REVIEW

FLYERS CREEK WIND FARM APPROVAL 25 NOVEMBER 2013

CLIENT:

Flyers Creek Wind Turbine Awareness Group (FCWTAG)

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EXECUTIVE SUMMARY

L Huson & Associates Pty has been commissioned to review the recommended noise conditions outlined in an Approval dated 25 November 2013 by the NSW Department of Planning & Infrastructure for the Flyers Creek Wind Farm.

This report presents infrasound measurements and results from attenuation testing of rural properties in Australia and New Zealand that indicate that the Director General's Environmental Assessment report dated 25 November 2013 may have been ill informed.

Suggestions have been made to redress the perceived problems with modifications to the proposed noise conditions.

Issues such as amplitude modulation and infrasound should be included within the noise conditions and the noise targets to protect the health of residents should be clearly identified.

The Proponent has not addressed all of the issues raised that warranted further information by SKM. Accordingly, the Proponent has not satisfied its obligations in relation to the Director-General's requirements and South Australian EPA – Wind Farms – Environmental Noise Guidelines, 2003.

Prepared by

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INTRODUCTION

L Huson & Associates Pty Ltd has been commissioned to review the Approval and recommended noise conditions issued for the Flyers Creek Wind Farm on 25 November 2013.

This review points out and addresses a number of misgivings we have about comments made in Part 5.1 of the Director-General’s Environmental Assessment Report of 25 November 2013 (DGEAR).

A set of proposed draft conditions has been prepared based upon the DGEAR and we consider that some amendments are appropriate.

APPROPRIATE TARGET NOISE LIMITS

The first misunderstanding in the DGEAR (page 21) is the statement that an indoor sound level of 30 dBA will be achieved for an outdoor sound level of 45 dBA with windows open. This headline statement is commonly used to support wind farm developments and the Director-General’s department has been misled in this regard. The following extract is from the WHO (Berglund & Lindvall) Community Noise Guidelines pertaining to sleep disturbance, consideration of vulnerable groups and the derivation of outside noise levels that correctly reflect the indoor sound level target. A fuller reference was included in our review (Huson review) of the Vipac Environmental Assessment.

> *10.7 Summary*
>
> ***…..****Inside bedrooms the sound pressure level should not exceed 30 dB LAeq for steady-state continuous noise, and for a noise event not exceed 45 dB LAmax, preferably even lower (maybe 40 dB LAmax). Still lower levels may be annoying depending on the nature of the noise source. At nighttime, sound pressure levels outdoors should not exceed 45 dB LAeq, so that people may sleep with bedroom windows open. Even lower levels may be required pending the design of the window opening, maybe 35-37 dB LAeq outdoors.*

The target ‘steady state’ noise parameter indoors (for sounds not containing high low frequency content for non-vulnerable people) of 30 dB(A) is in terms of the Leq. The sound power calculations and measurements from wind turbines are also in terms of the Leq parameter. The generally accepted conversion from Leq to L90 is 2 dB. For the sake of simplicity, we can assume that the correction from Leq to L90 is 2dB (Leq = L90 + 2 dB). This means that the steady state target internal noise limit of 30 dB(A), Leq becomes an internal target noise limit of 28 dB(A), L90.

It should be recognised that the difference between Leq and L90 becomes greater if there is amplitude modulation and that the L90 statistic greatly underestimates the impact of modulated sound. For this reason, we would not recommend the use of LA90 as either an outside or inside noise criteria. Thankfully, the recommended conditions in G7 use LAeq.

We have measured actual attenuation from dwellings with windows open in Queensland and Victoria and have found that outside to inside attenuation results vary depending upon the frequency of the external sound. The overall A-weighted attenuation from outside to inside a sample of four different bedrooms surveyed in Queensland was between 4.1 dB(A) and -1.2 dB(A).

Our recent research on amplitude modulation will be presented at a conference on amplitude modulation hosted by the Institute of Acoustics in the UK in March 2014. We have identified that for a typical dwelling in Victoria the attenuation of wind turbine sound from outside to inside a room is governed by the acoustic modes of the room. At the room mode frequencies around 50 Hz and between 120Hz and 500Hz there can be no attenuation at all. Furthermore, the broadband swish noise outside a dwelling is modified to have a particular frequency characteristic that can be classed as tonal indoors and is dependent upon the receiving room dimensions. Amplitude modulation levels can also be enhanced indoors.

In summary, attenuation of wind turbine sounds from outdoors to indoors is certainly much less than 15 dB for an open window. However, if outdoor sound levels are to be chosen for permit conditions then it is a simple task to assess the real attenuation of potentially affected dwellings from measurement and correct accordingly.

ETSU-R-97

The general assessment methodology for measurement of outdoor sound levels from wind farms in Australia (eg. SA03, SA09 Guidelines and NZS6808) all derive from the method described in ETSU-R-97 'The assessment and rating of noise from wind farms' from the UK. The following extract from ETSU-R-97 considers indoor or outdoor measurements.

