Acoustic Impact Assessment of the Proposed Extension to Cleator Energy Storage Project

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Revision History

Issue	Date	Author	Nature & Location of Change
01	20 Jun 2022	Andrew Birchby	First created

CONTENTS

1.0 INTRODUCTION & SCOPE

This report contains an assessment of the acoustic impact of the proposed extension to Cleator energy storage project. Two Members of the Institute of Acoustics have been involved in its production. Details of their experience and qualifications can be found in Appendix A.

The scope includes predicting sound levels due to the proposed extension and combining them with those for the already existing site in order to assess the level of cumulative impact in accordance with relevant planning guidance.

2.0 PLANNING GUIDANCE

2.1 National Planning Policy Framework

Within England, the treatment of noise is defined in the planning context by the National Planning Policy Framework (NPPF)[1] which details the Government's planning policies and how these are expected to be applied. The NPPF provides advice on the role of the planning system in helping to prevent and limit the adverse effects of noise, stating that planning policies and decisions should aim to avoid noise giving rise to significant adverse impacts, whilst at the same time mitigating and reducing to a minimum other adverse impacts on health and quality of life. At this point the NPPF refers to the Noise Policy Statement for England (NPSE)[2] which provides guidance on the categorisation of impact levels.

2.2 Noise Policy Statement for England

The Noise Policy Statement for England (NPSE) sets out the long-term vision of Government noise policy: to promote good health and quality of life through effective noise management within the context of sustainable development. In order to weigh noise impacts against the economic and social benefits of the activity under consideration, NPSE defines three categories of effect level:

- No Observed Effect Level (NOEL): noise levels below this have no detectable effect on health and quality of life;

- Lowest Observed Adverse Effect Level (LOAEL): the level above which adverse effects on health and quality of life can be detected; and

- Significant Observed Adverse Effect Level (SOAEL): the level above which effects on health and quality of life become significant.

2.3 National Planning Practice Guidance

National Planning Practice Guidance (NPPG)[3] puts the effect levels defined by NPSE into greater context by explaining how such noise levels might be perceived, providing examples of outcomes based on likely average response, and advising on appropriate actions. These are reproduced in Table 1 below.

[1] "National Planning Policy Framework", Department for Communities and Local Government, March 2012
[2] "Noise Policy Statement for England (NPSE)", Department for Environment, Food and Rural Affairs, March 2010
[3] "National Planning Practice Guidance", Department for Communities and Local Government, March 2014

Table 1 - Noise Exposure Hierarchy

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
No Observed Effect Level (NOEL)			
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level (LOAEL)			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level (SOAEL)			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

2.4 National Policy Statements

In addition to the aforementioned guidance which is applicable to all forms of environmental noise, specific guidance relating to nationally significant energy infrastructure has been published by the Department of Energy and Climate Change (DECC). Whilst the proposed development is not of a scale that would be deemed nationally significant, the relevant National Policy Statements are informative in that they suggest an assessment methodology that would be considered appropriate for the type of development being proposed.

The Overarching National Policy Statement for Energy (EN-1)[4] notes that energy storage is expected to play an important role as the country transitions to a low carbon electricity system.

[4] "Overarching National Policy Statement for Energy (EN-1)", Department of Energy and Climate Change, July 2011

However, referring back to the NPSE, EN-1 recognises the potential for energy infrastructure to impact on health and quality of life if it results in excessive noise. It goes on to say that where noise impacts are likely to arise, they should be assessed according to the principles of the relevant British Standards.

Of the examples provided, BS 4142[5] and BS 8233[6] relate to operational sound. BS 4142 describes methods for rating and assessing sound of an industrial or commercial nature. Outdoor sound levels are used to assess the likely effects on people who might be inside or outside a residential property. BS 8233 provides guidance on the control of noise for new buildings or those undergoing refurbishment. It does not provide guidance on assessing the effect of changes in external noise levels on occupants of existing buildings.

The National Policy Statement for Electricity Networks Infrastructure (EN-5)[7], relevant to the transmission and distribution parts of the electricity network along with any associated infrastructure, such as substations and converter stations, again points to the appropriateness of BS 4142 in assessing the acoustic impact of such projects. The inverters and transformers deployed as part of the proposed project are examples of infrastructure of this kind.

