

Dr. John Yelland MA DPhil (Oxon) MInstP FIET AMASA MIOA describes the importance of the WHO Noise Guidelines with reference to Wind Turbine Noise

1.1 United Nations World Health Organisation Guidance

- 1.1.1 On 10th October 2018 a highly significant report, *“Environmental Noise Guidelines for the European Region”*, was published by the World Health Organisation (WHO), a specialised agency of the United Nations. The UK is of course a member of the UN and the WHO, and must heed the WHO’s guidance in matters of public health, such as WTN. The significance of this report derives on the one hand from the status of the WHO and on the other hand from its relevance in the matter of ILFN. This, the current WHO report, addresses all noise sources, not just wind turbines; I make little reference to earlier versions of the report because WTN received no attention in them.
- 1.1.2 The status of the WHO is quite simply unassailable, in both competence and objectivity. Its findings are based on assessments of peer reviewed academic papers from independent researchers, all of whom are respected specialists in their fields, and it does not yield to lobbying from industry, governments or pressure groups of any sort.
- 1.1.3 Although the WHO has previously published *“Environmental Noise Guidelines”* (in 1999 and 2009) the 2019 edition is the first to consider WTN. It makes cogent criticisms of the some of the documents offered for assessment and makes precise recommendations only where it had sufficient input data to do so.
- 1.1.4 The WHO uses two levels of recommendation – “strong” or “conditional”. Conditional recommendations should not be seen as weak, but as based on inadequate input data; from page xv:

*“A strong recommendation can be adopted as policy **in most situations**. The guideline is based on the confidence that the desirable effects of adherence to the recommendation outweigh the undesirable consequences. The quality of evidence for a net benefit – combined with information about the values, preferences and resources – inform this recommendation, which should be implemented in most circumstances.”*

*“A conditional recommendation requires a policy-making process with **substantial debate and involvement of various stakeholders**. There is less certainty of its efficacy owing to lower quality of evidence of a net benefit, opposing values and preferences of individuals and populations affected or the high resource implications of the recommendation, meaning there may be circumstances or settings in which it will not apply.”*

The recommendations in respect of WTN are conditional for daytime noise and, because of the inadequate evidence base, absent for night time noise. The recommendations are accompanied by surprisingly strong (but in my opinion entirely appropriate) criticisms (page 100):

*“The current evidence on health outcomes related to wind turbine noise is **unavailable or of low/very low quality** and mainly comes from cross-sectional studies. Methodologically robust longitudinal studies with **large samples investigating the quantitative relationship between noise from wind turbines and health effects are needed.**”*

- 1.1.5 More general criticisms can be found elsewhere in the report, e.g. at page 85/86:

“There are serious issues with noise exposure assessment related to wind turbines.”

and:

“Standard methods of measuring sound, most commonly including A-weighting, may not capture the low-frequency sound and amplitude modulation characteristic of wind turbine noise... » Based on all these factors, it may be concluded that the acoustical description

4.2 Implications for research on health impacts from wind turbine noise

Further research into the health impacts from wind turbine noise is needed so that better-quality evidence can inform any future public health recommendations properly. For the assessment of health effects from wind turbines, the evidence was either unavailable or rated low/very low quality. Recommendations for research addressing this priority are proposed in Table 53.

Table 53. Implications for research on health impacts from wind turbine noise

Current state of the evidence	The current evidence on health outcomes related to wind turbine noise is unavailable or of low/very low quality and mainly comes from cross-sectional studies. Methodologically robust longitudinal studies with large samples investigating the quantitative relationship between noise from wind turbines and health effects are needed.
Population of interest	Research is needed into effects of exposure on children and adults exposed and living near sources of wind turbine noise. Studies should assess subgroup differences in effects for vulnerable groups such as children, elderly people and those with existing poor physical and mental health.
Exposure of interest	Exposure to noise at a wide range of levels and frequencies (including low-frequency noise), with information on noise levels measured outdoors and indoors (particularly relevant for effects on sleep) at the residence is needed. The noise exposure should be measured objectively and common protocols for exposure to wind turbine noise should be established, considering a variety of noise characteristics specific to wind turbine noise.
Comparison of interest	The data should be compared to the effects in similar areas without wind turbines. Pre/post studies of new wind turbine installations are needed, especially if “before measures” unbiased by the stress and knowledge of potential wind turbine farm development need to be developed.
Outcomes of interest	Measures of health outcomes are required, assessed objectively – for example, according to common protocols (ICBEN scale for annoyance and self-reported sleep disturbance). The studies should include the most important situational and personal confounding variables, such as negative attitudes towards wind turbines, visual impact, economic gain and other socioeconomic factors.
Time stamp	The systematic review included studies between October 2014 (review on annoyance) and December 2016 (review on cardiovascular disease).

of wind turbine noise by means of Lden or Lnight may be a poor characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes.”

1.1.6 The absence of objective research into the adverse health impacts of WTN, explicitly including low frequency noise, is addressed at page 100:

1.1.7 At page 155 the report states:

“4.1 Quality of life, well-being and mental health

*Five low-quality systematic reviews of wind turbine noise effects on mental health and well-being have been carried out (Ellenbogen et al., 2012; Kurpas et al., 2013; Merlin et al., 2013; Onakpoya et al., 2015; Schmidt & Klokke, 2014). These reviews differed in their conclusions and delivered inconsistent evidence that wind turbine noise exposure is associated with poorer quality of life, wellbeing and mental health. **Therefore, the evidence for no substantial effect of wind turbine noise on quality of life, well-being or mental health was rated very low quality.**”*

1.1.8 Note the application of the “Precautionary Principle” here; the WHO requires the wind energy industry to provide **evidence of safety**, not for those suffering AHEs from WTN to provide **evidence of harm** to themselves from wind turbines.

