

Management of Sound Emissions from Wind Turbines

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1. Purpose

The purpose of this document is first to blow the whistle on the handling of dangerous sound emissions from wind turbines by Responsible Authorities and the wind industry; and second to define what is necessary to ensure that the industry, in future, is constrained to operate safely.

2. Existing Australian Regulations

The current Noise Guidelines (“Regulations”) for wind turbine noise pollution set by the various States never have, and never will, provide a safe sleeping, living, or working environment for many of those living near wind projects.

This conclusion is the undeniable outcome of independent observations by uncompromised acousticians and appropriate medical specialists over the last 30 years; and of an industry that played an unhealthy part in setting its own standards and that has never been required to present independent research to prove its machines are safe to place in inhabited rural environments.

The Regulations fail because they focus on a weighted average (dBA) of audible sound (commonly labelled ‘noise’) and completely ignore the largely inaudible sound produced by the turbines in the infrasound or low frequency sound ranges (together called ILFN).

Information that wind turbines produce impulsive ILFN was available in the 1980s from work undertaken by NASA affiliated researchers in the USA, led by Dr Neil Kelleyⁱ, and has been reaffirmed in more recent work in the USAⁱⁱ, Australiaⁱⁱⁱ, Canada^{iv}, the UK^v, Russia^{vi} and elsewhere.

It has long been known that ILFN can be extremely dangerous at certain combinations of power and frequency and that ongoing exposure to ILFN induces rising sensitivity in some people thereby progressively increasing the severity of their symptoms and sensitivity to certain other industrial sources of ILFN.

It has always been true that sound emitted by industrial-sized wind turbines significantly and cruelly impacts many neighbours. Australian acoustician Steven Cooper’s excellent investigation of the problem in three houses at Cape

Bridgewater has verified and extended the known technical information identifying and explaining this problem. ^{See reference (iii)}

Conclusion: the present Noise (Sound) Regulations are dangerous and unsafe and urgently need rewriting.

3. Sound Limits for Wind Turbine Projects

There is much ignorance (often willful) about the levels and frequencies of sound emitted by turbines and the impact on neighbours^{vii}. The industry has been very successful in claiming either there are no impacts, and even if there are, their machinery is not the cause.

Comment: staggeringly the industry has never been required to prove either of these assertions.

Whilst cause and effect is already clear, focussed high value field and recently laboratory research, funded by independent entities is, step by step, unravelling the characteristics of sound pressure wave emissions by different size turbines, distances travelled, bodily reception and impacts. Much of this is cutting edge science and is not something that various State Departments of Planning can, (or wish) to understand.

Under the strangely forceful advice and guidance of the industry, Responsible Authorities and normally serious scientific institutions will continue to fail to develop a real and useful understanding of sound impacts and limits.

a) What is Known?

Those that are up to date with the real science know that:

- wind turbines emit sound energy that is the cause of unacceptable damage or impacts to neighbours;
- the cause of the damage is largely the ILFN component of the sound energy spectrum;
- the percentage of ILFN in the sound emissions from turbines increases as turbine size increases;
- turbines are being placed too close together leading to turbulent air flowing into adjacent turbines thereby increasing vibration and sound emissions;
- the damage has been noted at up to 10 to 12 km from the nearest turbine;
- the damage is serious, and sufferers find the damage increases with

- exposure;
- there is no medical or any other health oriented professional treatment that removes or lessens the impact; the only way to eliminate the impact is by separating the sufferers from the source; which, of course can mean removing or closing down that source;
- present noise standards are absolutely useless and worse as they are a guarantee of harm.

b) What Is Not Known

- The percentage of residents badly impacted at various distances from turbines.
- The quantitative relationship between impact and cumulative exposure.
- The maximum tolerable (on a long term basis) sound level (“MTL”) in dB inside dwellings.
- The relationship between extent of exposure and the MTL, which level can be expected to decrease with increased exposure.
- The sound frequencies and changes in the frequency which cause maximum impact.
- The detail of the pathways whereby ILFN enters and disrupts bodily functions.