"Internal or external noise limits?
Given that one of the aims of imposing noise limits is to protect the internal environment one might consider it appropriate to set these limits and hence monitoring locations at positions within the building. There are, however, some practicalities to take into consideration which lead us to believe that the current practice of setting external limits on noise is the more sensible approach:

- Monitoring of noise to demonstrate compliance with planning conditions may require data to be logged over a period of days in order to capture enough data at the required conditions. It may not always be feasible or reasonable to expect to leave equipment set up in someone's bedroom or living room for this period of time.
- Noise levels inside a dwelling would be extremely difficult to predict as they would depend upon the noise insulation properties of the windows, doors, roof and walls and the acoustic properties of the rooms. Each room in each property would have to be considered separately. It is simpler and as safe to predict free-field noise levels outside of the property and then make a conservative assumption on the attenuation properties of the building envelope.
- Noise limits, and therefore measurements, are in any event required outside the property to protect the external amenity. If internal noise levels can be inferred from these external limits then a requirement for internal measurements would place an unreasonable burden on the operator."

The first bullet point above is not valid. ETSU-R-97 page 44 states "In some circumstances access to nearest properties may prove problematical but it is the Noise Working Group's experience that in general residents are happy to allow access to monitor noise levels, particularly if monitoring is required in response to complaints." We have found that complainants have always been willing to allow access to the dwelling to take sound level measurements over many days.

The first part of the second bullet point is overstated. It would involve a survey time of less than half a day to assess the attenuation levels for all rooms of a dwelling. The external noise measurement approach is not a 'safe' or conservative method to yield an accurate assessment of indoor sound levels. Modern noise modelling programs produce octave or one-third octave predicted sound levels at chosen locations. These results can easily be used with measured attenuation levels to provide a better estimate of expected indoor noise exposure.

The Achilles heel of setting outdoor noise targets as a proxy for indoor sound levels is the 'conservative assumption' (in the second bullet point above) used for the acoustic attenuation of a dwelling with windows open. ETSU-R-97 uses an allowance of 10dB(A) for the attenuation into a dwelling. This has been shown to be incorrect for Australian and New Zealand rural dwellings. Furthermore, ETSU-R-97 states "The potential for "hot-spots" due to particular building configurations should be discussed with the EHO during the initial site assessment. For example, courtyards with an open side facing the site of the proposed wind farm will require special consideration." Such building layouts that may cause 'hot-spots' of enhanced sound levels are not considered in Australian wind farm assessments or the proposed noise conditions of this Approval.

The third bullet point provides no justification for only setting outdoor sound level targets since internal sound levels using a simplistic 10 dBA attenuation have been shown to be flawed. However, if real measured attenuations are used then there is no reason why outdoor proxy levels cannot be set. We do not see where any unreasonable burden is applied to an operator.

Considering that the outdoor measurement methodology requires long term monitoring, that typically takes over 30 days in total (background plus compliance testing), it would be less of a cost burden to simply measure indoor compliance against the suggested target of 30 dB(A) indoors. It is the indoor noise target that forms the basis (for health protection) of all the wind farm assessment methods used in Australia. This is the preferred assessment methodology in the SA wind farm guidelines 2009 (note at end of section 2.3) for turbine hosts. We believe this approach should also apply to other potentially affected residents.

Another advantage of indoor measurements is that low frequency noise can also be assessed in accordance with the 'Procedure for the assessment of low frequency noise complaints' Feb 2005, DEFRA contract NANR45 developed in the UK. This procedure is also referenced in the draft NSW wind farm guidelines.

