Monday, 30 September 2024

Project number: M240363
Reference: M240363LT1A

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RES
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Dear Sami,

Lal Lal Wind Farm
Peer Review of Post-Construction Noise Monitoring Report – Amplitude Modulation and Background Noise Reassessment

1 Introduction

As requested, we have undertaken a review of the Stage 2 Post-Construction Noise Monitoring Report prepared for Lal Lal Wind Farm by SLR Consulting Australia (SLR).[1] This letter sets out the key findings of our review.

We note that our review is limited to the following aspects:

- The methodology used for the assessment of amplitude modulation special audible characteristics in the Stage 2 Post-Construction Noise Monitoring Report prepared for Lal Lal Wind Farm.
- The methodology used to reanalyse baseline noise levels measured at Receptor K15aa.

Other aspects of the noise monitoring and assessment process have not been considered.

2 Summary

In summary, we consider that the methodology used for the assessment of amplitude modulation special audible characteristics in the Stage 2 Post-Construction Noise Monitoring Report utilises current best practice methodologies for the determination of amplitude modulation in wind turbine noise. The methodology adopted to apply a penalty to detected amplitude modulation is considered to be consistent with both New Zealand Standard (NZS) 6808:2010[2] and the Noise Compliance Test Plan (NCTP) prepared for Lal Lal Wind Farm.[3]

We note that the application of the penalties to the measured operational noise levels has been done in a conservative manner that may overstate the wind turbine noise level to a limited extent. As the measured noise levels are determined to be compliant with the applicable noise limits, this conservatism means that the margin of compliance may be slightly greater than stated in the Stage 2 Post-Construction Noise Monitoring Report. Given that it would not alter the outcomes of the assessment, we do not consider than an update to the methodology is required.

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[1] SLR Consulting Australia, 20 September 2024, *Post-construction Noise Assessment – Stage 2 – Lal Lal Wind Farm*, 640.11872 Revision 1.2

[2] Standards New Zealand, 2010, NZS 6808 *Acoustics – Wind farm noise*.

[3] Marshall Day Acoustics, 23 January 2018, *Lal Lal Wind Farm – Noise Compliance Test Plan*, Rp 003 R03 20170649.

We also consider that the methodology employed to assess the potential effect that limited wind turbine commissioning activities may have had on the measured 2019 baseline noise levels on Receptor K15aa is appropriate. The assessment demonstrates that the limited commissioning activities had negligible effect on the measured baseline noise levels and, therefore, negligible effect on any conclusions from the post-construction noise monitoring assessments.

3 Background

SLR has been engaged by Lal Lal Wind Farms Nom Co Pty Ltd to undertake an assessment of the noise emissions from Lal Lal Wind Farm, with the Stage 2 Post Construction Noise Monitoring Report detailing the outcomes of noise monitoring conducted between March 2023 and January 2024. The assessment has been conducted to fulfil obligations under Planning Permit No. PL-SP/05/0461-2, which requires that the noise levels comply with NZS 6808:2010 and that measurements are conducted in accordance with the NCTP.

During subjective assessments carried out by SLR, it was identified that there was potential amplitude modulation characteristics. As such, SLR carried out an objective assessment of amplitude modulation and applied penalties to any detected occurrences of it as part of the noise compliance assessment.

Furthermore, as part of the Stage 2 assessment, SLR undertook a reanalysis of baseline noise monitoring data previously captured at Receptor K15aa in 2019. This reanalysis was deemed necessary as, during unrelated investigations in 2024, it was observed that the wind farm had been undergoing commissioning activities during the baseline noise monitoring period that may have meant that wind turbine noise had a minor contribution to some of the baseline data. While the commissioning activities would have limited potential to affect the measurements, this information was not known during the 2019 baseline noise assessment at K15aa and, therefore, SLR undertook a reassessment with the intent of ensuring that any effect of the commissioning activities on the baseline data was appropriately accounted for in accordance with NZS 6808:2010. This effect was analysed in Appendix H of the Stage 2 Post Construction Noise Monitoring Report for both the Stage 1 and Stage 2 post-construction noise monitoring results.

4 Comments

Our comments on the Stage 2 Post Construction Noise Monitoring Report are provided in Table 1.

