THE ACOUSTIC GROUP PTY LTD
CONSULTING ACOUSTICAL & VIBRATION ENGINEERS

RENEWABLE ENERGY (ELECTRICITY) AMENDMENT (EXCESSIVE NOISE FROM WIND FARMS) BILL 2012

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SUBMISSION TO THE SENATE ENVIRONMENT AND COMMUNICATIONS/LEGISLATION COMMITTEE

In the matter of Renewable Energy (Electricity) Amendment (Excessive Noise from Wind Farms) Bill 2012

1.0 INTRODUCTION

This submission is to support the proposed amendments, with minor corrections to address the technical terminology to accompany the amendments.

The "Overview of the Bill" contained in the Explanatory Memorandum circulated under authority of Senator John Madigan and Senator Nick Xenophon states:

> This bill amends the *Renewable Energy (Electricity) Act 2000* to give powers to the Regulator that ensure that accredited power stations that are wind farms, either in whole or in part, to not create excessive noise.

The intent of the Bill is clear. The Bill is of importance to communities in proximity to wind farms in that the general concept for the assessment of wind farms in Australia is to consider noise in terms of numerical limits that do not in fact address the acoustic impact of the wind farm.

The Bill proposes that Subsection 5.1 is to include a definition of excessive noise as defined by Subsection 14 (6). Subsection 14(6) states:

> (6) For the purposes of this Act, a wind farm ***creates excessive noise*** if the level of noise that is attributable to the wind farm exceeds background noise by 10 dB(A) or more when measured within 30 metres of any premises:
> (a) that is used for residential purposes; or
> (b) that is a person's primary place of work; or
> (c) where persons habitually congregate.

From a technical view point for a person involved in acoustics whilst understanding the intent of the definition of "creates excessive noise", there would need to be some minor amendments to make the definition both technically correct and work in a practical sense.

There is a new section 20AB which requires publication on the Internet of information in relation to the operation of wind farms:

> **20AB Wind farms – publishing on internet information about noise, wind speed and direction, weather conditions and power output**
>
> (1) The nominated persons for an accredited power station that is a wind farm must ensure that information prescribed by the regulations relating to the following is published on the internet:
>
> (a) noise attributable to the wind farm;
>
> (b) wind speed and direction at the wind farm;
>
> (c) weather conditions at the wind farm;
>
> (d) power output of individual turbines at the wind farm.
>
> (2) The information must be published on the internet in accordance with any requirements prescribed by the regulations for the purposes of this subsection.
>
> Example. A requirement that the information be published in real time.

This submission supports the proposed Bill. The provision of the material set out in clause 20AB is essential for the purpose of establishing and verifying acoustic compliance of wind farms. Under current approval conditions wind farm operators have claimed that acoustic compliance cannot be determined without actual data related to the operation of the wind farm. But this material is often asserted to be "commercial-in-confidence". Hence the community is and has been unable to independently assess the acoustic compliance of wind farms.

This submission suggests a number of amendments which, from a technical point of view, are needed to ensure that the legislation is technically correct and works in a practical sense. These amendments are dealt with in the substance of the submission and are summarised in its conclusion.

The material contained in this submission is based on a number of reviews in relation to applications for proposed wind farms, acoustic measurements recorded of existing wind farms, and the nature of noise disturbance identified by residents in the course of such measurements.

2.0 QUALIFICATIONS OF THE REVIEWER

To provide the basis of this submission it is necessary to identify my professional experience and qualifications in relation to noise assessments.

I Steven Edwin Cooper am the principal of The Acoustic Group Pty Ltd, Consulting Acoustical and Vibration Engineers.

I have been in practice as an Acoustical Consulting Engineer for 35 years. I hold a Bachelor of Science (Engineering) degree from the University of New South Wales and a Master of Science (Architecture) being a research degree in Acoustics from the University of Sydney and am a Chartered Professional Engineer. I am a Fellow of the Institution of Engineers Australia, a Member of the Australian Acoustical Society and a Member of the Institute of Noise Control Engineering (USA).

In the course of my acoustical consulting practice I have been involved in numerous projects for private, commercial and government organisations requiring expertise in acoustics, noise and vibration issues.