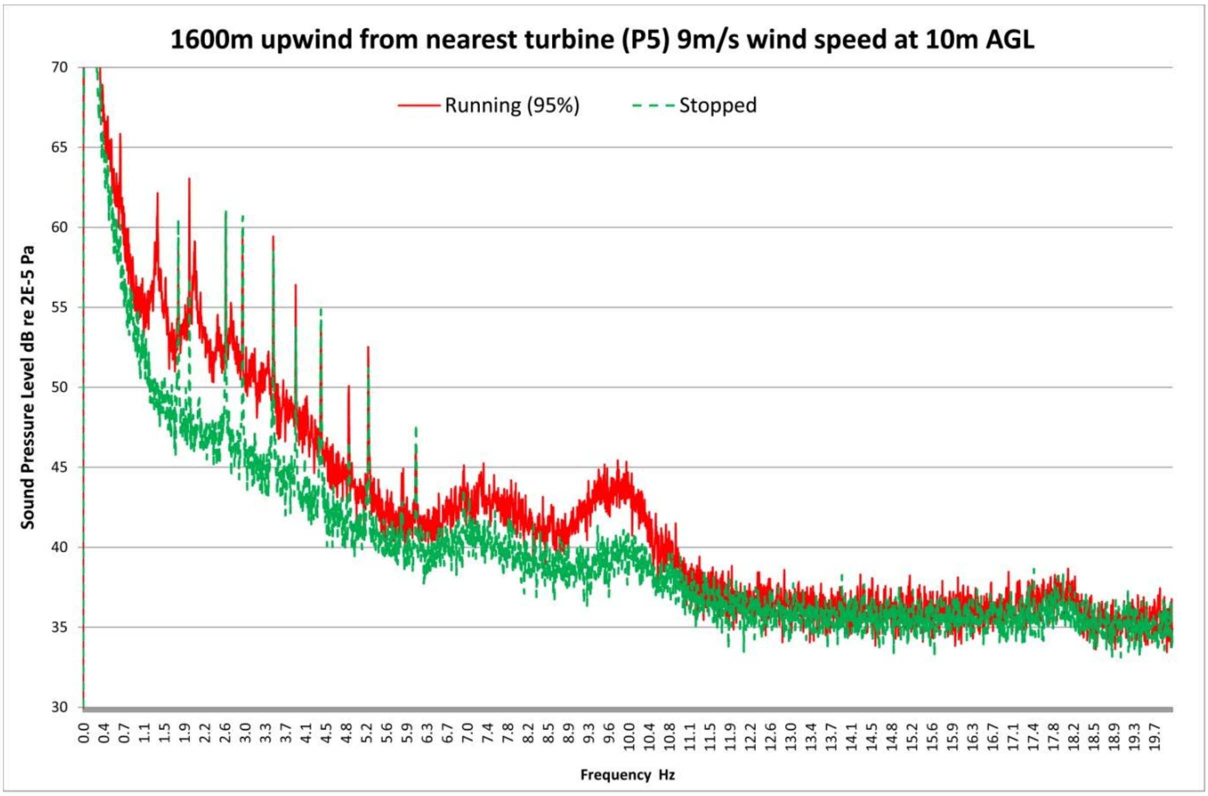
INFRASOUND

The SKM peer review considered comments in the Vipac report about infrasound and concluded that infrasound is not problematic, based upon current research. Furthermore, the

DGEAR on pages 21 and 22 accept the Proponents submission that modern wind turbines do not produce infrasound above the level of perception. We can now demonstrate that such claims are unsubstantiated.

Our more recent research has completed indoor measurements at dwellings located at varying distances from a number of wind farms. The data we are continuing to collect is accompanied by diary notes of the dwelling occupants. The data we have collected is awaiting publication.

We have recently taken infrasound measurements at the Macarthur wind farm in Victoria, which has 140 V112 wind turbines, during a full shutdown and start-up of all the available turbines (approximately 138 turbines). The shutdown happened around 12.30pm on 14 August 2013 and the start-up was around 1am on 15 August 2013. The measurement location was 1,600m upwind of the nearest wind turbine and we have found that there was only a minor variation in infrasound level emissions whether the turbine blades were rotating or parked. The Macarthur wind farm was operating at approximately 95% capacity prior to the shutdown, see below.



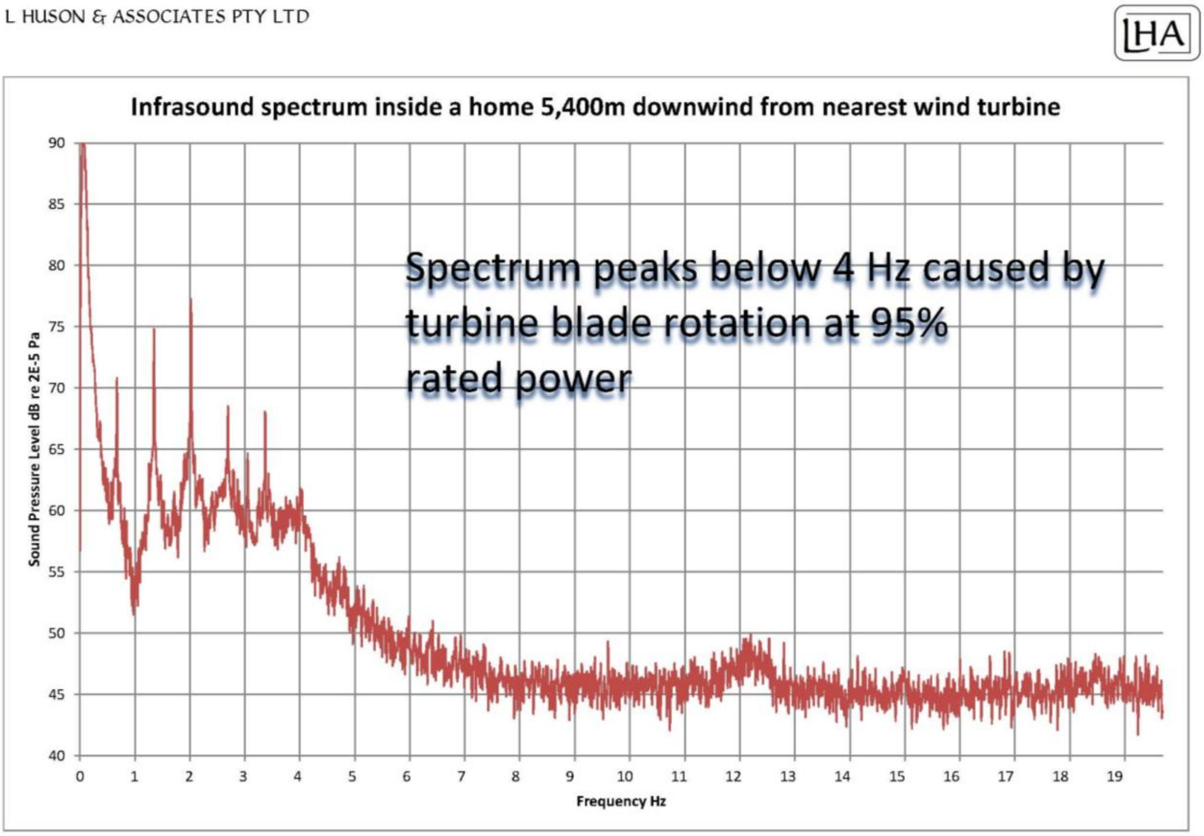
Spectrum from a 20-minute microbarometer recording

