	94	88

FIGURE 3 Example of two OCGT power generation units

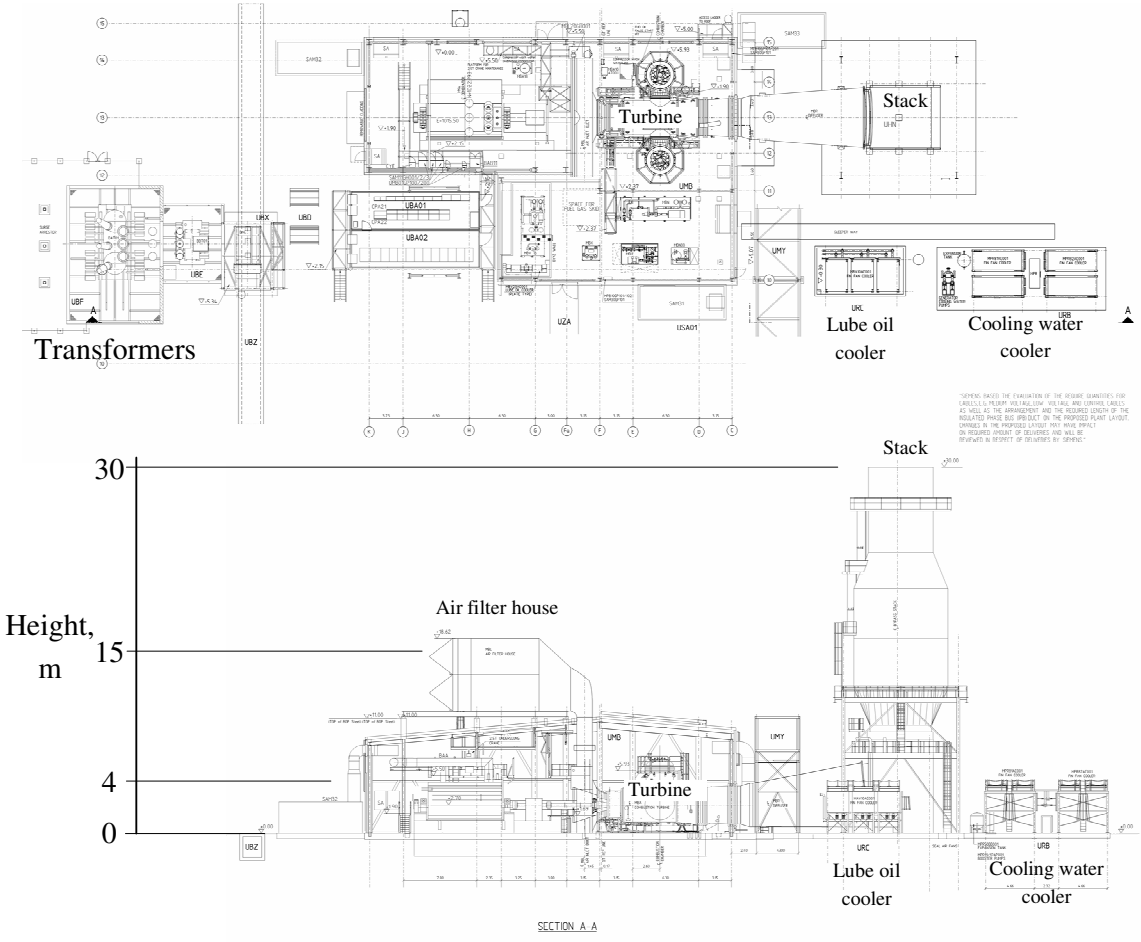

FIGURE 4 Plan and section of an OCGT power generation unit

Sections 9.2 and 10 of the Siemens report indicated that impulsive types of noise, such as associated with steam blow-off systems and safety valves, do not exist in a gas turbine plant. Section 5.2.2 of the report [3], referring to noise mitigation procedures to be undertaken, contained the following statement: …. *Clearly audible tonal components shall be avoided.* From the information provided it was understood that adjustments for pure tones or impulsive nature of the noise were not applicable in deriving the rating level of noise.

6. IMPACT OF NOISE AT RECEIVER LOCATIONS – OPERATION PHASE

6.1. Calculation procedure

At the time of the original noise impact study the assessment was based on the anticipation that the OCGT units would normally operate for a total of two hours during the daytime period between 06:00 hrs and 22:00 hrs for five days a week (JKA, 2005).

The anticipated operating hours have since increased to a total of five hours during the daytime period between 06:00 hrs and 22:00 hrs for five days a week.