Furthermore as a practising Acoustical Consulting Engineer I am or have been a member of the Standards Association of Australia Committees AV4, AV/10, AV/10/4 and EV/11 dealing with Architectural Acoustics, Whole-Body Vibration, Rail Traffic Noise, and Aircraft Noise respectively. I was a member of the Australian Acoustical Society NSW Membership Grading Committee from 1979 to 1997 and was a member of the Australian Acoustical Society Federal Grading Committee in 1998. My Curriculum Vitae is set out in Appendix A.

It is noted that in the course of my professional career I have been involved in projects where I have appeared for Applicants, Objectors, Councils, Government Departments (State and Federal) and as a Court Appointed Expert.

I am not a member of any political party.

I have not been retained or approached by any wind farm proponents to undertake an assessment of wind farm noise.

I have extensive experience in the measurement and assessment of large industrial premises where there is a requirement to maintain compliance with specified noise limits under all weather scenarios.

I have also conducted research into various acoustic issues concerning the propagation of aircraft noise and sound dispersion in enclosed spaces that has questioned the status quo of various Standards or acoustic texts leading to modification/amendments to Australian Standards and International guidelines.

On turning to my practical involvement in the measurement and assessment of wind farm noise, whilst I have not been engaged by any wind farm applicant to undertake an acoustic assessment or compliance testing of planned or operational wind farms, I was requested in late 2011 by a community group opposing a proposed wind farm at Flyers Creek (in NSW) to review an application.

I prepared a desktop review of the acoustic assessment that had been prepared for the Flyers Creek Wind Farm. The Applicant's acoustic assessment of the Flyers Creek Wind Farm was based upon guidelines issued by the South Australian EPA.

My desktop audit was contained in a submission from the Flyers Creek Wind Turbine Awareness Group ("FCWTAG") in relation to the proposed Flyers Creek Wind Farm. The desktop review raised issues as to the ambient background levels, the predicted noise emission levels and the absence of an assessment of the noise impact of the proposed wind farm.

The desktop review was supplemented by preliminary noise testing in proximity to the Capital Wind Farm (in NSW). The preliminary testing highlighted a number of issues with respect to the assessment and evaluation of wind farm noise where currently the predominant acoustic descriptor is the dB(A) level.

I found at times there to be no audible noise inside or outside residential dwellings, whilst on other occasions I was able to detect wind farm noise both outside and inside dwellings.

My testing identified the possibility that noise originating from the wind farm could affect individuals and that further testing/investigations were required as set out in my review of the Flyers Creek Wind Farm application (available on the NSW Department of Planning website).

The NSW Department of Planning issued in late 2011 a draft set of wind farm guidelines for public comment ("the NSW Guidelines"). The NSW guidelines (if implemented) are more stringent than the SA wind farm noise guidelines.

As part of my review of the draft NSW guidelines I undertook further measurements and analysis of wind farm noise (Capital, Cullerin and Woodlawn wind farms) to research wind farm noise and assess the practicality of compliance testing as set out in the draft NSW Guidelines.

I prepared a technical submission on the draft NSW Guidelines. I was not engaged by any party to prepare my submission, but as my review relied upon previous material prepared for the Flyers Creek submission, my review of the draft NSW Guidelines was added to the Flyers Creek community submissions (available on the NSW Department of Planning website).

As part of my on-going investigations into wind farm noise I have attended residential properties and public roads in proximity to Waterloo and Hallett wind farms (in South Australia) and Cape Bridgewater, Glenthompson and Waubra wind farms (in Victoria) in order to place in context claims of excessive noise/impacts from those wind farms.

As experienced for the NSW wind farms I have attended, at some sites in South Australia and Victoria there was clearly audible noise from the wind farm, at other sites some noise was audible, whilst at other sites there was no audible noise.

In the reporting of wind farm noise, there are claims and counter claims as to bias in the presentation of data that is a fundamental issue to be addressed for any wind farm assessment/review.

As a Member of the Australian Acoustical Society (the "AAS") and a Fellow of the Institution of Engineers Australia I am required to abide by the Code of Ethics for those two organisations.

Appendix B provides a copy of the Code of Ethics of the Australian Acoustical Society.

If there is potential for an industry to jeopardise the welfare, health or safety of the public, or affect the well being of the community I am duty bound to identify those issues under the Code of Ethics of the Australian Acoustical Society.

The AAS Code of Ethics requires that the acoustical assessment in relation to a wind farm is accurate and contains all the relevant material. This is the obligation placed on the acoustician. The acoustician has a heavy professional obligation and should be neither pro nor anti wind farm in approach.