1.1.9 It is instructive to compare the noise level recommendations for aircraft noise with those for WTN (on page 100 of the report; the red underline is my emphasis):

 Aircraft noise	
Recommendation	Strength
For average noise exposure, the GDG strongly recommends reducing noise levels produced by aircraft below 45 dB L_{den} , as aircraft noise above this level is associated with adverse health effects.	Strong
For night noise exposure, the GDG strongly recommends reducing noise levels produced by aircraft during night time below 40 dB L_{night} , as night-time aircraft noise above this level is associated with adverse effects on sleep.	Strong
To reduce health effects, the GDG strongly recommends that policy-makers implement suitable measures to reduce noise exposure from aircraft in the population exposed to levels above the guideline values for average and night noise exposure. For specific interventions the GDG recommends implementing suitable changes in infrastructure.	Strong
 Wind turbine noise	
Recommendation	Strength
For average noise exposure, the GDG conditionally recommends reducing noise levels produced by wind turbines below 45 dB L_{den} , as wind turbine noise above this level is associated with adverse health effects.	Conditional
No recommendation is made for average night noise exposure L_{night} of wind turbines. <u>The quality of evidence of night-time exposure to wind turbine noise is too low to allow a recommendation.</u>	
To reduce health effects, the GDG conditionally recommends that policy-makers implement suitable measures to reduce noise exposure from wind turbines in the population exposed to levels above the guideline values for average noise exposure. <u>No evidence is available,</u> however, to facilitate the recommendation of one particular type of intervention over another.	Conditional

1.1.10 WTN is continuous whenever there is wind in excess of a few m/s, whilst aircraft noise is intermittent during daytime and usually forbidden at night. It may therefore be considered that the proposed 45 dB L_{den} / 40 dB L_{night} for aircraft noise would be excessive for WTN. The absence of a figure for night time noise exposure does not of course imply that there is no need for any control thereof. In the absence of adequate data it would not be at all conservative to adopt the above 40 dB L_{night} aircraft noise, albeit in the knowledge that it is almost certainly inadequate.

1.2 Summary of Effectiveness of Planning Guidance

1.2.1 ETSU has never been a comprehensive planning document, nor has it claimed to be. Over two decades have passed since its publication in 1997, but it has never been revised in spite of its authors' caveat on page 111 that:

"The Noise Working Group therefore suggests this report and its recommendations are reviewed in 2 years time. We anticipate that the wind industry will itself take the initiative for such a review and that this review will be undertaken by a cross-section of users of the report"

The wind industry has not taken its anticipated initiative to revise ETSU, and in any event it is not clear that "the wind industry itself" was the most appropriate body to revise it.

1.2.2 Both ETSU and the IOAGPG were substantially authored by acousticians working primarily for or within the wind industry. Nevertheless rigorous compliance with the two documents does usually provide an acceptable degree of protection for wind farm neighbours against excessive audible noise, albeit with little margin.

1.2.3 There are three aspects of compliance required to ensure that a wind energy development will not be a nuisance or a threat to health due to its acoustic emissions:

- The planning guidance must address all known aspects of acoustic emissions relevant to noise nuisance and health, must be informed by and comply with good science, and must provide competent technicians with sufficiently detailed unambiguous guidance;
- The NIA for the development must demonstrate compliance with the methods of measurement and methods of prediction proposed by the guidance itself and by any documents to which the guidance refers;
- The NIA for the development must demonstrate that the numeric values of the predicted acoustic immission levels do not exceed those permitted by the guidance.

I have found that rigorous adherence to ETSU and the IOAGPG in NIAs submitted in wind energy planning applications is unusual. I have also observed that errors that overstate background noise outnumber those that understate it, whereas errors that underpredict turbine emission noise outnumber those that overpredict it.

1.2.4 The Achilles' heel of current wind energy planning guidance however is not audible noise; it is its high level of ILFN emissions, which can and do cause serious AHEs. The wind industry has consistently denied or ignored this problem, and has successfully steered attention away from infrasound to the phenomenon of amplitude modulation, which is claimed to cause "*enhanced annoyance*".

1.2.5 It is important to understand that the absence of a quantified WHO recommendation for a night time WTN limit stems not from any absence of need thereof but from the absence of reliable evidence from which to derive such a limit.

1.2.6 It will be observed that the WHO proposed limits are absolute, not relative like the limits of the ETSU standard procedure. The L_{den} and L_{night} descriptors will be less familiar to UK acousticians than the familiar LA90 etc, but what is important here is the difference between relative limits and absolute limits. The ETSU relative limit of "background + 5 dB" whatever the background noise level is open to abuse; as has happened at Rakewood. If the measured background noise is dangerously high then "dangerous + 5 dB" would be ETSU compliant.

1.2.7 The WHO report is a most welcome advance in regulatory understanding of WTN, specifically because it accepts the relevance of infrasound and the inadequacy to date of health studies related thereto.

WHO European noise-guidelines-10-10-2018

Acronyms:

WHO: World Health Organisation

UN: United Nations

WTN: Wind Turbine Noise

ILFN: Infrasound and Low Frequency Noise

AHE: Adverse Health Effects

IOAGPG: Institute of Accoustics Good Practice Guide

ETSU: Energy Technology Support Unit (for ETSU-R-97, « The Assessment and Rating of Noise From Wind Farms »)

NIA: Noise Impact Assessment