INSTITUTE OF ACOUSTICS

IOA CONSULTATION QUESTIONNAIRE

IOA CONSULTATION QUESTIONNAIRE FOR

"METHODS FOR RATING AMPLITUDE MODULATION IN WIND TURBINE NOISE"

APRIL 2015

FOREWORD

** PLEASE READ BEFORE PROCEEDING TO THE MAIN DOCUMENT **

This discussion document has been produced by a working group on behalf of the Institute of Acoustics consisting of the following members:

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This questionnaire has been produced specifically to promote discussion of the relevant issues during the consultation on a metric for amplitude modulation (AM) from wind turbines and should be read in conjunction with the "IOA AMWG Discussion Document". Respondents to the consultation are encouraged to provide their comments on the form provided. A word version has been provided to allow respondents to increase box sizes as required.
All comments on the consultation draft should be sent electronically to:

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Alternatively, written responses can be sent to:
IOA AMWG Consultation Feedback
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The closing date for the receipt of comments is **30th June 2015**. Late comments may not be reflected in the deliberations on the choice of the AM metric.

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INTRODUCTION TO THE CONSULTATION

Background

The Institute of Acoustics Amplitude Modulation Working Group (IOA AMWG) has prepared a discussion document on methods for rating amplitude modulation in wind turbine noise, for the purpose of consultation to IOA Members and other interested parties.

The discussion document considers various methods and has proposed three methods for consultation. The intention of the IOA AMWG post-consultation is to recommend one method but at this consultation stage, three candidate methods are proposed. The AMWG will not be proposing a threshold or penalty mechanism for rating the subjective response.

This document is written to initiate the discussion and asks a number of specific questions but feedback is encouraged on all aspects of the document, whether positive or negative, and it is not necessary to limit the response to the questions in this document.

Subsequent section numbers refer to the main discussion document.

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General Comments on Consultation

IoA Consultation Process Flawed

1. This is the third consultation on wind turbine noise carried out by the IoA in recent years. The first two were a) that for the Good Practice Guidance (GPG) and b) the Supplementary Guidance Notes (SGN).
2. The process adopted by the IoA for these earlier consultations was flawed. It is a normal requirement following a consultation that a consultation response document is produced in which the specific points raised by consultees are addressed. Where a consultee has made a recommendation or criticism of the original document, the IoA, as a professional body, must explain either what adjustment to the guidance was made to accommodate the point, or, on what evidential basis the point was rejected. The IoA has not done this.
3. Instead, the IoA has argued that reports made by planning inspectors following planning inquiries provides sufficient detail to explain why the IoA does not need to respond to technical criticism of acoustic issues contained within IoA Guidance. (See http://www.ioa.org.uk/sites/default/files/IOA%20statement%20on%20wind%20farm%20noise%20assessment%2019-12-2014.pdf). This position is absurd and untenable; no other professional, let alone scientific body would delegate the responsibility of technical rebuttal to a planning inspector whose own expertise is in Town Planning.
4. We urge the IoA to respond to the current consultation with a professional consultation response document that explains what regard has been paid to the consultation responses and why.
5. We further note that the consultation responses to both the GPG and SGN reports are not apparently available on the IoA website in spite of an earlier statement that they were to be published. This should be rectified, and the responses to this AM consultation also published.
6. In spite of our organisation, the Renewable Energy Foundation, having responded to both the GPG and SGN consultations, and having produced original work on AM that is cited (inaccurately) in the IoA AM Discussion Document, REF was not notified of this consultation by the IoA. This suggests that other individuals and organisations who have responded to the earlier consultations might similarly have been ignored in this consultation process. This undermines confidence in the IoA's ability to carry out a proper consultation exercise.
7. In summary, the process for earlier IoA consultations has been seriously and significantly inadequate; there are worrying signs that the current consultation will be no better. The pattern that is emerging does no credit to the IoA and must be rectified if reputational harm is to be avoided.