The present study thus considers the impact of the calculated rating level of noise, $L_{Req,d}$, at receiver locations due to the operation of the OCGT units for five hours (T = 5 hours) averaged (on an energy basis) over the 16-hour daytime period as well as the $L_{Aeq,T}$ for continuous operation. "Continuous operation" is understood to mean either the daytime rating level $L_{Req,d}$ where the duration T = 16 hours; or the night time period $L_{Req,n}$ where the duration T = 8 hours. Due to constant conditions, hence constant emission of noise during operation, it is also the A-weighted sound level measured/experienced at any time during operation of the OCGT units.

Continuous 24-hour operation presents a worst-case operation scenario.

For continuous 24-hour operation the day/night rating level, $L_{R,dn}$, is often used. The author has found that this descriptor often causes confusion among non-specialists and is thus omitted in this report. Continuous, 24-hour operation implies operation during day- and night-time periods. The more sensitive, hence the lower acceptable night-time rating level, $L_{Req,n}$, is used in this study for the assessment of noise during 24-hour operation of the OCGT units.

The linear-weighted frequency octave band sound power levels in Table 1 were used to calculate the A-weighted sound pressure levels at receiver locations due to the combined contribution of each source of each of the OCGT power generation unit, emanating from

its respective height above ground level in accordance with procedures contained in SANS 10357, *The calculation of sound propagation by the Concawe method*. The rating levels associated with the duration of operation was subsequently calculated for the following scenarios:

- The three 150 MW OCGT units presently being installed operating continuously and for 5 hours out of the 16-hour daytime period between 06:00 hrs and 22:00 hrs;
- A total of six 150 MW OCGT units comprising the three units presently being installed plus the three proposed 150 MW OCGT units all operating continuously and for 5 hours out of the 16-hour daytime period;

According to information received the OCGT plant, under normal operating conditions would primarily operate at time periods close to sunrise and sunset. These periods coincide with meteorological conditions favouring the propagation of sound from a noise source to a receiver location. The appropriate meteorological conditions were applied in the calculation of sound propagation.

6.2 Results of the calculations

The calculated noise contours for various scenarios are displayed in Figures 5 through 8.

In Figures 5 and 7 “continuous operation” can have the following meanings:

- For 16-hour continuous daytime operation the contours represent $L_{Req,d}$;
- For 8-hour continuous night time operation the contours represent $L_{Req,n}$;
- For continuous operation during any time period T the contours represent $L_{Req,T}$;
- For a worst-case scenario of continuous 24-hour operation, the night time rating level, $L_{Req,n}$, is used in this report for assessment purposes.

The scenarios are as follows:

Existing plant of three OCGT units

Figure 5 Continuous operation of all three units.

Figure 6 Operation of three existing units for a total of 5 hours during a 16-hour day.

Existing plant of three OCGT units plus three proposed units - total 6 units

Figure 7 Continuous operation of all six units.

Figure 8 Operation of six units for a total of 5 hours during a 16-hour day.

The rating level due to noise from the OCGT units being equal to the measured level of 43dBA is depicted by a broken blue contour line. The rating levels due to noise from the OCGT in excess of the measured level of 43dBA are depicted by continuous red contours.

The rating level due to noise from the units being equal to the acceptable night time rating level of 35dBA is depicted by a continuous green contour. The red and blue contours depict rating levels in excess of the acceptable night time rating level of 35dBA.