I approach all my work in accordance with my professional Code of Ethics. Contrary to misleading statements made by some wind industry representatives I make the specific statement that **I am not anti-wind farm**.

Any project, be it an industrial application or a wind farm, should operate without giving rise to disturbance, health effects or adverse impacts on the community. If it can do so then, from a noise point of view, it may be permitted.

However where any industrial application or wind farm gives rise to excessive noise, sleep or health impacts and interferes with the rest and repose of individuals then the excessive noise needs to be addressed.

In light of matters raised by the community concerning acoustic assessments that have accompanied wind farm applications and "acoustic compliance tests" of wind farms, I prepared a technical discussion paper "*Wind Farm Noise – An ethical dilemma for the Australian Acoustical Society?*" that was published in the August issue of the Society's journal "Acoustics Australia". I have attached this paper as Appendix C as it is relevant to the Bill.

I have attached at Appendix D a recent paper "*Are Wind Farms Too Close To Communities?*" This paper is also relevant to the Bill. It deals with the basis of a number of the technical comments in this Submission which underlie my suggested alterations to clause 14(6) i.e. currently noise criteria for wind farms in Australia are primarily expressed in terms of an external dB(A) level, that in itself does not address low frequency sound and infrasound (below 20 Hz). The presence of audible and inaudible characteristics in the wind turbine noise signature both external to and inside dwellings needs to be included in the determination of excessive noise.

3.0 CURRENT CRITERIA

As identified above the intent of the amendments to the Renewable Energy (Electricity) Bill is to address the issue of excessive noise from wind farms.

At the present point in time, in Australia, noise criteria applicable to existing or proposed wind farms can be based on either the 2003 or the 2009 version of the South Australian EPA Wind Farm Guidelines, or the 1998 or 2010 New Zealand Standard 6808 Acoustics - Wind Farm Noise.

The New Zealand Standard and the South Australian EPA guidelines utilise a basic concept of a base noise level of 35 or 40 dB(A) as one criterion and then background + 5 dB(A) as the second criterion. The application of the assessment procedure is to consider the greater value of either criterion, dependent upon the hub height wind speed.

It should be noted at the outset that there is a critical difference between the assessment of background noise for wind farms and that of background noise for general environmental acoustic assessments or noise emission from industrial premises and the like. The latter utilise the repeated minimum level of the background which **excludes** measurements conducted with wind speeds (at the microphone) greater than 5 metres per second.

However as wind farms require wind to be occurring at the turbine then the background level for wind speeds **greater than 5 m/s** is applied in the determination of background sound levels.

The manner of assessing background levels for wind farms has been to consider the background level at residential receivers referenced to the wind at the turbine height or (on earlier versions of the documents) to consider wind at a height of 10 metres above ground level at the wind farm site.

This concept is based on an expectation that the residential receivers will be subject to higher noise levels when the wind occurs that permits the turbines to operate. This leads to the concept that where the background is elevated at times when the turbines are operating then background + 5 dB(A) would apply once the base threshold level has been exceeded.

Whilst there is logic in the concept of a sliding scale that represents an increase in the ambient noise as a result of the wind there are problems with the current methodology.

The current methodology of assessing the background levels relative to the wind at the hub height (or ten metres above ground level) at the wind farm does not directly correlate with background levels at receiver locations because of the residential receivers are not necessarily in a similar topographical situation to that at the exposed turbine position.

It is not uncommon to find turbines located on elevated ridges in order to catch the wind rather than locating turbines in the bottom of valleys where there is an expectation of a lower wind flow.

It therefore follows that where a turbine site might be exposed to wind, receiver locations that are situated at lower elevations can be subject to entirely different wind strengths and there is a different wind induced noise level at the receiver locations.

If one takes the situation of a residential location being on the leeward side of a hill, that residential location being in a wind shielded position can be understood to receive a lower wind generated background noise. For the reverse situation of a residence on the side of a hill that is exposed to the wind (i.e. upwind of the turbine) that residence can. if appropriately exposed, have a higher background level for a similar turbine wind speed than the position on the lee side of the hill.

In other words if one plots the hub height wind speed versus the noise level at the receiver location for any nominated wind speed there will be a range of noise levels. Examination of applications for various wind farms demonstrates that that range is significant (see Appendix E).

