APPENDIX 9.2 - NOISE PREDICTION METHODOLOGY

1. ISO 9613-2 PREDICTION MODEL

1.1 The ISO 9613-2 standard is used for predicting sound pressure level for downwind propagation by taking the source sound power level for each noise source in separate octave bands and subtracting a number of attenuation factors according to the following:

Predicted Octave Band Noise Level = $L_w + D - A_{geo} - A_{atm} - A_{gr} - A_{bar} - A_{misc}$

1.2 These factors are discussed in detail below. The predicted octave band levels from each noise source are summed together to give the overall ‘A’ weighted predicted sound level.

L_W - Source Sound Power Level

1.3 The sound power level of a noise source is normally expressed in dB re: 1pW. Noise predictions are based on sound power levels detailed in the main body of the report.

1.4 The octave band noise spectra used for the predictions have been calculated based on the results of measurements discussed at Appendix 9.1 and these are provided within the main noise assessment chapter.

D – Directivity Factor

1.5 The directivity factor allows for an adjustment to be made where the sound radiated in the direction of interest is higher than that for which the sound power level is specified. In this case the sound power levels are calculated from measurements taken in the directions corresponding to the worst case propagation conditions considered here and needs no further adjustment.

A_{geo} – Geometrical Divergence

1.6 The geometrical divergence accounts for spherical spreading in the free-field from a point sound source resulting in an attenuation depending on distance according to:

$$A_{geo} = 20 \times \log(d) + 11$$

where d = distance from the source

1.7 The noise sources included in the assessment may be considered to be point sources due to the relatively large distances between the power station and residential noise receptors.

A_{atm} - Atmospheric Absorption

1.8 Sound propagation through the atmosphere is attenuated by the conversion of the sound energy into heat. This attenuation is dependent on the temperature and relative humidity of the air through which the sound is travelling and is frequency dependent with increasing attenuation towards higher frequencies. The attenuation depends on distance according to:

$$A_{atm} = d \times \alpha$$

where d = distance from the turbine

α = atmospheric absorption coefficient in dB/m

1.9 Values of 'α' from ISO 9613 Part 1[1] corresponding to a temperature of 10ºC and a relative humidity of 70% have been used, which give relatively low levels of atmospheric attenuation and correspondingly worst case noise predictions, as given below.

Frequency dependent atmospheric absorption coefficients

Octave Band Centre Frequency (Hz)	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Atmospheric Absorption Coefficient (dB/m)	0.000122	0.000411	0.00104	0.00193	0.0037	0.00966	0.0328	0.117

A_{gr} - Ground Effect

1.10 Ground effect is the interference of sound reflected by the ground with the sound propagating directly from source to receiver. The prediction of ground effects are inherently complex and depend on the source height, receiver height, propagation height between the source and receiver and the ground conditions. The ground conditions are described according to a variable G which varies between 0 for 'hard' ground (includes paving, water, ice, concrete & any sites with low porosity) and 1 for 'soft' ground (includes ground covered by grass, trees or other vegetation). A ground factor of G = 0.5 and a receptor height of 4m has been used here.

A_{bar} - Barrier Attenuation

1.11 The effect of any barrier between the noise source and the receiver position is that noise will be reduced according to the relative heights of the source, receiver and barrier and the

1 ISO 9613-1, Acoustics - Attenuation of sound during propagation outdoors, Part 1: Method of calculation of the attenuation of sound by atmospheric absorption, International Organization for Standardization, 1992

frequency spectrum of the noise. The barrier attenuations predicted by the ISO 9613 model have, however, been shown to be significantly greater than that measured in practice under down wind conditions and should therefore be used with caution.

A_{misc} – Miscellaneous Other Effects

E1. ISO 9613 includes effects of propagation through foliage, industrial plants and housing as additional attenuation effects. These have not been included here and any such effects are unlikely to significantly reduce noise levels below those predicted.

Wind Direction Effects

1.12 Where wind direction effects are considered appropriate to be included in the prediction model, a supplementary term is been added to the ISO9613-2 methodology to allow for the effects of wind direction. For any given wind direction, each nearby residential receptor is classified as being either downwind, crosswind, or upwind of each of the turbines and differing amounts of attenuation are applied. However, the predictions in this noise assessment are for downwind conditions and no adjustment for wind direction has been made.