2.5 WHO Guidance

The World Health Organisation (WHO) has also published noise guidance. The Guidelines for Community Noise[8] recommend sound levels intended to minimise health impacts in specific environments. At dwellings they recommend that outside sound levels should not exceed 45 dB L_{Aeq} so that people may sleep with the windows open and not be disturbed. During the daytime the sound level should not exceed 50 dB L_{Aeq} to protect the majority of people from being moderately annoyed.

In addition to the Guidelines for Community Noise the WHO subsequently published the Night Noise Guidelines[9]. These guidelines are described as complementary to the Guidelines for Community Noise and recommend a limit of 40 dB L_{night}, outside. This is a yearly average night time sound level so could potentially be exceeded on some nights of the year such that it isn't necessarily inconsistent with the Guidelines for Community Noise if the sound levels do not exceed 45 dB L_{Aeq} on those nights.

3.0 METHODOLOGY

3.1 Propagation

The ISO 9613-2[10] propagation model shall be used to predict the specific sound levels due to the proposed development at nearby residential properties. The propagation model takes account of sound attenuation due to geometric spreading and atmospheric absorption. The assumed temperature and relative humidity are 10 ˚C and 70 % respectively.

Ground effects are also taken into account by the propagation model, with a ground factor of 0.5 adopted to reflect a mix of hard and porous ground between the site and the assessment locations. A 4 m receiver height shall be used. The effect of surface features such as buildings (except those located within the site boundary) and trees shall not be included in the model. There is a level of conservatism built into the model as a result of the adoption of these settings.

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[5] "Methods for rating and assessing industrial and commercial sound", The British Standards Institution 2014
[6] "Guidance on sound insulation and noise reduction for buildings", The British Standards Institution 2014
[7] "National Policy Statement for Electricity Networks Infrastructure (EN-5)", Department of Energy and Climate Change, July 2011
[8] "Guidelines for Community Noise", World Health Organisation, March 1999
[9] "Night Noise Guidelines for Europe", World Health Organisation, 2009
[10] "Acoustics - Attenuation of Sound During Propagation Outdoors, Part 2: General Method of Calculation", International Organisation for Standardisation 1996

ISO 9613-2 is a downwind propagation model. Where conditions less favourable to sound propagation occur, such as when the assessment locations are crosswind or upwind of the proposed development, the sound levels would be expected to be less and the downwind predictions presented here would be regarded as conservative.

3.2 *Assessment*

An assessment in accordance with BS 4142: 2014 would typically be undertaken in order to determine the acoustic impact of the proposed development. This approach is consistent with the guidance provided in the National Policy Statements published by DECC for this type of development. BS 4142: 2014 lends itself well to an assessment in accordance with NPPF, NPSE and NPPG as it allows the level of impact to be ascertained.

Whilst BS 4142: 2014 would normally be used, it states that absolute levels might be more relevant than the margin above background in circumstances where the background sound levels are low, which is expected to be the case at this site due to its rural location.

The predicted sound levels due to the proposed development shall therefore be assessed against the limits recommended by the WHO Guidelines for Community Noise and the WHO Night Noise Guidelines. If 15 dB attenuation through a partly open window is assumed, the outdoor limits recommended by the WHO Community Noise Guidelines translate into indoor sound levels of 35 dB L_{Aeq} during the day and 30 dB L_{Aeq} at night. These are consistent with the indoor ambient sound levels that BS 8233: 2014 recommends aren't exceeded at dwellings for sleeping or daytime resting.

4.0 ASSESSMENT

Details of the properties included in the assessment are shown in Table 2.

Table 2 - Locations of Nearby Properties

House ID	X	Y
H1	301076	512966
H2	300974	512947
H3	301292	513060

The main sources of sound within the proposed development are the cooling fans for the inverters housed within the three Power Conversion System (PCS) units, air conditioning for the Energy Storage System (ESS) units and the transformers. The three ESS units are expected to be continuously charging and discharging. If there are any rest periods for the transformers or PCS units these are likely to be infrequent and the Heating Ventilation and Air Conditioning systems (HVAC) will still be functioning. There are 24 EnerOne cubes per ESS unit.