This range in noise levels *without identification of the wind direction relative to the receiver and wind turbine positions* is currently resolved in the Guidelines in a simplistic format by taking an averaged regression line through the measurement data. From the regression line analysis and using the definition of the base line and background + 5 dB(A) – whichever is the greater the predicted noise emission level of the wind farm is assessed in terms of the dB(A) parameter.

However in reality there are a number of problems with the regression line method:

- The regression analysis method does not differentiate between the background levels that occur at night versus the background levels that occur in the day. One typically expects night time background levels to be lower than in the day. If one was seeking to conduct an assessment of the impact of the wind farm on the community it would be appropriate to differentiate between the acoustic environments that exists in the day versus that in the night.

  If the data was presented just for the night time measurements, which tend to be the critical time of concern to residents, then one would automatically expect a different regression curve to that obtained for the daytime or for the entire 24 hour period.

- Typically the instrumentation used for background noise measurements is incapable of measuring below certain levels – it does not measure lowest levels. Therefore the derived regression line must be higher than if the real background levels were recorded.

- By eliminating wind speeds of less than 5 m/s at the microphone, as set out above, the calculation of background levels for wind farms will be higher than for other assessments of industrial noise. The ambient background level used for the assessment of industrial noise looks to wind speeds less than 5 m/s at the microphone and selects the lowest 10 percentile of the background levels. The lowest 10 percentile of the background levels will obtain a lower value than the average line in the regression analysis used for the operational "background" level. Accordingly, one has a "background" level for the area different to the "background" level for the assessment of the operation of a wind farm. If the regression lines are extrapolated to identify the background level (for the area) prior to the turbine cut-in speed then one would expect a lower background level to prevail.

- The wind monitoring data for a proposed wind farm is typically carried out over a period of not less than 12 months. Yet the background sound level monitoring is typically only over a two week period. As such it becomes questionable as to whether the background levels are representative of the area., noting that there can be considerable difference between the seasons.

Having assessed the predicted noise emission level of the wind farm in terms of the dB(A) parameter as set out above, the various guidelines refer to modifying corrections to the dB(A) value if there are tones, low frequency or modulation components to the noise.

These are dealt further with at Section 5.00 below. But it is noted that under the current dB(A) assessment basis, the noise from the wind farm is to include corrections for tonality, modulation or low frequency characteristics.

Therefore clause 14 (6) requires a notation:

> **(d) for the purpose of this clause the dB(A) noise emission from the wind farm includes any corrections for tonality, infrasound, modulation and low frequency characteristics.**

There is a further reason for this suggested addition as the definition at Subsection 14(6) relates to external measurements only. Consideration of the internal sound levels is relevant in relation to the noise and health impacts that residents receive, particularly at night. In this regard the acoustic environment inside a dwelling is different to that outside and in many cases the requirement for the modifying factors may arise from the subjective characteristics of the sound/noise inside the dwelling.

4.0 ACCEPTABLE NOISE LEVELS

4.1 "Excessive Noise" Definition

Neither the body of the SA EPA Guideline document nor the glossary defines "adverse noise impacts". As such the Guidelines do not assist the community by defining "adverse noise". Similarly whilst Section 4.6 of the Guidelines is headed "Excessive noise," there is no definition of excessive noise. If one assumes the SA EPA has a responsibility to protect the community from unreasonable disturbance and to prevent or minimise any resulting environmental harm then it is not unreasonable to expect the noise criteria to reflect that situation.

The Bill provides a definition of Excessive Noise, which assists in addressing the inadequacy of the SA EPA Guideline.

This amendment is suggested to avoid any argument that the Bill is technically flawed or biased. **The correct terminology for background in the Bill for sub section 14 (6) should be changed to "background sound level" rather than "background noise level".**

Under previous versions of Australian Standard AS 1055, a noise level that exceeds the background may be considered to be annoying. Noise levels up to 5 dB(A) above the background were considered to be of marginal significance.

In NSW "offensive noise" is a noise that is harmful to a person or a noise that interferes with the rest and repose of a person. Noise from a wind farm that gives rise to sleep disturbance clearly interferes with the rest and repose of a person. There are a significant number of residents in proximity to wind farms who regularly complain of sleep disturbance, headaches and nausea when the wind farm is operating. In some cases people have had to abandon their homes due to ongoing sleep disturbance and adverse health effects.

From an acoustic perspective one may consider an adverse impact to occur at a noise level of greater than what may be considered a significant impact, which for an A-weighted value may be assigned background + 5 dB(A).