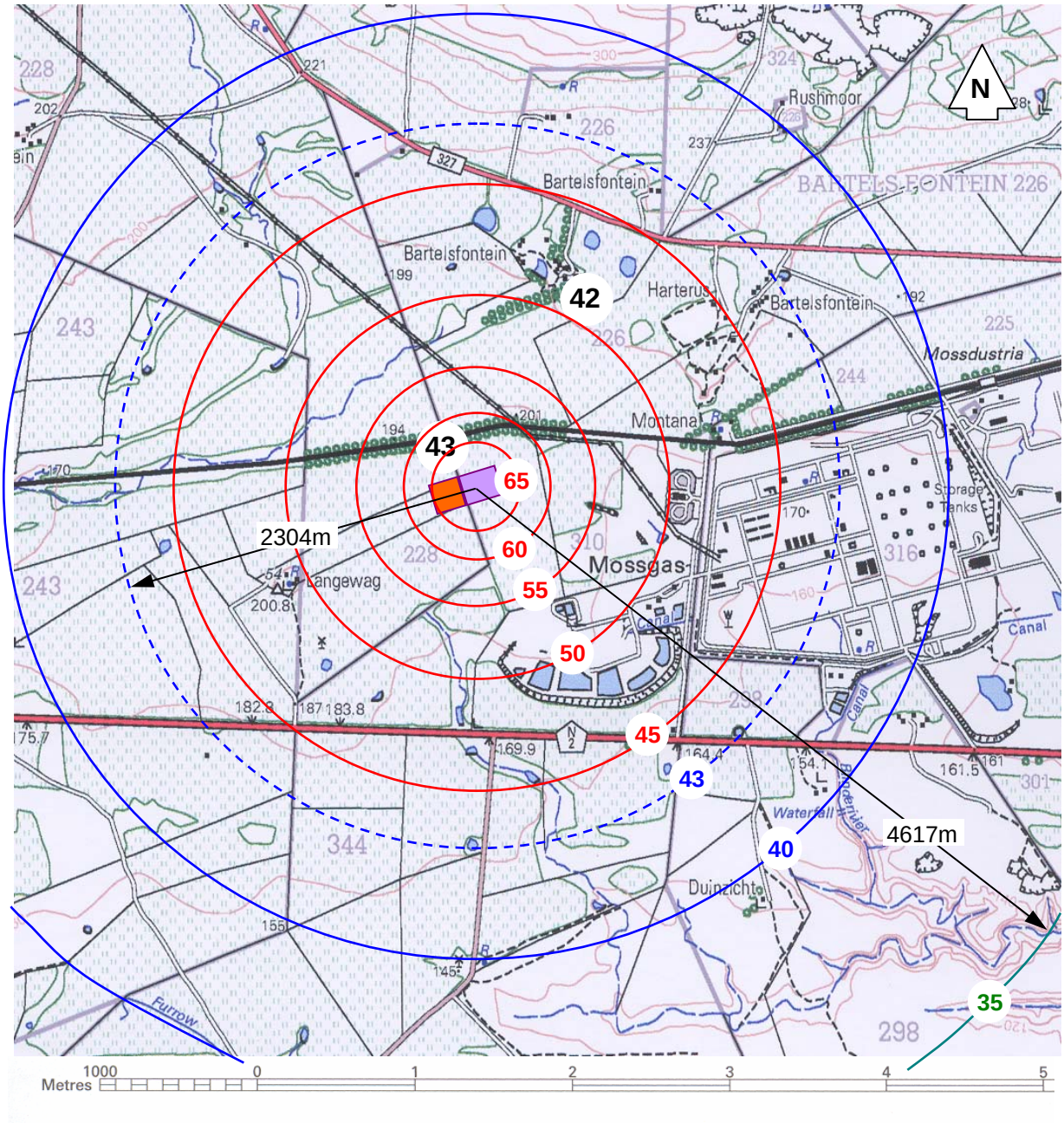

FIGURE 5 $L_{Req,T}$ **for three existing OCGT units operating continuously**