Selection of NWG Members

8. In any exercise involving recommendations of how to define a potential noise nuisance, it is important that the participants involved in formulating the recommendations are seen to have no vested interest in the outcome, or that the recommendations are framed in such a properly scientific manner that they are seen to be reasonable and not to unfairly serve any interest.
9. There is a long history related to AM noise nuisance. Following the 2006 DTI report by Hayes McKenzie Partnership (HMP) which highlighted the fact that UK wind farms were producing AM noise at levels that exceeded what is accounted for in the ETSU-R-97 guidance, a NWG was set up by the then Department of Trade and Industry (DTI). Many of the same members and or organisations in the IoA NWG and AM subgroup were represented in the 2006 DTI NWG.
10. The draft minutes and emails relating to the meetings of the 2006 NWG were released under a Freedom of Information request.[1]

[1] http://www.ref.org.uk/publications/328-foi-dti-noise-working-group

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11. It is clear from these released documents that there was wholesale resistance to the idea of limiting AM noise even though it was recognised that AM levels of 15dB had been measured as long ago as 1997. It is also plain that the concerns of neighbours and objectors were treated by some members with disdain. It is also plain that considerations other than purely acoustic issues coloured the judgement of some members of the group.
12. No empirical AM data was collected nor were any attempts to limit AM problems made as a result of the efforts of 2006 NWG. In fact, the situation nine years later is unchanged from when the last NWG group was convened.
13. The fact that the same people and/or organisations have been chosen to form the 2015 NWG is profoundly alarming and unlikely to generate confidence or improve the prevailing public opinion of the IoA as an appropriate organisation to formulate robust and fair wind farm noise guidance.

Lack of real world evidence

14. The 2006 DTI report by the Hayes McKenzie Partnership (HMP) gathered AM data at three sites. One of the sites, Far Old Wind Farm at Askam in Cumbria could be considered a benchmark site for AM noise problems. It is the wind farm site in the UK with the most neighbour complaints about AM noise and has been causing these complaints for 14 years since April 2001.[2] We find it surprising that no effort has been made to test the suggested methodologies by quantifying the AM measured by HMP that actually triggered the AM debate.
15. We need to understand how the different methodologies proposed by the IoA would quantify AM at the wind farm sites with incontrovertible AM problems, such as Askam and Deeping St Nicholas for example. REF has carried out the exercise on the Askam data for both the original Den Brook AM condition and the RUK AM condition and shown that the former condition would be breached and the latter not breached at Askam.[3]
16. This is definitely the sort of exercise that the IoA NWG should be carrying out.
17. There is a clear bias in the document towards a penalty mechanism which we could not possibly endorse for the reasons spelled out below in the answer to the time interval question in Section 5. However, if the reader was provided with the quantified AM level under each of the proposed methodologies for Askam and other sites with outstanding long-term AM complaints, it would be possible to see if a penalty scheme would result in a breach or no breach.
18. Without provision of real world data of this sort, the document seems likely to result in another decade where wind farm developers can build too close to neighbours and generate AM noise with impunity. This would suit wind farm developers, but would amount to a professional betrayal of lay members of the public to whom the IoA has a professional duty of care.

Section 3 – AM Definition

Do you agree with the Definition of AM? Does it relate to your experience?

19. We disagree with the definition. Although superficially it appears reasonable, this definition can be exploited by the wind industry to the unacceptable disadvantage of wind farm neighbours. Evidence for this can be seen in the developers' revision to the AM condition at Den Brook. In that case, a scheme was put in place that includes a step which states:

[2] http://www.ref.org.uk/Files/D.pdf
[3] http://www.ref.org.uk/publications/310-the-efficacy-of-the-ruk-am-condition
http://www.ref.org.uk/publications/242-the-den-brook-amplitude-modulation-noise-condition

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"4 c) if this assessment indicates that GTE-AM is present, then the $L_{Aeq,125msec}$ data required by Condition 20 shall be band pass filtered, from $0.9f_c$ to $1.1f_c$, and the application of the Condition 20 methodology repeated. **This is essential to ensure that the variation causing apparent non-compliance with Condition 20 derives solely from that occurring at the blade passing frequency, f_c.**" (emphasis added)

20. This demonstrates how the definition recommended by the IoA AM NWG can be misused. By filtering out the harmonics using FFT techniques as required in the amended Den Brook scheme, the level of AM at blade passing frequency will significantly understate the AM depth experienced by neighbours.

21. Given that three of the members of the IoA AM NWG were involved with drafting and validating the Den Brook amended AM condition, we are surprised and concerned that this loophole in the definition of AM has been allowed to persist in the IoA document.

Is the Definition of AM applicable to smaller turbines?

Is it appropriate to measure AM Outside in free-field conditions? If not can you propose alternatives?

22. No. The 2006 DTI report by Hayes McKenzie explicitly noted that greater AM had been measured indoors than outside in free-field conditions. We are surprised that this evidence and its significance is not discussed in the IoA report.