c) The Dilemma Then Is

- The existing guidelines cause unacceptable human damage.
- There is not enough time related data available to set new guidelines with reasonable certainty that they will not be proven inadequate to ensure future damage from sensitisation. Such quantitative information cannot be gathered except over a long period of time.
- It follows that no new projects can be built until: the knowledge gaps are filled (hence the argument for a moratorium), or a conservative MTL is fixed for any new project for the period ahead, or that something other than sound, for example impact, is used for regulation.

4. New Regulations

New regulations must start by stating their purpose as:

“To protect the basic right of citizens to continue to live and sleep in their houses without encountering disturbing and dangerous physiological and psychological impacts and mounting health problems (formerly inadequately

classified as annoyance or nuisance), from sound emissions emitted by wind turbines.”

Comment: if this is not the purpose for sound limits then one can only conclude that the limits are directed to promote, not control, the industry; and those that drafted and those that enacted the present standards did not, and still do not, care about harming country people or their human rights.

Followed by a statement that: “it is the responsibility of the developer to ensure that there is no nuisance, or physiological or psychological harm, or impact on project neighbours”. (The “No Impact Requirement” (or “NIR”)).

Comment: If this is not a reasonable allocation of responsibility, then why is this industry not responsible for its actions and, if it is not, then who is?

Then a warning that the present noise guidelines are no longer operative and may be the cause of unacceptable impacts on neighbours. Further, meeting those guidelines will not be considered proof, or even an ameliorating consideration, of the NIR.

Comment: This simple direction places the responsibility back on the proponent and the funders of a project where, of course, it should be; and on equipment manufacturers to provide some guarantee about pressure pulse emissions by their turbines.

Finally authorities responsible for the evaluation and granting of permits will request, as part of the planning panel hearing, and on behalf of residents soon to be neighbours of the wind project, independent evidence that the project will not impact neighbours. Parties that present evidence for the proponent as well as the proponent itself, will be liable for the evidence they give on this subject. This evidence must be available to members of the public.

It is not possible to talk about noise standards without joining it with a discussion about compliance to the standards. Accordingly the standards must be clear that if a project, as licensed, fails the NIR then the developer of a project has to remedy the problem.

Until the problem is rectified, the project has to shut down between 6pm. and 7am. It is not for responsible authorities to detail mechanisms whereby the problem may be solved, but for the developer and their advising acousticians.

Comment: A number of Australia’s larger acoustic practices have developed

a lucrative business advising on layouts of turbines within a wind project to meet (what they must know to be harmful) noise standards. Never will they admit the present standards are inadequate and cause harm, nor will they opine on the impact of their recommended layout on neighbours. They are also well aware of the various techniques of fiddling compliance testing. It is time these firms upgraded their technical knowledge, their business ethics and the quality of their advice particularly in respect of the NIR.

Ensuring these acoustic advisors are liable for their evidence will likely dramatically ensure the desired improvement in their performance and, as a result, reduce the volume of harm at existing and future projects.

The identification of the no impact test and ensuring the industry and its advisors are liable if harm is caused, is not only equitable, but it is remarkably simple:

- noise predictions will no longer be built on a fluctuating base, i.e., background noise;
- the methodology removes the current favoritism of wind by at least 5dB over all other industrial sound emitters, (background plus 5dB or 40dBA whichever is the higher for wind, versus background plus 5db or 35dBA whichever is the less for other sources);

Question: who decided this imposition on rural residents was appropriate and safe?