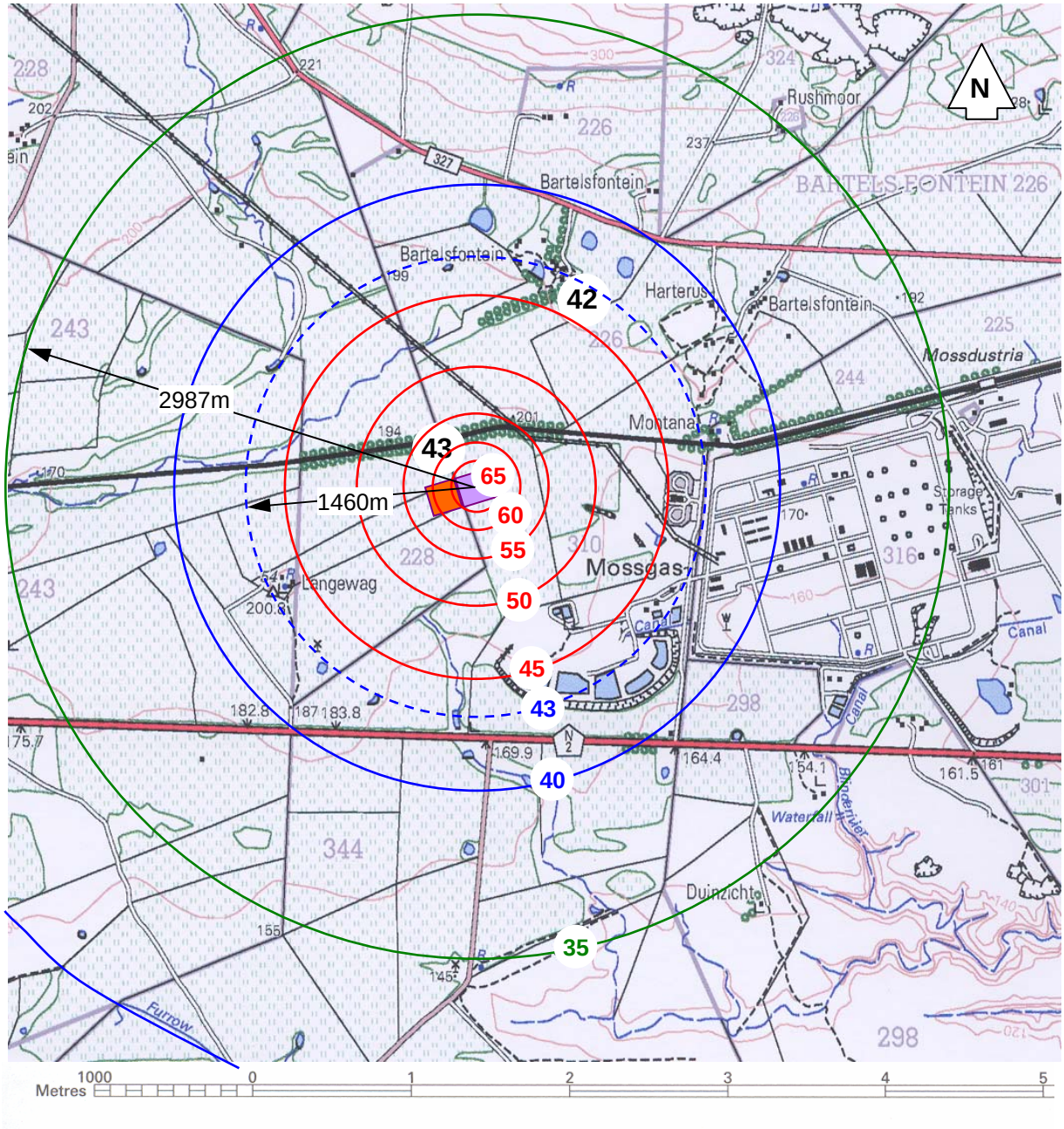

FIGURE 6 $L_{Req,d}$ **for three existing OCGT units operating 5 hours during daytime**