Sound level meters comply with Type or Class accuracies defined in Australian and international standards. Unfortunately, the accuracy of sound level measurements at frequencies below 20 Hz is poor. For example, the sound pressure level accuracy required of a Class 1 meter at 12.5 Hz is +3 dB to minus infinity.

Some sound level meters have a G-weighting filter included that comply with ISO7196, but there are no standardised accuracy requirements and different sound level meters can easily produce differing results.

Microbarometers, unlike typical sound level meters that use microphones, can extend from 0Hz (DC) to 20 Hz with a flat response. The microbarometer instruments we use have a response from 0.075Hz to 20 Hz +0/-1.2dB.

An infrasound spectrum follows that was measured using a microbarometer in a bedroom of a dwelling located 5,400 m downwind from the nearest of 140 V112 wind turbines at the Macarthur wind farm.



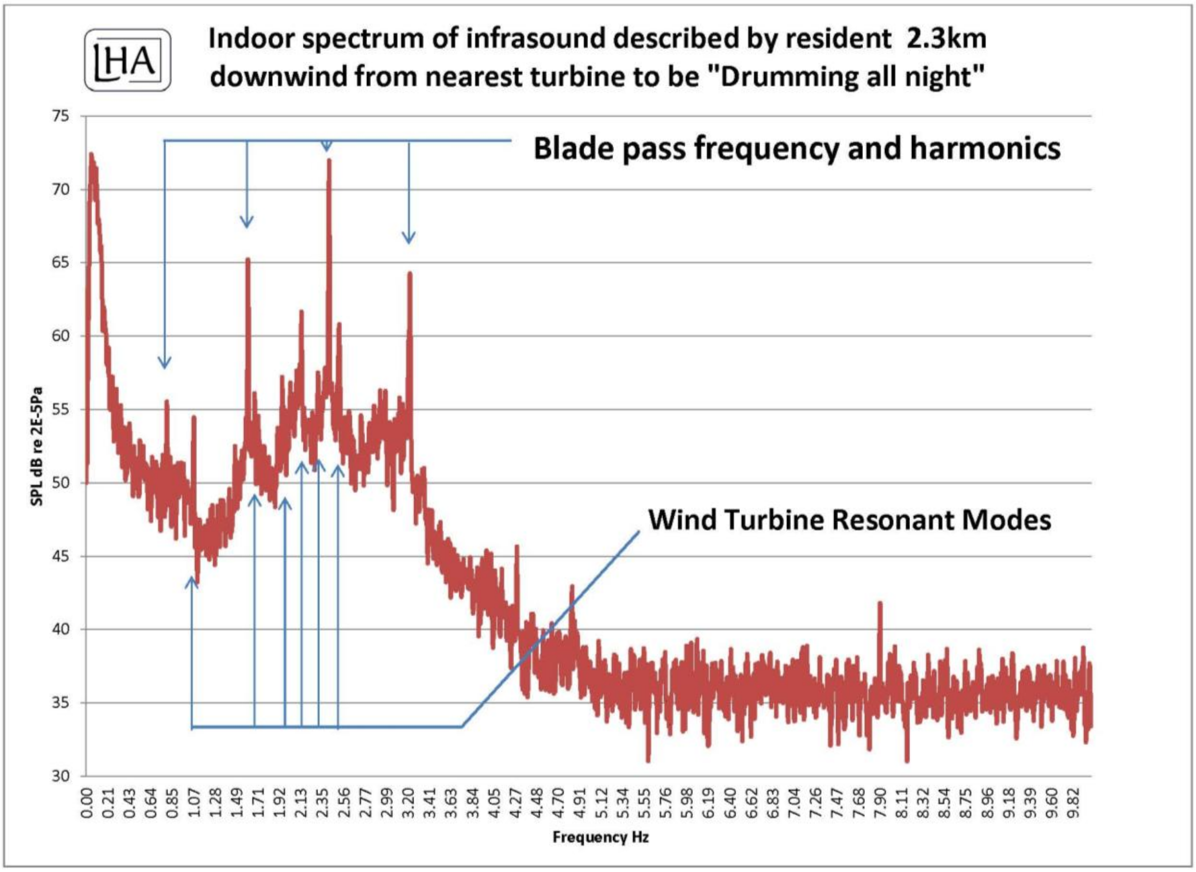
Spectrum from a 20-minute microbarometer recording

The two spectrum charts above demonstrate that downwind infrasound levels are clearly greater than upwind measurements, despite the measurement location being over three times further away from the nearest wind turbines. Two different microbarometers were used to record data for the two charts. The unit 5,400 m from the nearest turbines has a noise floor at 45 dB compared to the other unit that has a noise floor at 35 dB.