Section 4 – Literature Review

Are there any other rating methods or important references that the AMWG should consider?

23. There are inaccuracies in Section 4 that need to be corrected.

24. The REF work on AM is described at page 20 as a criticism of the RenewableUK AM research produced in 2013. The REF work cited is a 2011 paper on the Den Brook AM condition and clearly cannot be a criticism of the RUK work produced 2 years later. The correct reference is http://www.ref.org.uk/attachments/article/310/ref.info.note.ruk.am.condition.20140319.pdf

25. The brief comment on REF's work included in the IoA document does not accurately represent the conclusions we reached. To summarise, these were that the methodology always understated the actual AM, it is too complex and computationally intensive to provide a reasonably accessible and transparent methodology for assessing excessive AM noise and that, crucially, it would not be

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breached at Askam wind farm. Askam is a benchmark site for AM noise problems. It is the wind farm site in the UK with the most neighbour complaints about AM noise and has been triggering these complaints for 14 years since April 2001.[4]

26. Bizarrely, given that three of the members of the AM NWG were closely involved with devising and approving the Den Brook condition 21 scheme (that modifies the original Den Brook AM condition), it is incorrectly described at page 22. What is omitted is the crucial part of Condition 21 that states if the AM levels breach the original 3dB limit set by a planning inspector, the noise data is filtered via a Fourier transform to restrict the assessed noise data to blade passing frequency +/- 10%. A breach is only recorded if this band pass filtered data also exceeds 3dB. The corollary of this is that although the Inspector limited AM to 3dB, the developer and local authority have subsequently raised that limit to as much as 4 to 5 dB.

27. It is important that the Den Brook condition 21 scheme is correctly characterised in the IoA document because the increase in permitted AM depth was justified on the basis of the definition of AM which is the same as the IoA are proposing in this consultation. See the response to Section 3 AM definition above.

Section 5 – Towards a preferred metric

In principle, which is the best domain for rating and describing amplitude modulation: the time domain; the frequency domain; or is a hybrid method preferred? Can you explain why?

28. The time domain is unquestionably the best domain. As the RUK document, this IoA document and others, including REF's review of the RUK AM condition[5] have all demonstrated, any methodology involving Fourier transforms is absurdly esoteric. If the aim was to exclude the neighbours affected by AM noise from understanding whether a wind farm complies with an AM noise condition or not, a better methodology could not have been chosen. This is unacceptable and must be corrected.
29. The only acceptable methodology for a noise condition needs to be one that can be implemented readily and understandably with ordinary equipment such that no suspicion or controversy regarding compliance arises. We have previously demonstrated that the original Den Brook condition (prior to its recent amendment) is straightforward to implement and understand.[6]

Do you agree with time intervals proposed, that is: 100 millisecond samples, 10 second blocks, 10 minute periods?

30. We don't understand the rationale for 10 minute periods unless the IoA NWG is already committed to recommending a penalty for AM. This would be wholly unacceptable. It is unreasonable to treat the annoyance arising from the beating noise character of wind farm AM noise as an adjunct to the

[4] http://www.ref.org.uk/Files/D.pdf
[5] http://www.ref.org.uk/publications/310-the-efficacy-of-the-ruk-am-condition
[6] http://www.ref.org.uk/publications/242-the-den-brook-amplitude-modulation-noise-condition

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total sound levels rather than as a distinct problem in its own right. Applying a correction to the measured sound levels will not address the issue of noise complaints arising from excess AM noise; it should be treated as a standalone problem. This is because annoyance is not linked to overall noise level, but to its modulation even at low noise levels. It is AM that has to be removed not just compensated for in a way which is inevitably ineffective.

31. The fact that a penalty will be ineffective arises because of the IoA GPG and SGN recommending use of the so-called 'standardised' wind speeds as distinct from actual wind speeds. The corollary of this is that more headroom is available for wind farms to make noise at times of high wind shear and at night time; exactly the times when AM is likely to become a nuisance to neighbours. Evidence demonstrating this extra headroom for wind farm noise provided by the IoA guidance was covered in our SGN consultation response.[7]
32. Furthermore, by limiting quantification of AM to specific blocks of time in this way and electing to use the FFT methodology, it also dictates the start and end times of the measured samples. As anyone who has worked on real-world AM data will appreciate, varying the starting point changes the outcome value of AM depth.

Do you agree with the band-limiting filtering approach for rating AM?