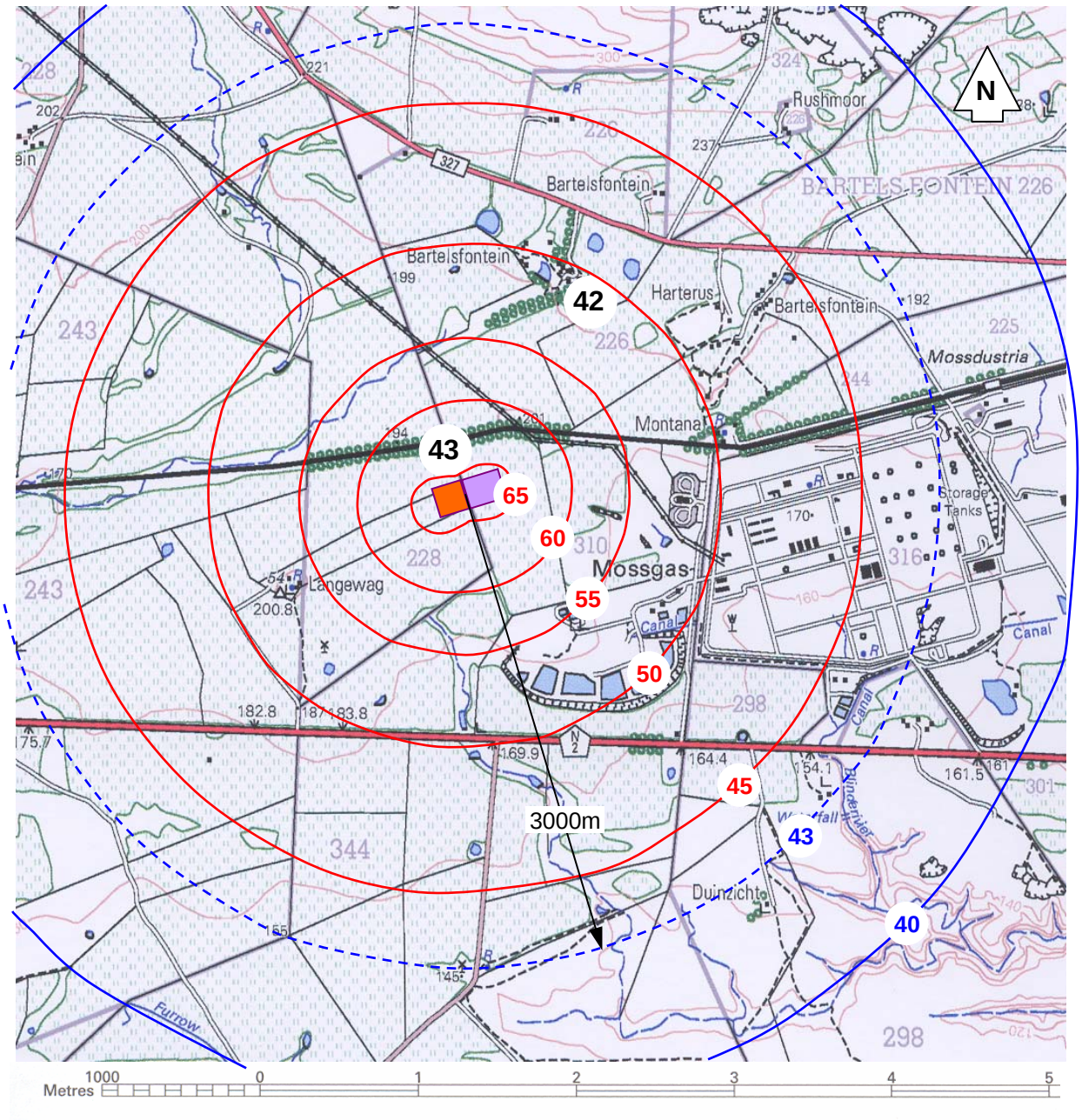

FIGURE 7 $L_{Req,T}$ **for six OCGT units operating continuously**

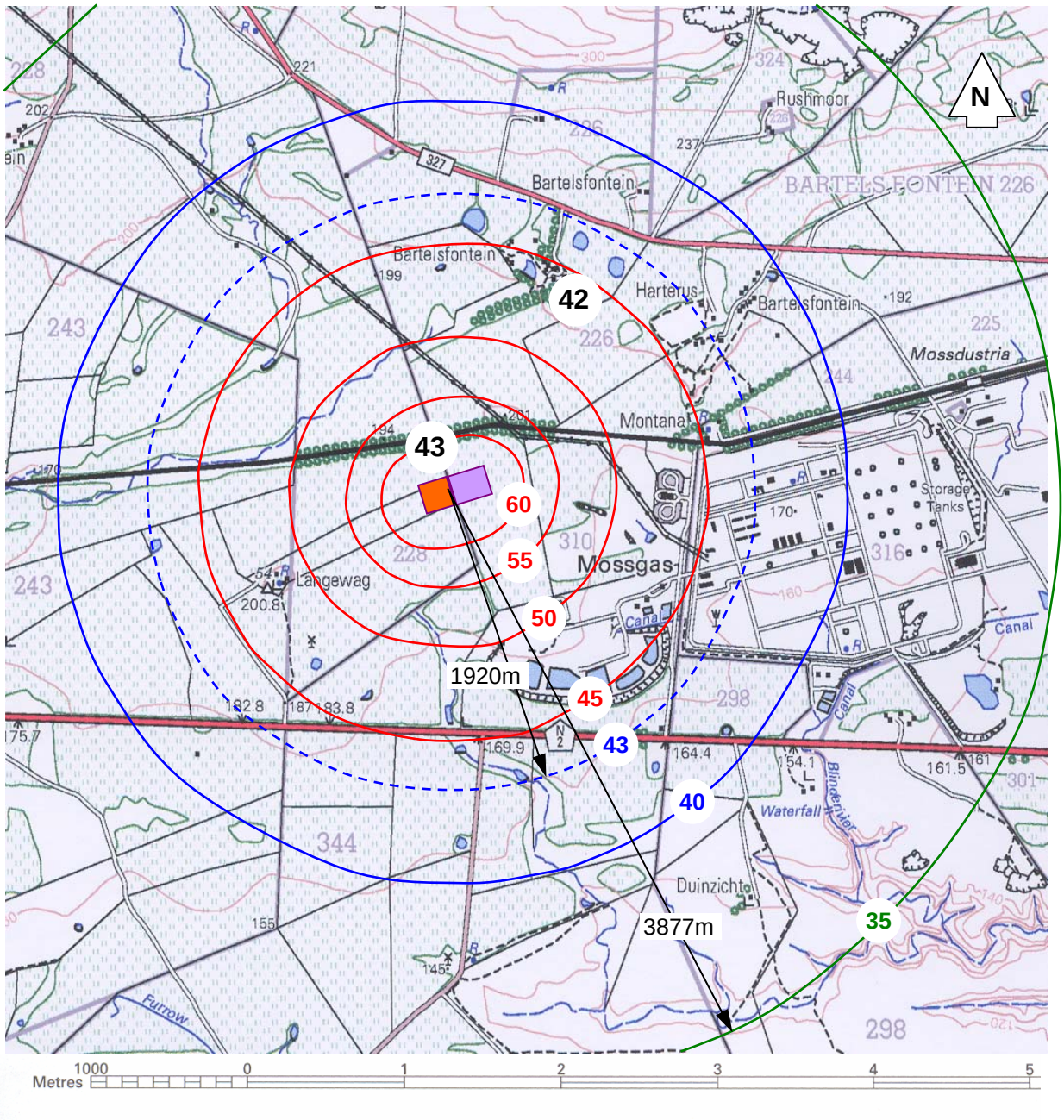

FIGURE 8 $L_{Req,d}$ **for six OCGT units operating 5 hours during daytime**

6.2. Assessment of the results

The assessments of the results were based on the following assumptions:

- The OCGT noise emission data provided was representative of that to be constructed.
- Normal/typical daytime operation of the OCGT plant would be restricted to a total of five hours during the daytime period from 06:00hrs to 22:00hrs.
- The noise emanating from the plant did not contain pure tones and was not of an impulsive nature.

The rating level of existing outdoor residual (or ambient) noise on farm land to the north of the OCGT plant site was approximately 43dBA during daytime. Refer to Section 4.1. This was slightly lower than the outdoor daytime acceptable rating level of 45dBA for a "rural residential district". The noise was almost entirely due to the continuous 24-hour operation of the PetroSA gas-to-liquid plant. The measured 43dBA therefore also represented the night time ambient level in the absence of noise from the OCGT units.

Experience has shown that where a source of noise causes the level of ambient noise to increase by approximately 10dB or more above the residual noise level, even for relatively short periods of time, the noise from the source would be distinctly noticeable. This would be applicable to land within a 53dBA contour (not shown in the Figures). This knowledge, however, does not form part of any South African National Standard.

6.2.1. Assessment in terms of SANS 10103

Operation of three OCGT units presently under construction

For normal daytime operation of three existing OCGT units for 5 hours out of 16 hours the $L_{Req,d}$ of noise due to the units is expected to exceed the measured ambient level of 43dBA within a radius of 1460m from the centre of OCGT plant. Refer to Figure 6. This is the distance to the Bartelsfontein residential dwellings north of the site at which a level of 42dBA was measured. It is also the distance to the residential dwellings at Langewag SW of the site and almost to the Montana farm NE of the site. The intensity of noise impact at these locations would be Negligible to Low. Beyond this distance no noise impact would be expected due to operation of the three OCGT units for normal daytime operation.