We have concluded that wind turbines emit readily measurable infrasound in the frequency range below 5 Hz, even if they are stopped. The cause for this infrasound emission is the natural resonant modes of the flexible blades when excited by passing wind. An operating (rotating) wind turbine adds blade pass impulses of pressure in the infrasound region to the natural resonant mode emissions.

The following chart is an example from the Lake Bonnie wind farm in South Australia where the occupant described a drumming feeling inside the house. Survey data is available from

December 2013 through to January 2014. The turbine rotor resonant modes and blade pass frequencies are marked.



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The G-weighting filter used in recent infrasound reports from Resonate Acoustics and Sonus is shown below.

It is clear that a G-weighted filter will significantly attenuate the infrasound emissions from both operating and stationary wind turbine rotors. It is therefore not surprising that little change in G-weighted measurements are shown in the most recent Resonate Acoustics report for the Macarthur wind farm or the study for the SA EPA under various operating conditions. Furthermore, the emissions below 4 Hz at the levels shown are detectable by people, despite these levels being below the expected threshold of audibility for the average person. These tone/spectrum peaks are not present at sites remote from wind farms; even those near the ocean.

Our infrasound data set has started to become available from measurements since August 2013 and further measurements are continuing. One would expect that with the right measurement equipment the acoustic consultants employed by wind farm developers can easily replicate these findings. We recommended such a measurement approach to AGL, the owners of the Macarthur wind farm in February 2013. AGL chose to continue with the work already commenced by Resonate Acoustics using sound level meters and G-weighting.

G frequency weighting

The SA EPA 2009 wind farm guidelines state that "The EPA has ... completed an extensive search but is not aware of infrasound being present at any modern wind farm site". The 2009 SA EPA wind farm guideline does not reflect recent and ongoing research in the area of infrasound or amplitude modulation.

Amplitude modulation is a hot topic in the UK at the moment where amplitude modulation is known to be a problem. The method described in the 2010 version of NZS6808 to assess amplitude modulation supersedes the SA guideline 2009 and is worthy of consideration as a criteria for this approval. We do not believe that amplitude modulation is addressed adequately in the SA EPA wind farm guidelines 2009 or at all in the Approval recommended conditions for the Flyers Creek wind farm.

The SKM review has explained in great detail how the conversion of sound pressure vs. time data can be converted into the frequency domain and that attention is required to sampling time sample rates and analysis bandwidth. The charts we have presented in the frequency domain required averaging over approximately 20-minutes. The results are rms *estimates* of energy in particular frequency bands.

The problem with converting time pressure charts to the frequency domain for low frequencies is the resulting lack of information over shorter time periods that the analysis method *cannot* complete. Whilst analysis in the frequency domain is useful, it may not represent the response to low frequency sound over shorter time periods that a Human subject may experience. For this reason we believe that sound pressure vs. time charts should be the preferred assessment approach to Human reaction to infrasound. This type of analysis is common (Rushforth et al, 2003). Frequency analysis is useful to indicate the source of the energy overall but with long averaging times required at low frequency it is a poor tool to use in Human response assessments.

APPROVAL CONDITIONS

We have reviewed the recommended noise conditions issued by the NSW Department of Planning & Infrastructure dated 25 November 2013.

Recommended Condition G7 will not protect the community and fails to address the real noise target which is an indoor sound level that is chosen to protect sleep. This condition effectively sets in stone a set of background noise levels from the Proponent's Environmental Assessment - Appendix G1 that have been criticised by SKM and others. Furthermore, the DGEAR required re-monitoring of background noise levels at receiver locations 78 and 89.

Background noise levels vary seasonally (Delaire and Walsh, 2009). This condition does not allow for on-off testing and along with G9 firmly requires only outdoor noise measurements. This condition blindly accepts the assumption of building attenuation that will protect sleep and achieve an indoor sound level that does not exceed 30 dB(A), Leq, as per the WHO Community Noise Guidelines and enHealth recommendation. It should not.

The SKM Review states on page 17 "Huson quotes a lengthy extract from the WHO guideline in relation to the outdoor target noise level of Leq 45 dBA. This criterion is based on the assumed nominal noise level reduction of 15 dBA for an open window. If the open window noise level reduction is lower than 15 dBA, and Huson suggests it could be as low as 3 dBA, then the outdoor criterion level would have to be reduced to minimise the possibility of sleep disturbance. This is a good point and Vipac should explain the impact of this reduced open window effect."

Unfortunately, Vipac did not address this issue in their responses and this deficiency should warrant an appropriate noise condition.

We acknowledge that the target outdoor sound level is in terms of $L_{Aeq(10\text{-minutes})}$, despite the fact that the SA EPA wind farm guideline is in terms of $L_{A90(10minute)}$ records. Our interpretation of the recommended G7 condition is that the target outdoor noise level is in terms of $L_{Aeq(10minute)}$ at 35 dB(A) or Background plus 5 dB, measured also in terms of $L_{Aeq(10minute)}$.