33. No because it can be misused in an opaque way to remove wind farm noise – see response to the first question of Section 3.

Is the default frequency range appropriate? What other frequency ranges could be considered, taking into account the desirability to characterize the frequency range in which AM occurs, the desirability to exclude spurious noise sources and the need for a consistent approach to avoid differences?

34. This question presupposes that frequency space analysis is acceptable which it is not.

Section 6 – Time Series Method

Do you think the time series method proposed is suitable for rating AM? If not, can you explain why?

35. Yes

[7] Page 14ff of http://www.ref.org.uk/attachments/article/305/REFIoAConsultation2014.02.07v2.pdf

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Section 7 – Frequency Domain Method

Do you think the frequency domain method proposed is suitable for rating AM? If not, can you explain why?

36. Not suitable
37. REF provided a detailed, evidence-based critique of frequency domain methodology in the report at http://www.ref.org.uk/publications/310-the-efficacy-of-the-ruk-am-condition
38. In addition to these criticisms, Section 7 of the IoA document has a number of problems. Firstly, the data represented in Figure 7.1 looks implausible. The frequency domain spectrum shows a significant harmonic contribution in addition to the fundamental peak of 5.2 dB. It seems unlikely that a reverse FT of that frequency spectrum would generate the time series which appears to show AM of around 5dB. i.e. the clear presence of a harmonic means the fundamental peak would not be expected to be as great as 5.2dB. Whether an error has arisen in the scaling because the time series is 20s not 10s as labelled is not clear, but it does appear that there is an error in the figure. This could mislead readers into believing that the fundamental in a Fourier transform of a typically asymmetric wind turbine AM signal would give a reasonably accurate measure of the actual modulation in the time domain.
39. The method as described requires the blade passing frequency and the SCADA data is suggested as a source of this data. It is claimed that the rotational speed is unlikely to vary significantly but there is no evidence to back up this assertion – even though members of the IoA AM NWG would certainly have access to this sort of information. In fact for multiple turbines in a wind farm, the rotational speed will vary significantly – not only from one turbine to the next but also over a ten minute period. There will be considerable difficulty in deciding which BPF to use with the resultant debate and suspicion that any results are unrepresentative of the true impacts.
40. We cannot endorse any methodology where key bits of data are in the hands of the wind farm owners and obtaining that data is at their discretion. This is not likely to be perceived as fair or reasonable by wind farm neighbours.

Should other parameters be used in the application of this method and why?

41. As stated, frequency domain analysis is not suitable for a wind farm noise condition administered by hard pressed local authorities and requiring the confidence of wind farm neighbours that the condition is fair.

Section 8 – Hybrid Method

Do you think the hybrid method proposed is suitable for rating AM? If not, can you explain why?

42. No – because it implies frequency domain analysis is acceptable.

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Should other parameters be used in the application of this method and why?

Section 9 – Comparison of Methods

Of the three methods proposed, which is your preferred method?

43. A time domain method

Is there another alternative method not recommended by the AMWG which would be preferable? Explain why.

44. A straightforward implementation of the Condition 20 Den Brook AM condition as demonstrated in the REF report at http://www.ref.org.uk/publications/242-the-den-brook-amplitude-modulation-noise-condition

Section 10 – Instrumentation

Are the proposed requirements for instrumentation appropriate?

Would you like instrument manufacturers to make available an “AM rating” option for sound level meters?

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Section 11 – Software

Should the IOA make available software for rating AM?

45. Absolutely not. Any noise condition that requires black-box software is inevitably going to be mistrusted by the neighbours of any wind farm site. In view of the EIA requirements, we would anticipate that the raw code underpinning any software would be required to be in the public domain which indicates proprietary software could not be used. It is surprising to us that the IoA is confident they could write and support what is clearly quite complex software from first principles.
46. Furthermore provision of software is subject to all the well-known problems and risks associated with all IT products including bugs, support, obsolescence, and licensing. The IoA presumably has no track record as a successful software supplier and would be extremely ill-advised to diversify into such an expensive and risk-prone area.

Do you have any comments on the software released?

Recommendations for Further Study and any other comments

Your details

Please provide your name and contact details in case the working group wishes to clarify any of the points raised in your feedback: Can you also indicate if you would like your response to be published anonymously or not published at all by the IOA?

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I am happy for this response to be published by the IOA and do not seek anonymity

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The IOA AMWG thanks you for your help in completing this document.

Gavin Irvine
AMWG Chair

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