Acoustic emission data for the proposed equipment is detailed in Table 3. The data corresponds to the maximum acoustic emission for each device as advised by the manufacturer. Predictions based on this data therefore represent the worst case and the noise levels would be expected to be less when the site isn't operating at maximum capacity.

Table 3 - Acoustic Emission Data

Equipment	Sound Pressure Level at 1m, dB L_{Aeq}
PCS unit (inverter & transformer)	71
EnerOne cube at 25˚C	71
EnerOne cube at 15˚C	67

There is an existing 4 m bund on the western, southern and northern boundaries of the site which reduces the sound levels at the nearest properties. Predicted sound levels due to the proposed extension with this mitigation measure in place are detailed in Table 4 for daytime periods and Table 5 for night-time periods. The predicted cumulative sound levels are also shown. The existing scheme is assumed to be operating up to its conditioned limit of 35 dB L_{Aeq} at the nearest property.

Modelling the scheme at its maximum acoustic emission during the night is overly conservative as the need for cooling would be less due to the lower ambient temperature. Separate day and night predicted noise levels are therefore shown corresponding to ambient temperatures of 25˚C during the day and 15˚C at night.

Table 4 - Predicted Sound Levels - Day

House ID	Sound Level due to Extension, dB L_{Aeq}	Cumulative Sound Level, dB L_{Aeq}
H1	43	43
H2	36	38
H3	36	37

Table 5 - Predicted Sound Levels - Night

House ID	Sound Level due to Extension, dB L_{Aeq}	Cumulative Sound Level, dB L_{Aeq}
H1	39	40
H2	33	35
H3	33	34

The margin between the cumulative predicted sound level and the limits recommended by WHO guidance are shown in Table 6 with a negative margin indicating that the criteria are met. The smallest margins occur at H1. The limits recommended by the WHO Guidelines for Community Noise are met by margins of 7 dB(A) during the day and 5 dB(A) at night at this location. The limit recommended by the WHO Night Noise Guidelines is met by a margin of 0 dB(A), noting that this is a conservative assessment as the maximum predicted sound level due to the proposed development is being compared to an annual average limit.

Table 6 - WHO Assessment Results

House ID	CNG Day Margin, dB	CNG Night Margin, dB	NNG Margin, dB
H1	-7	-5	0
H2	-12	-10	-5
H3	-13	-11	-6

Illustrative sound footprints for the proposed development showing the predicted sound level for day and night-time periods are provided in Figures 1 & 2 (Appendix B). A level of conservatism, in the form of propagation model settings which are expected to result in predicted sound levels greater than those experienced for the majority of the time in practice, has been built into the assessment to compensate for the potential impact of uncertainty.

5.0 CONCLUSIONS

An assessment of the acoustic impact of the proposed extension to Cleator energy storage project has been undertaken. The results show that relevant limits would be met during both day and night-time periods in the cumulative scenario with the existing site.

APPENDIX A - EXPERIENCE AND QUALIFICATIONS

Author:

Name	Andrew Birchby
Experience	Acoustic Specialist, Renewable Energy Systems, 2017-Present Senior Acoustic Analyst, Renewable Energy Systems, 2014-2016 Acoustic Analyst, Renewable Energy Systems, 2012-2014 Technical Analyst, Renewable Energy Systems, 2006-2012
Qualifications	MIOA, Member of the Institute of Acoustics MSc Environmental Governance, Manchester University IOA Postgraduate Diploma in Acoustics and Noise Control MEng Systems Engineering, Loughborough University

Checker/Approver:

Name	Dr Jeremy Bass
Experience	Head of Specialist Services/Senior Technical Manager, Renewable Energy Systems, 2000-Present Technical Analyst/Senior Technical Analyst, Renewable Energy Systems, 1990-2000 Foreign Exchange Researcher, Mechanical Engineering Laboratory, Tsukuba, Japan, 1989-1990 Research Associate, Energy Research Unit, Rutherford Appleton Laboratory, 1986-1989
Qualifications	MIOA, Member of the Institute of Acoustics MInstP, Member of the Institute of Physics PhD, The Potential of Combined Heat & Power, Wind Power & Load Management for Cost Reduction in Small Electricity Supply Systems, Department of Applied Physics, University of Strathclyde BSc Physics, University of Durham