Other similar conditions for the Gullen Range Wind Farm have different wording, where the Gullen condition only refers to the <u>location</u> of the background measurement, not the <u>results</u>.

G7 does not separate outdoor noise criteria into Day and Night. Night time background noise levels are generally lower than day time and this would set a more stringent noise target at night. This has been recognised by NSW Planning, see below.

There are no conditions relating to amplitude modulation or low frequency noise. The NSW Planning department has recognised that these special audible characteristics (SAC) can cause nuisance. SACs should be included in G10 and may reflect the text from the NSW Draft Wind Farm Noise Planning Guideline , as follows:

> "For a new wind farm development, the predicted equivalent noise level (Leq, 10 minute), adjusted for any excessive levels of tonality, amplitude modulation or low frequency, but including all other normal wind farm characteristics, should not exceed 35dB(A) or the background noise (L90) by more than 5dB(A), whichever is the greater, at all relevant receivers not associated with the wind farm, for wind speed from cut-in to rated power of the WTG and each integer wind speed in between.
>
> The noise criteria must be established on the basis of separate daytime (7am to 10pm) and night-time (10pm to 7am) periods.
>
> **Amplitude Modulation**
>
> Amplitude modulation (AM) refers to aerodynamic noise from a wind turbine's blades, and is sometimes referred to as 'swish' or 'thump'. Noise from a wind turbine typically includes an inherent level of reasonable amplitude modulation. The criteria in these guidelines have been determined with the inherent characteristics of wind turbine noise – including reasonable levels of amplitude modulation – taken into consideration.
>
> An excessive level of modulation is taken to be a variation of greater than 4dB(A) at the blade passing frequency.
>
> If excessive modulation is found to be a repeated characteristic of the wind turbine noise, 5dB(A) should be added to the predicted or measured noise level from the wind farm. If modulation is only identified for certain wind directions and speeds, the penalty shall only be applied to measurements made under those meteorological conditions.
>
> The modulation characteristic penalty applies only if the modulation from the wind turbine is audible at the relevant receiver. Absence of excessive modulation in noise emissions measured at an intermediate location is sufficient proof that the modulation is not a feature of the wind farm."

We note that the Bodangora Wind Farm Approved conditions include some provisions for SACs. However, we do have concerns how those conditions have been phrased and they could be improved.

Considering the effects that building orientation and construction can have on the real attenuation of sound from outside to inside a dwelling we believe that condition G7 is overly optimistic.

It would be appropriate to have a G7 condition stating that:

The target noise criteria is 30 dB(A), $L_{Aeq(10minute)}$ inside any bedroom, adjusted for any special audible characteristics such as tonality or amplitude modulation up to a maximum penalty of 5 dB. If the Proponent can demonstrate an actual attenuation value through measurement for a particular room compared to an outdoor noise measurement location then outdoor measurements according to the SA EPA wind farm guideline 2003 may be utilised. However, indoor sound level measurements are preferred.

The outdoor amenity noise target is a sound level of 35 dB(A), $L_{eq(10min)}$, or background ($L_{A90(10minute)}$) plus 5 dB, measured as $L_{Aeq(10minute)}$. The outdoor measurements shall comply with the SA EPA wind farm guideline 2003 and shall be adjusted for special audible characteristics.

Alternatively, recommended condition G11 could be changed to include any resident, not just those having a financial interest in the project.

Special Audible Characteristics (SAC) should be defined elsewhere as separate conditions. A suitable example set of assessments for SACs can be found in Appendix B of NZS6808:2010.

The advantage of the indoor measurement approach is that a measurement period shorter that 10 days can suffice if the survey time is chosen to be representative of worst case conditions. Indoor measurements are not prone to extraneous noise on microphones from wind or rain and often a simple 1-hour attended survey can suffice to check compliance in the event of a complaint. In our experience, complainants welcome more extended indoor measurements.

CONDITION G8 REVISED NOISE ASSESSMENT

Condition G8 requires a revised Noise Assessment for the final turbine choice and layout.

We have commented on the original EA completed by Vipac, as has The Acoustics Group and SKM. Since those reviews another review of the Acoustic Group review has been prepared by Sonus. We have not reviewed the Sonus report, apart from reference to it by SKM.

The SKM Review of Response to Submissions has commented on the issues raised in the different reviews and provided an item by item opinion. A general six point summary of the issues raised from the Vipac Environmental Assessment was included in the Conclusions and Recommendations with a note stating that 'Further details are particularly included in Section 4 and Section 7.2 '. Unfortunately, the additional information provided from Vipac only referenced the six points and did not answer other issues raised in the SKM review.