- it focusses attention on what causes harm and will encourage developers and their advisors to quickly build an understanding of that problem;

Comment: listening to independent acousticians and the Waubra Foundation would be a good start;

- it does not exclude sound pressure waves inside houses as a cause of harm;
- it implicitly accounts for topography and wind variations;
- it will focus developers and their acoustic advisors' attention on improving the layouts by avoiding, for example, input wind to turbines being turbulent (which requires optimising spacing between adjacent turbines), and the attention of developers and turbine manufacturers

on dampening the speed of turbine reactions to wind speed and wind direction changes;

Comment: both identified as causing severe sensations; see reference (ii)

- it will also focus developers and their acoustic advisors' attention on utilising the wind turbine signature to understand sound pressure waves around and inside homes, workplaces and other buildings; and on the impact on neighbours of wave peaks as opposed to pressure averages to which the body does not respond;
- it lends itself to the fitting of automatic feedback controls which is the only way that wind turbines can be relied upon not to cause harm.^{viii}

Neither this industry, nor any other, has the right, or social licence, to harm its neighbours from excessive noise pollution. In practice, only the Federal government can protect country people from the depredations of this industry as State politicians and bureaucrats have proven over a period of 25 years that they are unwilling to challenge the miscreants.

Many knowledgeable people would argue for a staged shutdown of the industry, and failing that all new projects are to be 30km offshore.

5. Compliance Testing

Whilst proving compliance to incompetent regulations does not protect anyone, it is a permit requirement that all existing projects must be properly and routinely tested for compliance. If compliance determined by a properly defined protocol is not proven, then the issuing of renewable energy certificates (RECs) must cease until the failure is rectified.

Currently compliance testing (to the existing noise standards) is often being fudged.^{ix} This can be dealt with by the use of a relatively simple protocol that can be written to ensure that compliance testing is thorough, independent and complete.

It is quite possible that rigorous compliance to existing standards for sound pressure may contribute to some reduction in the severity of health impacts in some locations; but because the standard is faulty, forcing proper compliance to faulty standards, is by no means a full solution.

Credible compliance is needed to protect the public from subsidising non-

complaint projects.

Faux or sham compliance is not identified or investigated by the Clean Energy Regulator (CER), which is responsible for issuing RECs for projects that meet “all state and federal” requirements.

Comment: Clearly the CER needs better direction in this matter, and given their response to critical questions, a more formal investigation.

6. Some Elements of a Proper Compliance Testing Protocol

a) Purpose

Compliance testing is to ensure that a wind project does not exceed the noise levels set by the permit which in turn must confirm to the noise standards.

b) Independent Acoustician to Be Appointed

Unless or until there is a National Noise Pollution Regulatory Authority an independent acoustician(s) or acoustical practice (herein the investigator) is to be engaged to undertake the compliance testing. Under no circumstances is the same organisation or individual that provided opinions or expert advice at the planning permit hearings, or pre-construction noise predictions, to be engaged to undertake this work.

Whilst the owner of the wind project will be responsible for the investigator’s costs, the investigator’s appointment documents must clearly state that the investigator has an equal and separate responsibility to the project neighbors for the accuracy of his findings; and that such findings and data will be made publically available.

In all cases an investigator in delivering a compliance opinion must personally sign off on the opinion; and where that person is part of a multi-professional practice, partnership or corporation, then the senior person in that entity must also sign off on the opinion.

The reporting of noise from the wind farm must accord with the Uniform Civil Rules (or equivalent) so that the document can be automatically tendered in court with the required acknowledgment by the report’s author(s) that the report has been prepared in accordance with the relevant expert witness code of conduct.

c) Instruments

Sound levels for compliance are to be measured using instruments that can measure unweighted sound from 0.5 Hz hertz to 20 kHz and analyse the data in 1/3 octave bands across the audible range, 1/12 octave bands across the LF range and narrow band (FFT) over the infrasound range.

d) Instrument Location

Whilst the turbine layout and the topography may indicate to the compliance investigator that certain buildings and workplaces are the most likely locations where the sound limit might be exceeded, the project operator will provide the investigator with copies of all noise complaints received. The investigator will then decide which houses and other places need investigation and will then seek permission from the occupants to place measuring equipment within their homes.

e) Timing

For projects of less than 30 turbines, compliance measurements must start within 60 days of commencing full operation.