APPENDIX B - FIGURES

Figure 1 - Predicted Sound Footprint - Day

The L_{Aeq} descriptor has been used

Grid intervals at 1km

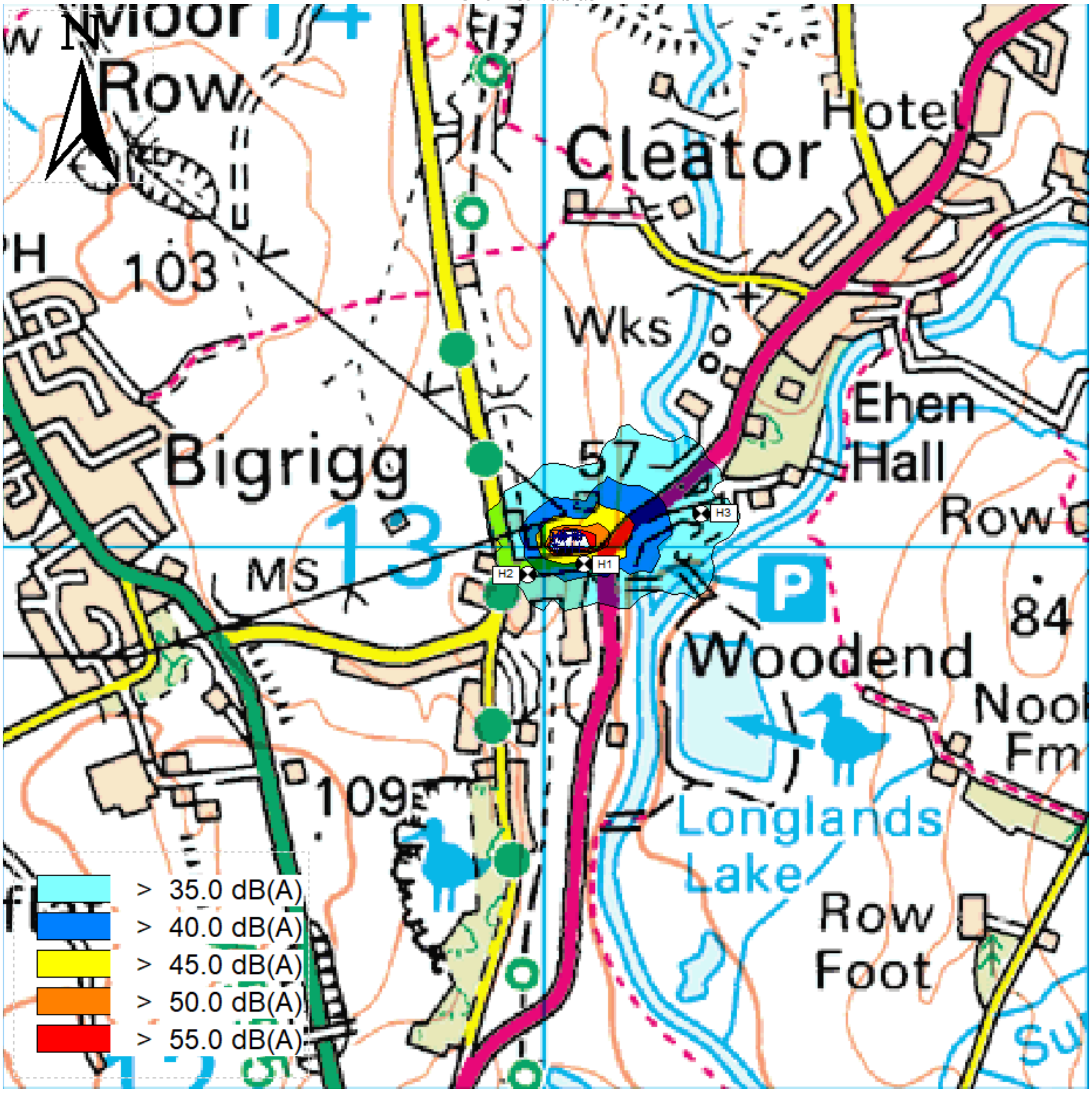

Figure 2 – Predicted Sound Footprint - Night

The L_{Aeq} descriptor has been used

Grid intervals at 1km