The SKM review of our Huson review agrees with all the points raised except for the issue of inflow turbulence affecting increased noise emissions. SKM reference a paper by Cooper and Evans from 2012 that supposedly report minimal wake effects. We have reviewed this reference and the conclusion states that between 1dB and 1.5dB increase in sound levels were measured in the wind speed range 3m/3 to 5m/s. The paper then attempts to offset this result with an *assumption* that a lower power output caused by the inflow turbulence can reduce sound emissions commensurately. However, no evidence to support this is provided and the authors recommend further research in this regard. In summary, there is an increase in sound emission in the wind speed range where the predicted noise levels often approach the knee of noise target curves (where the 35 dB(A) base level starts to increase due to background influences). Given that Vipac predict compliance at a number of properties with only a 0.5dB(A) margin it is apparent that compliance is not assured. The SKM review comments that our Huson Review did not provide any supporting information to show that there are other influences that alter noise model results unfavourably. To address this comment I provide the following reference to a presentation given in 2004 by Erik Sloth of Vestas to the Australian Wind Energy Association

(AUSWEA) that was prepared by staff of Vestas, Bonus Energy and Delta (See: **http://docs.wind-watch.org/Vestas-Bonus-AUSWEA-2004.ppt**)

The AUSWEA presentation clearly identifies the limits associated with noise modelling and recommends that IEC61400.11 sound power data only be used for verification of warranties and that such data is not a good tool for predicting noise at imission points where people actually can get annoyed. Parameters that are not used in the noise models are identified that are known to generate sound emissions above those determined using IEC61400.11.

A summary of the issues raised in the presentation titled 'Problems related to the use of the existing noise measurement standards when predicting noise from wind turbines and wind farms' follow:

> **Typical problems in using the measurement results**
>
> The wind turbines are almost always raised at sites where roughness differ from the standardized completely flat measurement site.
>
> Further we see:
> Different air density
> Different wind shear
> Different turbulence in inflow air
> Different inflow angles
>
> Finally we often see other hub heights than used during documentation.
>
> **Conclusion on measurement results**
>
> The differences in site conditions creates differences in emitted sound power level.
> The differences could be both increased and decreased emitted sound power levels in real life applications.
> The differences will transfer directly to the imitted sound power levels, and may thereby create increased annoyances in real life.
>
> Therefore – site specific sound power levels should be used unless a good safety margin is present using standardized emission levels.
>
> **Solution to the outlined problems**
>
> Accept that different sound power levels should be used in predictions and warranties.
> Avoid using sound power levels that include inaccuracy in predictions unless there is a good safety margin.
> The inaccuracy should be included in the calculation – the higher the number of WTG's the less the probability that all are in the high end of the uncertainty interval.
> Use sound power levels that at least are corrected for: hub height, wind shear, air density, turbulence, inflow angle.
> Be careful to make sure that the background noise measurements and wind conditions at the turbine positions uses the same reference position.

> Most noise level calculation models are developed for noise from industry, wind speeds below 5 m/s and standard meteorological conditions and must be suspected to give poor results at larger distances. ...
>
> **Noise Assessment**
>
> The noise level at the imission points are normally given as an A-weighted noise level at different wind speeds.
> A tonality evaluation is normally included for the receiving points.
>
> What we know of the annoyance of the noise:
>
> We know that noise from wind turbines sometimes annoys people even if the noise is below the noise limits.
> Often people complaints on low frequency noise which many investigations often show in not present.
> The noise limits are usually adapted from industrial noise limits and are based on the principle that a given percentage of the population will feel annoyed when the limit is exactly fulfilled.
> Evaluation of tonality in the turbine noise is based more on the reproducibility of the results than on pure knowledge on what is actually annoying.
>
> Other descriptors need to be investigated to understand the annoyance caused by wind turbines:
> Low frequency noise and Infrasound – we cannot see it in our measurements
> Modulation – may be the parameter that is heard as low frequency noise
> Masking – which noise can mask noise from wind turbines
> Other characteristics ...

Any noise prediction model prepared for the final turbine siting should address the deficiencies identified and provide a truly conservative (over predicted) model. Any noise model not considering the effects identified in the presentation that simply use data from IEC61400-11 testing and produces slim compliance results (as is the case from the Vipac Environmental Assessment) should be viewed with suspicion.

Vipac have responded with noise floor data for the equipment used in the background noise study they completed. It is not uncommon for the performance of sound level meters to feign the ability to measure sound levels lower than what the meters are actually approved for by stating electrical noise floors, as in the Vipac response.

Sound level meters are required to comply with at least Type 2 certification in accordance with Australian Standard AS 1259ë1990 or IEC-61672 (International Electrotechnical Commission 2002) from the SA wind farm guidelines 2003. Compliance with these standards occurs only in the stated measurement range issued by the manufacturer. Outside the manufacturer's published operating range they are non-compliant. This has a marked effect on the ability to maintain standards compliance at low sound pressure levels. For example, the ARL316 logger is specified to be standards compliant only down to 30 dB(A), even though the electrical noise floor may be 23.5 dB(A) quoted by Vipac. The SA wind farm guidelines 2003 are moot on the minimum sound level measurement requirements. However, it is obvious that a logger with an operating range of, say, 40 dB(A) would be inappropriate to use for assessing rural background noise levels. We accept that three of the 6 loggers used by Vipac having electrical noise floors at 17.5 dB(A) and 16.6 dB(A) may be suitable, but remember that these instruments are only standards-compliant at 23.5 dB(A) and 22.6 dB(A) respectively. Data presented on charts between these two levels should be shown to be non-compliant with the required standards.