Table 1 Peer review comments

Aspect	Item	Comment	Recomm-endations
Amplitude modulation assessment	Scope of objective assessment	SLR took a cautious approach to the objective amplitude modulation assessment by undertaking an assessment of all valid data points, not just data points captured under the conditions for which the subjective assessment had detected potential special audible characteristics. The analysis of valid data points only is considered appropriate, as any data point that was not considered valid would not be able to give an accurate wind turbine noise level as either: • the noise level would have been affected by extraneous noise sources, such as rainfall or excessive insect noise, or • insufficient wind turbines would have been operating.	Nil.
Amplitude modulation assessment	Objective assessment methodology	SLR adopted the use of the UK Institute of Acoustics (IoA) Amplitude Modulation Working Group (AMWG) method for the determination of the magnitude of any wind turbine noise amplitude modulation. This was used in preference to the interim test method suggested in NZS 6808:2010. The use of the IoA AMWG method is consistent with the requirements of the NCTP, which forms part of the Planning Permit. In addition to it being a requirement of the Planning Permit, we consider the use of the IoA AMWG method to represent current best practice, noting that: • NZS 6808:2010 clearly states in CB3.2 that its interim test method is expected to be replaced by a more robust objective method. The IoA AMWG method fulfils that description. • The interim test method is not clearly specified, for example there is no definition as to what a 'regularly varying basis' is. This makes it impractical to apply on large datasets as required by the NCTP for this project. The IoA AMWG method is designed for application on large datasets. • The IoA AMWG has been adopted in the recent international standard IEC TS 61400-11-2:2024 *Wind energy generation systems – Part 11-2: Measurement of wind turbine noise characteristics in receptor position*, demonstrating its broader industry acceptance.	Nil.

Aspect	Item	Comment	Recommendations
Amplitude modulation assessment	Determination of AM penalty for individual data points	SLR identified that there is an uncertainty that arises from the NCTP, which states that: • guidance on a penalty scheme is given by the UK government in the *Wind Turbine AM Review Phase 2 Report* dated August 2016 (UK Government AM Review), and • a fixed +5 dB penalty shall be applied to any 10-minute data point for instances of amplitude modulation special audible characteristics. As the UK Government AM Review sets out a sliding scale of penalties from 3 to 5 dB depending on modulation depth, there is interpretation that is required as to whether the 5 dB penalty should only apply where a 5 dB penalty would apply under the UK Government AM Review (e.g. a modulation depth of 10 dB) or at a lower value. SLR has taken an approach of comparing modulation depths determined from the IoA AMWG to NZS 6808:2010 interim method thresholds for a 5 dB penalty. This comparison has resulted in the identification that a 4.4 dB modulation depth represents a threshold at which the interim test method would typically recommend a 5 dB penalty, as this relates to the level at which the worst-case one-third octave band would be modulating by more than 6 dB on regularly varying basis. Due to the complexities associated with direct application of the interim test method, a visual comparison of the data has also been carried out on a selected sample as set out in Appendix G of the Stage 2 Post Construction Noise Assessment Report. We consider that the methodology applied by SLR is robust and results in a cautious application of a 5 dB penalty for amplitude modulation in a manner that maintains consistency with NZS 6808:2010 and the NCTP.	Nil.