Therefore the concept of excessive noise from a wind farm to occur at background + 10 dB(A) relates to a level above the levels normally considered by Environmental Authorities as an appropriate limit that gives rise to an annoyance of marginal significance.

If one considers the area where the regression line + 5 dB(A) applies for a wind farm then the concept of the Excessive Noise definition nominated in the Bill is clearly appropriate as the wind farm would be in breach of the consent conditions and such a level of exceedance could only be described as excessive.

Similarly for the current threshold limit (before the application of background + 5 dB(A)) a noise level emitted by the wind farm that is near or at the limit will for rural areas be significantly greater than background + 5 dB(A) and therefore is likely to create excessive noise.

Examination of "noise impact assessments" for proposed wind farms reveal a significant number of applications proposed to generate excessive noise as defined in the Bill.

5.1 The Base Threshold Level

As set out above, the New Zealand Standard and the South Australian EPA guidelines utilise a basic concept of a base noise level of 35 or 40 dB(A) as one criterion. Neither the NZ Standard or the SA EPA Guidelines identify the basis of the base threshold level for rural areas by reference to any studies or measurements. On some occasions there is a reference to the World Health Organisation Guidelines that relate to suburban areas and impact of traffic – not rural areas or the impact of wind farms.

It is a fundamental problem with current criteria that they are based on an unsubstantiated base threshold level.

If one assumes that the wind farm ambient background level of the area from the regression analysis is around 20 dB(A) at the cut-out speed, then it is an undeniable fact that wind farm noise at the nominal limit of 35 dB(A), would be clearly audible both inside and outside residential dwellings and would represent a significant impact in terms of the existing environment., i.e. excessive noise.

Similarly even a contribution from the wind farm of 30 dB(A) would be clearly audible both outside and inside residential dwellings when one considers that the noise level detected by residents in proximity to wind farms is that of a low frequency noise which is not necessarily identified in the dB(A) value.

If one is to be consistent with standard practice of noise assessment then the base threshold level needs to reflect typical background levels in rural environments and separate day versus night.

Whilst acknowledging that background levels at night can in rural areas fall below 20 dB(A), and as the background sound level monitoring is typically only over a two week period, the appropriate baseline threshold should be 25 dB(A) to which the background + 5 dB(A) regression line concept could be applied.

Whilst is it questionable as to whether two weeks of background levels are representative of the area the use of 25 dB(A) or background + 5 dB(A) whichever is the greater would fall in with the current methodology used for wind farms in Australia. If the Environmental or Health Authorities were to comply with their required duties to protect the community then the noise target for wind farms in Australia should be:

- a threshold level of 25 dB(A),
- or background + 5 dB(A) , whichever is the greater.

Whilst changing the noise targets for wind farms is outside the scope of the subject Bill, the above matters are outlined as they are relevant to the concept of excessive noise. **The Excessive Noise requirement of the Bill addresses the incorrect use of the unsubstantiated threshold concepts which are currently applied.**

5. MODIFICATIONS TO THE A-WEIGHTED ASSESSMENT LEVEL

The acoustic impact of an operational wind farm includes components not necessarily picked up in the A-weighted value. As discussed in the proceeding sections, modifications are required under the SA EPA Guideline and the NZ Standard if the additional characteristics are present.

Nevertheless, wind farm development applications frequently assume that the noise from the wind farm will not exhibit modulation or tonality at residential receivers and that no adjustment to predicted noise levels is required. Further, the SA EPA Guideline asserts that a modern well-maintained wind farm does not generate infrasound.

Testing effected by The Acoustic Group at residential dwellings in the vicinity of operating wind farms clearly identifies the limitations of the dB(A) value in reflecting noise impact.

My peer review of the "noise impact" of the proposed Collector Wind Farm, for example, provided measurement data for operational wind farms in Australia to highlight the inadequacies of the A-weighted value. The review identified both external and internal noise levels. The review is available on the NSW Department of Planning website. Some of its relevant material is also contained in my recent paper "Are wind farms too close to communities?" which is attached at Appendix D.

Noise generated from wind turbines covers the entire audio spectrum and includes infrasound. Where monitoring reveals compliance with the nominated dB(A) noise criteria there are instances where residents still hear the wind farm noise and complain about sleep disturbance.