For larger projects, compliance testing shall commence within 60 days of the first 30 turbines being brought into operation and then repeated within 60 days of the whole project being completed, or, if the project is to be built in distinct stages, then 60 days after each stage becomes operational.

f) Duration

The testing must be of sufficient duration to investigate the various operating conditions including wind speed and direction, atmospheric condition and night and day.

g) Shutdown

The investigator may require one or more shutdown periods where no turbines are operating to obtain information on background noise and confirm the narrow band signature for the subject turbines. The operator must comply with such requests.

If the planning permit requires turbines to be operated in a certain mode, then normal operation and the different modes of operation relevant to the permit shall be included in the testing.

h) Compliance Check of Existing Projects

The fundamental purpose of a compliance check is to ensure that existing projects with wind turbines of 600 kW or greater capacity have actually been properly investigated before being deemed compliant to the guidelines existing at the time they received permits.

At the time of the compliance check, the investigator will also be required to investigate the levels of the wind turbine signature inside any house (hereinafter “limited habitability” houses) which residents thereof are reporting sleep and health impacts. Should the levels inside these houses exceed 45dB L(S-WT)^{See Ref (iii)} then the houses will be reclassified as “unsafe”.

i) Remedies and Enforcement

If a **new project** is non-compliant to the new maximum sound levels it cannot be issued Renewable Energy Certificates (RECs) until it is rendered compliant.

Comment: It is the owners' responsibility to build a compliant project and to only operate that project in a compliant mode and in a manner in which it does not cause a noise nuisance to neighbours.

The issue of RECs may only commence when the project is considered compliant by the investigator and accepted as so by the CER.

If an existing project is checked and shown to be non-compliant to its permitted sound levels then it may not claim or receive RECs. The issue of RECs may be reinstated only when the project is returned to compliance and signed off as so by the investigator.

If an operator of a new or existing project wishes to challenge a declaration by the investigator that a project is non-compliant, then RECs will be suspended during the period of the challenge, but will be accumulated in case the challenge by the operator is successful, in which case the accumulated RECs will be issued to the operator.

In the case of a legal challenge, the operator will be required to pay all reasonable technical and legal costs of the investigator unless the investigator is shown to have been negligent.

This document has been prepared in good faith from information available at the time of writing. The author does not warrant that the information is complete or that the conclusions are necessarily correct. What the author does represent however is that the science he has had access to has been interpreted and summarised with care, and without bias, to the best of his ability.

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- ⁱ <http://waubrafoundation.org.au/resources/kelley-et-al-1985-acoustic-noise-associated-with-mod-1-wind-turbine/>
 - ⁱⁱ <http://waubrafoundation.org.au/resources/co-operative-measurement-survey-analysis-low-frequency-infrasound-at-shirley-wind-farm/>
 - ⁱⁱⁱ <http://waubrafoundation.org.au/resources/acoustic-engineering-investigation-at-cape-bridgewater-wind-facility/>
 - ^{iv} <https://www.wind-watch.org/documents/wind-turbine-noise-propagation-below-100-hz/>
 - ^v <http://waubrafoundation.org.au/resources/huson-wl-navitus-bay-wind-park-submission/>
 - ^{vi} <http://waubrafoundation.org.au/resources/stepanovv-health-risk-factors-low-frequency-noise-oscillation-below-20-hz/>
 - ^{vii} <http://waubrafoundation.org.au/resources/wind-turbine-noise-simple-statement-facts-australian-experience/>
 - ^{viii} <http://waubrafoundation.org.au/resources/wind-turbine-noise-measurement-control-system-specification/>
 - ^{ix} <http://waubrafoundation.org.au/resources/madigan-sen-john-corruption-fraud-power-generation-industry/>