On all land within this radius a noise impact would be expected with an intensity ranging between Low at the furthest distance to Very High at the boundary of the OCGT plant site. This includes areas of farmland to the N and W of the site.

For continuous operation of the existing three OCGT units (refer to Figure 5):

- For 24-hour operation the $L_{Req,n}$ is used for assessment. The $L_{Req,n}$ of noise due to the three units is expected to exceed the acceptable night time level of 35 dBA within a radius of 4617m. This would encompass all farmland within and beyond the study area including that to the south of the N2. Road traffic noise could, however, to a certain extent be expected to tend to mask the OCGT noise for land situated in the vicinity of the N2. The intensity of noise impact would be expected to be Low between the 35dBA and 40dBA noise and Medium between the 40dBA and 45dBA noise contours. Within the 45dBA and 50dBA noise contours the intensity would be High. This includes Langewag, Bartelsfontein, Montana and Harterus. Within the 50dBA noise contour the intensity would be Very High. This would include a significant area of farmland to the W and N of the railway line.
- For an operation duration, T, the $L_{Aeq,T}$ of noise due to the units is expected to exceed the existing daytime ambient noise level of 43dBA within a range of 2304m from the centre of the plant site. This would include farmland north of the R327 and south of the N2. Within the 53dBA noise contour (not shown) noise due to the OCGT plant would be distinctly noticeable.

Operation of six OCGT units – three existing plus three proposed

For normal daytime operation of six OCGT units for 5 hours out of 16 hours the $L_{Req,d}$ of noise due to the units is expected to exceed the measured ambient level of 43dBA within a distance of 1950m from the centre of the combined OCGT plants. Refer to Figure 8. This would include the farmlands to the N up to the R327, Montana and the residential dwellings at Harterus to the NE and Langewag to the SW. The intensity of noise impact would be expected to range between Negligible and Low at these locations. At closer ranges the Intensity would range between Medium to Very High near the boundary of the combined OCGT plant site.