In dealing with the emission of sound from turbines there can be audible components of a general noise, tonal components, modulation (regular variation) of the sound and an emphasis of the low frequency drone of a wind farm when removed from the source (often cited as like the sound of a propeller plane that never lands).

In addition to the audible sound the turbines generate sound that is below the frequency threshold of hearing that is termed infrasound.

The A-weighted filter curve significantly attenuates low frequencies (see Figure 2 in Appendix D) and cannot provide a true indication of potential low frequency noise issues, which is a common source of complaint concerning wind farms. Furthermore if one considers noise that is below the frequency range of human hearing (i.e. less than 20 Hz which is normally referred to as Infrasound) the A-weighted value for such frequencies is insignificant.

In dealing with the acoustic impact of wind farms it is necessary to move to a finer resolution of the sound by consideration of the spectral characteristics of the sound in 1/3 octaves and then narrow band analysis.

Various wind farm acoustic assessments refer to International Standard IEC 61400-11 "Wind turbine generator systems – Part 11: Acoustic noise measurement techniques". The current version is Edition is version 2.1 dated November 2006.

Annex A to the IEC Standard "Other possible characteristics of wind turbine noise emission and their quantification" is identified as informative and discusses the additional characteristics that may include some or all of the following:

- infrasound;
- low-frequency noise;
- impulsivity;
- low-frequency modulation of broad band or tonal noise;
- other, such as a whine, hiss, screech or hum, etc., distinct impulses in the noise, such as bangs, clatters, clicks, or thumps, etc.

In identifying some of the characteristics that have been measured in Australia it is noted that typically wind turbine noise spectra are also presented in A-weighed spectrum curves that show the maxima to be in the mid frequencies.

Figure 3 to Appendix D provides turbine power levels measured for various wind turbines on the assumption of hemispherical radiation and 6 dB per doubling of distance. The Figure provides the Linear results (upper set) and also the same results when presented as A-weighted levels. The difference in the identification of low frequency becomes obvious.

Figures 5 and 6 in Appendix D presents the 1/3 octave band results of the Quinns Gap Road (*Waterloo*) measurements over the SA EPA Guideline standard 10 minute sample. The results show the spectrum information on a statistical basis in a linear format (not A-weighted) and show the statistical variation in the noise level.

There were no other intrusive noises at the site, only turbine noise. The results *clearly identify distinct frequency peaks rather than a broadband noise*.

The measurement results show different frequency characteristics for noise off the front of the turbines compared with noise to the side.

The A-weighted level was not constant and exhibited a variation in level, which as nominated in the SA EPA Guideline is identified as modulation. The modulation occurs over the entire audio spectrum. Whilst not showing a significant variation in the A-weighted level the modulation is most obvious in the upper frequency bands.

Figure 7 in Appendix D presents an FFT analyses that show the sound spectrum in a linear format (rather than constant percentage bandwidth – 1/3 octave bands) over the bandwidth of 0 – 12.5 Hz, which by definition can only be infrasound.

The frequency graphs clearly show that there are low frequency and infrasound components generated by the turbine.

The results set out in Figures 5 – 7 of Appendix D for the measurements of the turbine reveal modulation, low frequency noise and infrasound components.

The issue of whether infrasound generated by turbines is present in residential dwellings is a contentious one.

Figures 8 and 9 in Appendix D provide measurements inside and outside a dwelling at 1300 metres. **Figures 10 and 11** show results for a residence 8 km from the nearest turbine at the *Waterloo Wind Farm. These figures show the presence of measureable infrasound inside and outside the dwellings*. The time signature revealed a modulation of the signal and audibly there was a low frequency noise present**.**

Annex A to IEC 61400-11 suggests the use of dB(G) for the measure of infrasound. However examination Annex B of the Standard indicates the instrumentation for the measurement of wind farm noise is only required to have a Linear response to 30 Hz that as such defeats the purpose of the dB(G) curve.

Figure 13 in Appendix D provides a graphical response of the dB(G) curve in both a logarithmic and linear axis across the frequency band. The decay in the frequency curve reveal that whilst dB(G) may be appropriate for addressing infrasound down to 10Hz the curve is not applicable for measuring down to the blade pass frequency of the turbine, that is normal around 0.8Hz, i.e. 40 dB below the 10H value.