The general rule is to add 6 dB to the electrical noise floor to determine the standards-compliant lower operating range. For the LD870 logger used (SN 0181) the lowest compliant operating measurement range becomes 34.9 dB(A). Clearly, this meter is not appropriate to assess background noise for rural areas. We do not accept that the discussion provided in section 6 of the Vipac response addresses the validity of the lower sound levels presented in their charts. Once account is made of the true standards-compliant operating range of some of the noise loggers used then I would expect a significant influence will be had on the background noise curves and they will be artificially too high.

We have seen at other wind farm developments the use of sound level equipment having a poor ability to correctly measure lower sound levels. Target noise levels using the resulting curves were artificially high. This was demonstrated when post construction compliance tests were completed by the same consultants but with the use of equipment having a lower sound level measurement capability. The result was that sound levels were demonstrated to reduce after the wind farm was constructed!

Again, the DGEAR has been ill informed. Furthermore, it is suggested that these background measurement results be used as a basis for noise targets in recommended condition G7. This would clearly be inappropriate.

LOW FREQUENCY NOISE

Other, recent wind farm approvals such as those for the Bodangora wind farm have additional requirements that modify condition G7 to require that the SA EPA wind farm guideline of 2003 include penalties for tonality and low frequency noise. We believe that this is appropriate for the Flyers Creek wind farm too. An assessment for low frequency noise can use the approach described in 'Proposed criteria for the assessment of low frequency noise disturbance' (UK Department for Environment, Food and Rural Affairs (DEFRA, 2005)). We do not believe a screening process using dB(C) levels is appropriate for wind farms and do not recommend this extra level of compliance complexity. The DEFRA, 2005 method can be implemented easily.

CUMULATIVE DEVELOPMENT

The SA EPA wind farm guidelines 2009 refers to cumulative developments. Reference is made to other wind farms but we believe the approach is also applicable to other industry in the area. To the west of the wind farm is the Cadia Mine. The mine has its own noise conditions and has approval to expand towards the Flyers Creek Wind Farm. It would be appropriate for the revised noise model to include the allowable noise emissions from the Cadia Mine for dwellings located between the mine and the Flyers Creek wind farm. So, for example, if the wind farm noise model predicts a sound level of 25 dB(A) at a residence that could be exposed to noise from the Cadia Mine, and if the authorised noise emission from the mine for that residence is also 25 dB(A), then the cumulative impact caused by the wind farm will be 28 dB(A).

This requirement should be an extra noise condition.

CONDITION G12 SUBSTATION NOISE

Substation noise emissions are generally tonal at multiple harmonics of mains frequency. In circumstances where room modes couple to any of these harmonics then indoor amplification can occur. This would typically occur in rooms having opposing walls 3.4m apart.

Under these circumstances it would be appropriate to assess indoor night time noise using the DEFRA 2005 method. It should not be left to the Proponent to suggest alternative noise assessment methods. An indoor assessment option according to DEFRA, 2005 should be specified, if requested by the resident.

NOISE COMPLIANCE PLAN

The Noise Compliance Plan detailed in G14 through to G18 should be based upon a more robust noise target in G7 that is based on internal noise exposure levels to protect the Community from disturbed sleep. Assumptions about attenuation should not be a part of or implicit in any condition.

The advantage of indoor measurements is that complaints can be addressed quicker than outdoor measurements because there is no requirement to statistically compensate for wind noise on the microphone, for example. Furthermore, the low frequency assessment of DEFRA, 2005 can be completed at the same time.

Outdoor measurements according to the method of the SA EPA wind farm guideline 2003 should not be the preferred method of assessment. Indoor measurements according to the 2009 version of this guideline may be appropriate, noting that the prevention of sleep disturbance is also a requirement in the 2003 guideline.

CONCLUSIONS

It has been reported to me that ‘one of the more active developers surprisingly inferred that he knew there was (or at least could be) a health problem by saying at a NSW meeting, words to the effect that: if we meet the guidelines then, if there is a problem, it is due to the standards being at fault, and that is the government's problem; however if we do not meet the standards then it is our fault and our problem.’

The information provided in this document highlights the deficiencies of the Approval dated 25 November 2013 from the Department of Planning & Infrastructure (DPI) for the Flyers Creek wind farm and the lack of protection provided for residents in the recommended noise conditions.

We have suggested some amendments to the DPI Approval recommended noise conditions that will address this ‘new’ information that the Department may not have been aware of previously.

If the NSW DPI choose not to change the noise conditions in the Approval to address the issues raised in this document then in the event that health complaints are upheld, despite compliance with the Approval conditions as they stand then the DPI would appear to be responsible.

Demonstration of adverse health effects only requires an independent assessment of bedroom noise levels to exceed the WHO recommended levels. This is what we are suggesting form part of the target noise limits that will minimise risk to the DPI.

The health effects of infrasound are slowly re-emerging from recent measurements and ongoing research. Extensive research by NASA (eg. Stephens et al 1982) also shows that wind farm generated infrasound can harm health. To again minimise risk to the DPI it would be appropriate to pass the onus of proof, that there is no adverse health effects from wind farm infrasound, to the Proponent. This could also be done through an appropriate condition.

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