For continuous operation of six OCGT units (refer to Figure 7):

- For 24-hour operation the $L_{Req,n}$ is used for assessment. The $L_{Req,n}$ of noise due to the three units is expected to exceed the acceptable night time level of 35 dBA within a distance of 5800m. This would include land areas well beyond the study area. Land within the 40dBA and 45dBA noise contours the intensity of noise impact would be

Medium. At Harterus and Montana the intensity would be High whereas it would be Very High at Langewag, Bartelsfontein and all farmland closer to the boundary of the combined OCGT plant site.

- For an operation duration, T, the $L_{Aeq,T}$ of noise due to the units is expected to exceed the existing daytime ambient noise level of 43dBA within a range of 3000m from the centre of the plant site. Within the 53dBA noise contour (not shown) noise due to the OCGT plant would be distinctly noticeable. This would include Langewag and Bartelsfontein residential dwellings.

6.2.2. Assessment in terms of the existing Noise Control Regulations

In terms of the existing Noise Control Regulations of the Province of the Western Cape (NCR), no cognisance is taken of the duration of the noise under investigation other than a minimum duration of ten minutes being required when the noise is being measured.

In terms of the NCR it might be interpreted that an assessment is made of a noise under investigation provided that the noise persists for more than ten minutes. Based on this interpretation, the noise emanating from the proposed OCGT plant, when operating for longer than ten minutes, would be construed to be a disturbing noise on land where the noise level would be 7dB higher than the ambient sound level of 43dBA. This would include all land within the L_{Aeq} = 50dBA contour.

For operation of the existing three OCGT units under construction the noise from the units would not be construed to be a disturbing noise at Langewag, Bartelsfontein and Montana residential dwellings. However, on farmland to the W and N of the railway line, situated closer to the existing plant boundary, the noise could be construed to be a disturbing noise.

For operation of the proposed six OCGT units the noise from the units would be construed to be a disturbing noise at Langewag, Bartelsfontein and Montana residential dwellings and on farmland to the W and N of the railway line, situated closer to the combined plant boundary.

6.3. Summary of noise impact

Table 2 provides a noise impact summary associated with the SANS 10103 assessments for the operation of the three OCGT units under construction and for the operation of six OCGT units. The range variation for Intensity and Significance are associated with the duration of operation of the units and distance of affected land from the OCGT plant site, hence area of affected land.

Table 2 Noise impact summary – operational phase

Number of OCGT units	Three	Six
Extent of impact:	Local	Local
Duration of impact:	Long term	Long term
Intensity	Low to Very High	Low to Very High
Probability of occurrence:	Definite	Definite
Legal requirements:	NCR	NCR
Status of impact:	Negative	Negative
Significance	Medium	Medium to High
Degree of confidence:	Probable	Probable

7. IMPACT OF NOISE AT RECEIVER LOCATIONS – CONSTRUCTION PHASE

Table 3 contains information regarding noise emanating from operations and machinery during construction of the OCGT (Siemens).

TABLE 3 Noise data relating to construction operations and machinery

Equipment	Sound Power Level dB(A)	Sound Pressure Level at 100 m distance dB(A)
Bulldozer	112	64
Excavator	116	68
Tractor	108	60
Truck	120	72
Compactor	124	76
Grader	120	72
Range of noise levels during reclamation		**60 – 80**
Trailer	110	62
Truck	120	72
Lorry	106	58
Range of noise levels during transportation		**62 - 78**
Drop Hammer (precast concrete piles)	128	80
Vibratory System (sheet piles)	120	72
Screened Drop Hammer	95	47
Range of noise levels depending which equipment is used		**47 - 80**
Concrete Mixer	112	64
Concrete Truck	120	72
Crane (Boring & Placing Precast Concrete & Concrete	123	75
Pouring		
Generator Set for Welding	110	62
Generator Set for Power	120	72
Hammer Drill	112	64
Chipping Hammer	119	71
Air Compressor	119	71
Range of noise levels of all construction equipment		**62 - 80**
Boiler blow out without noise protection	165	117
Boiler blow out with silencer, silent steam blow	120	72

The results of approximate calculations, using the information provided, indicated that the instantaneous levels of noise originating from the noisiest sources would be 45dBA at a range of 2300m. Due to the highly varying nature of construction noise, it was anticipated

that the $L_{Aeq,T}$ levels during a 16-hour day would be considerably less than the instantaneous levels.