Aspect	Item	Comment	Recommendations
Amplitude modulation assessment	Application of penalties to the measured noise data	In Section 9.0 of the Stage 2 Post Construction Noise Assessment Report, SLR set out how special audible characteristic penalties (for tonality and/or amplitude modulation) are applied to data. The penalties are applied to individual 10-minute data points to determine a "WTG + Background" trendline, which is then corrected by the background trendline to determine the "WTG only" trendline. We note that this method has the potential to overstate the effect of special audible characteristic penalties. This can be illustrated by considering an example of an overall noise level of 36.0 dB L_{A90} with a background noise contribution of 33.0 dB L_{A90} and a 5 dB penalty applied. The SLR method would adjust the level to 41.0 dB L_{A90} then correct by background to give a resultant level of 40.3 dB L_{A90}. However, this is, in effect, also applying the penalty to the background noise level. The ideal method would be to adjust for background first, and then apply the penalty such that it only applies to the wind turbine noise. This would involve correcting by background first to obtain a "WTG only" noise level of 33.0 dB L_{A90} and then applying the penalty to obtain a level of 38.0 dB L_{A90}, which is 2.3 dB lower. The difficulty with the ideal method is that the background noise level for each individual 10-minute data point can never be accurately determined. Only the trendline background noise level is known, which is an average value determined from analysis of many data points. This represents a difficulty with the application of special audible characteristic penalties under NZS 6808:2010. An alternative method that could be considered would be to compare the trendlines for the "WTG + Background" scenarios with and without special audible characteristic penalties applied to individual data points. The difference between the two trendlines can be considered to be the "Effective Penalty". The "WTG + Background" trendline without penalties applies is corrected by the "Background" trendline, with the "Effective Penalty" applied to determine the "WTG only" noise level. This means that the penalty is not applied to the background noise level and would be expected to result in a marginal (considering the relatively small occurrence of special audible characteristics) reduction in the "WTG only" noise level compared to the SLR method. Overall, however, we note that the SLR method is conservative as it would tend towards a higher "WTG only" noise level and therefore do not recommend any modifications be made as the noise level has been deemed to be compliant through application of the conservative method.	Nil.

Aspect	Item	Comment	Recomm-endations
K15aa baseline noise reassessment	Methodology	The approach employed by SLR to assess whether noise from commissioning activities had affected the baseline noise data is considered appropriate, utilising a well-established method for the prediction of wind turbine noise to identify 10-minute data points where the predicted wind turbine noise level was within 15 dB of the measured background noise level. In such cases, the predicted noise level was subtracted from the measured background noise level to remove any contribution of wind turbine noise from the data. We agree with SLR that the employed approach is preferable to simply removing the potentially affected data points, because it will tend to be the quieter data points that are more likely to be affected by low levels of wind turbine noise. In other words, had the potentially affected data been removed, the baseline noise levels may have increased as the average background noise level at a given wind speed would be higher. Such an outcome would not be accurate. The end outcome of the SLR reassessment at K15aa is that there was very little (0.2 dB or lower) effect on the outcome for the baseline noise assessment at K15aa. This is consistent with what would be expected for situations where only a very small number of wind turbines (typically only one) were operating, and often under wind directions where K15aa may not be downwind of the operating wind turbine. It therefore follows, as shown within the SLR report, that there would be similar negligible effect on the outcomes of the compliance noise assessments conducted for both Stage 1 and Stage 2.	Nil

5 Conclusion

We have undertaken a peer review of the methodology used for the assessment of amplitude modulation special audible characteristics in the Stage 2 Post-Construction Noise Monitoring Report prepared for Lal Lal Wind Farm.

Other than minor observations and recommendations for the amendment of typographical errors, we consider that the methodology used for the assessment of amplitude modulation special audible characteristics in the Stage 2 Post-Construction Noise Monitoring Report utilises current best practice methodologies for the determination of amplitude modulation in wind turbine noise. The methodology adopted to apply a penalty to detected amplitude modulation is considered to be consistent with both NZS 6808:2010 and the NCTP.

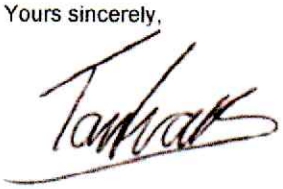
We note that the application of the penalties to the measured operational noise levels has been done in a conservative manner that may overstate the wind turbine noise level to a limited extent. As the measured noise levels are determined to be compliant with the applicable noise limits, this conservatism means that the margin of compliance may be slightly greater than stated in the Stage 2 Post-Construction Noise Monitoring Report. Given that it would not alter the outcomes of the assessment, we do not consider than an update to the methodology is required.

We also consider that the methodology employed to assess the potential effect that limited wind turbine commissioning activities may have had on the measured 2019 baseline noise levels on Receptor K15aa is appropriate. The assessment demonstrates that the limited commissioning activities had negligible effect on the

measured baseline noise levels and, therefore, negligible effect on any conclusions from the post-construction noise monitoring assessments.

Please let me know if you have any queries or wish to discuss the above.

Yours sincerely,



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