Therefore it would appear that *the assessment of infrasound and the modification to the dB(A) value that would be required is best addressed by looking at the infrasou*nd *below 20Hz using narrow band analysis similar to the tonal assessment contained in IEC 61400-11 for the audible components.*

With respect to the modifying corrections to the character of the wind turbine noise the use of the Industry accepted IEC 61400-11 is appropriate for identifying the corrections except for infrasound. A similar method for identifying tonality in the audible range (using a linear basis for 0 – 20 Hz) could be used for identifying the presence of an infrasound correction.

The application of the modifying factors to the wind farm noise is first assessed external to the dwelling. In light of complaints the assessment of the wind farm noise must be assessed inside the dwelling. *The Bill does not identify this requirement and consideration should be given to clarification that in some instances compliance testing needs to be conducted inside residences.*

6.0 PRACTICALITY OF THE PROVISION OF DATA

The proposed Section 20AB is relatively simple to implement and is long overdue in placing material in the public domain.

It is proposed that an additional sub section to part (1) is required to identify the angle (or feathering of the blades) that can be extracted in real time from the SCADA system associated with the subject wind farm control system. The publication of such data must be in format that is specific in the format and range of such controls.

At the present time the consent conditions rely upon the background regression level determined at the application stage. Because the regression line is expressed in terms of the wind at hub height then compliance (in terms of the current guidelines) cannot be checked.

The provision of weather data and operational data for the turbines is required for compliance with the conditions of consent and the Bill.

An interesting situation occurred for compliance testing of the Capital Wind Farm (apparently in the presence of Department of Planning officials) where the wind farm was shut down during the middle of one set of tests for a short period. *The background level without the wind farm operating was lower than the regression line derived before the wind farm was built.* It is highly unlikely the construction of wind farms that do not operate would suck up noise to reduce the background level. The actual testing is highly suggestive of the fact that the original background sound level data was not appropriate for the area. Yet under the current scenario the compliance testing is based on the (incorrect) background sound data recorded before the wind farm was built.

The provision of the data identified in the Bill would not only enable compliance testing to occur but would address issues of its transparency. It is not uncommon for residents who have been subject to compliance testing to identify during the testing the "noise" was not normal. Claims as to turbines turned off or feathered are not uncommon.

The issue of whether operating wind farms are compliant is a recurring one for residents complaining of noise impacts. The NSW Draft Wind Farm Guidelines proposed noise monitoring procedures. My submission outlined the methodology of conducting measurements on the wind farm boundary with supplementary measurements (continuous and portable stations) to establish the relationship between the site boundary and residential locations for different weather conditions. The monitoring would seek to develop a masking technique to provide the estimated noise levels at residential locations.

Public provision of the specified data would assist in enabling determination of this issue. It can only be to the benefit of the wind industry to establish that wind farms are compliant and not causing an impact as result of excessive noise.

The technology for providing real time (or near real time) monitoring of industrial plants and airports has already been proven to be realistic and practical. An Australian company Lochard (now part of the Bruel & Kjaer group) is the world's leading organisation involved in the monitoring of aircraft noise for airports around the world. A specialised system for military aircraft (specified by me and supplied by Lochard) has been operating at military aerodromes in Australia. Lochard (or now B & K EMS) have the technical expertise to integrate computer systems (such as the SCDATA) with real time monitoring noise monitoring. An example of the civil aviation airport operations real time monitoring as "webtrak" is available at http://webtrak.bksv.com/cbr.

7. CONCLUSIONS

The noise criteria presently applicable to wind farms in Australia have serious deficiencies which have been outlined above and which preclude them from effectively protecting communities from unreasonable disturbances.

There are problems with the determination of realistic background noise levels using the current methodology. This background level is basic to the noise assessment procedures currently adopted. There is a further fundamental problem with the noise guidelines currently in use in Australia in that they do not present the basis of the acceptability of the noise limits specified. The threshold criteria are unsubstantiated and although the SA EPA guidelines refer to excessive noise, they do not provide a definition.

These deficiencies have been confirmed by my measurements at residential properties in South Australian, Victoria and New South Wales. The data obtained confirms low frequency and infrasound, modulation and tonality. The measurement data establish that, one can determine an audible and inaudible "wind farm noise signature" at residential receivers – both inside and outside residences.

The Bill is supported because it goes some way to overcoming the deficiencies in the present legislative framework. It provides a definition of excessive noise that can give certainty to the residents in the vicinity of wind farms. It makes provision for the publication of data from which the compliance or otherwise of operating wind farms can be tested on a transparent basis.