According to information received (Siemens) it was considered unlikely that ground-borne vibration would be noticeable beyond the site boundary.

According to the information provided, it was anticipated that construction noise would be audible at the dwellings on Bartelfontein farm and at Langewag to the west of the proposed site. However, in terms of assessment in accordance with SANS 10103 it was anticipated that the intensity of impact of construction noise at these sites would vary between "negligible" and "low".

8. NOISE MITIGATION

The predominant source of noise of each OCGT unit is the outlet of the exhaust stack. The 30m elevation of the outlet above ground level renders any noise mitigation along the noise propagation path between plant and receiver impractical. Besides limiting the duration and number of operating units, the only meaningful noise mitigation procedure would be to reduce the exhaust stack noise emission by at least 5dB. A 10dB reduction in noise emission would enable six units to operate under normal conditions with minimal area of land experiencing a noise impact. For continuous operation of all six units the intensity of noise impact would reduce to between Low and Medium at all residential dwellings closest to the plant site.

9. CONCLUSIONS

The primary factor affecting the intensity of noise impact is the proximity of sources with high noise emission levels adjacent to noise sensitive land with the lowest acceptable noise levels.

The results of the study indicated that the potential intensity of impact of noise from the existing three OCGT power generation units operating under normal conditions of 5 hours during daytime would be Negligible to Low for residential dwellings at a radius of 1460m from the centre of OCGT plant. The intensity would increase to Very High on farmland adjacent to the plant boundary.

For continuous operation of the three OCGT units, large areas of land, encompassing the entire study area, would be exposed to a noise impact with an intensity at the nearest residential dwellings ranging between Medium and High and increase to Very High on farmland adjacent to the plant boundary.

For six OCGT units operating under normal conditions, the intensity of noise impact at the nearest residential dwellings would range between Low and Medium. The intensity would increase to Very High on farmland adjacent to the combined plant boundary.

For continuous operation of the six OCGT units, large areas of land, encompassing the entire study area, would be exposed to a noise impact with an intensity on all farmland and at all residential dwellings within the study area ranging between Medium and Very High.

The only meaningful noise mitigation procedure for operation of six OCGT units would require a significant reduction in noise emission level of the exhaust stack.

REFERENCES

JKA, 2005	*Environmental Noise Impact Assessment for the proposed Open Cycle Gas Turbine Power Plant at Mossel Bay*, Jongens Keet Associates, September 2005.
Siemens, 2005	*Noise Protection Concept OCGT Eskom – Atlantis* Report number W7P/2005/031, 18 August 2005.
Siemens	*Noise and Vibration during Civil and Construction Work*, undated.

APPENDIX A
Terminology used in the measurement and assessment of sound

Certain of the terms used in SANS 10103 are listed hereunder. Their meanings are in certain instances loosely described to facilitate understanding. Formal definitions of these and additional terms are contained in SANS 10103.

Ambient noise
the totally encompassing sound in a given situation at a given time, and is usually composed of sound from many sources, both near and far. It includes the noise from the noise source(s) under investigation.

A-weighted sound pressure level (sound level), L_{pA}
the sound pressure level, in decibels, relative to a reference sound pressure, and incorporating an electrical filter network in the measuring instrument corresponding with the human ear's different sensitivity to sound at different frequencies.

Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$.
A formal definition is contained in SANS 10103. The term "equivalent continuous" may be understood to mean the "average" A-weighted sound level measured continuously, or calculated, over a period of time, T.

Equivalent continuous rating level, $L_{Req,T}$
the equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$, measured or calculated during a specified time interval T, to which is added adjustments for tonal character, impulsiveness of the sound and the time of day.

An adjustment of 5 dB is added for any tonal character, if present. If the noise is of an impulsive nature a further adjustment of either 5 or 12 dB, or a value derived in accordance with Section 5.1.6.1 of the Standard is added. Where neither is present, the $L_{Req,T}$ is equal to the $L_{Aeq,T}$.

Reference time interval
The time interval to which an equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$, or rating level of noise, $L_{Req,T}$, is referred. Unless otherwise indicated, the reference time interval is interpreted as follows:

– Day-time	: 06:00 to 22:00	T = 16 hours	$L_{Req,d}$ replaces $L_{Req,T}$
– Night-time	: 22:00 to 06:00	T = 8 hours	$L_{Req,n}$ replaces $L_{Req,T}$

Residual noise
The ambient noise that remains at a given position in a given situation when one or more specific noises (usually those under investigation) are suppressed.