The Bill requires some amendments to achieve the stated aim of the Bill. I have set these out above. They include a change in the terminology for sub section 14 (6) – from "background noise level" to "background sound level". Further, Clause 14 (6) requires a notation:

> **(d) for the purpose of this clause the dB(A) noise emission from the wind farm includes any corrections for tonality, infrasound, modulation and low frequency characteristics.**

The Bill does not differentiate between outside and inside noise. It is assumed the assessment relates to an external noise measurement that requires the dB(A) value to be adjusted as per clause 14 (6) (d). The importance of internal measurements has been set out above. To deal with this, a further alternative to Subsection 14(6) should be explored:

(d) for the purpose of this clause the dB(A) noise emission from the wind farm when measured as an external levels shall include any corrections for tonality, infrasound, modulation and low frequency characteristics, derived for both external and internal locations.

An amendment to Section 20AB is proposed such that part (1) is required to identify the angle (or feathering of the blades that can be extracted in real time from the SCADA system associated with the subject wind farm control system. The publication of such data must be in format that is specific in the format and range of such controls.

The present Bill does not deal with the health and sleep impacts reported by residents in the vicinity of wind farms. The focus of my submission, as an acoustician, is to analyse the sound data. The health impacts of excessive noise are well-documented and best left to those with expertise in the health area. Nevertheless, in the course of my testing I have received complaints from residents who are not concerned with whether noise is audible, inaudible, infrasound, exhibiting tonal characteristics or modulating. They recite a range of complaints including sleeplessness, being woken at night, a constant drone and headaches. They also recite that they do not experience these symptoms if the turbines are turned off or if they are away from the wind farm.

A common complaint from residents relates to "noise". There is a range of descriptions provided by individuals that cover feeling the noise, a constant drone, headaches and being awoken at night.

It is noted that in Environmental Noise Legislation that "noise" includes "vibration". Some of the "noise" complaints may also be related to vibration received by residents whether as a result of ground vibration or airborne noise exciting the dwellings. This is another issue to be explored.

Finally, I raise a number of matters in relation to the evidence, which will be given in person to the Committee concerning this Bill. They are as follows:

1. Affiliations with the wind industry or community should be identified. For scientific or technical evidence, persons should state the Professional Code of Ethics, if any, that they are required to satisfy for their work.

2. Representatives of the wind industry should be asked the following two questions:

   - **<u>For the current noise conditions applicable for your wind farm(s)</u> or proposed wind farms can you guarantee that there will be no adverse noise effects, no offensive noise, no sleep disturbance and no adverse health effects from your wind farm.**

   - **<u>With the excessive noise limit as proposed in the Bill in place and the required monitoring information</u> can you guarantee that there will be no adverse noise effects, no offensive noise, no sleep disturbance and no adverse health effects from your wind farm.**

3. Environmental or Health Authorities coming before the committee should be asked

   - **As there is no material provided by an operating wind farm to prove that the operations do not generate adverse noise effects and do not generate offensive noise, then it would appear that if the Authority was to grant approval and the wind farm complied with the noise limits nominated by the Authority for the environmental assessment, and health impacts were found to occur then the Authority (not the applicant) would be liable. If so would the Authority support the use of excessive noise proposed in the Bill as a determining factor to protect the community?**

Yours faithfully,

<u>THE ACOUSTIC GROUP PTY LTD</u>

<u>STEVEN E. COOPER</u>

References

- SA EPA, "Wind Farms, Environmental Noise Guidelines" February 2003
- "Peer Review of Acoustic Assessment, Flyers Creek Wind Farm" TAG ref 41.4963.R1A, 15th December 2011041414
- NSW Planning & Infrastructure, "Draft NSW Planning Guidelines Wind Farms", December 2011
- "Review of Draft Wind Farm Guidelines" TAG ref 42.4963.R2, dated 14th March 2012
- Cooper S, "Wind Farm Noise – An ethical dilemma for the Australian Acoustical Society?" Acoustics Australia – Vol 40, No. 2, August 2012
- Australian Acoustical Society, "Code of Ethics"
- Cooper S, "Are Wind Farms too Close to Communities?" Australian Environment Foundation Annual Conference, October 2012.
- "Peer Review of Environmental Noise Assessment, Collector Wind Farm" TAG ref 45.5006.R1, 23rd September 2012