East Anglia ONE North and East Anglia TWO Offshore Windfarms

Clarification Note

Noise and Vibration Assessment

Applicants: East Anglia ONE North Limited and East Anglia TWO Limited
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Author: Royal HaskoningDHV

Applicable to East Anglia ONE North and East Anglia TWO

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Glossary of Acronyms

AIS	Air-Insultated Switchgear
AJA	Adrian James Acoustic Limited
APP	Application document
BS	British Standard
DCO	Development Consent Order
EHO	Environmental Health Officer
EIA	Environmental Impact Assessment
ES	Environmental Statement
ESC	East Suffolk Council
ETG	Expert Topic Group
GIS	Gas-Insulated Switchgear
HDD	Horizontal Directional Drill
Hz	Hertz
IEMA	Institute of Environmental Management and Assessment
ISO	International Organization for Standardization
kHz	Kilohertz
NPPF	National Planning Policy Framework
NSIP	Nationally Significant Infrastructure Project
OAEL	Observed Adverse Effect Level
PINS	Planning Inspectorate
PRoW	Public Right of Way
SLM	Sound Level Meter
SOAEL	Significant Observed Adverse Effect Level
SoCG	Statement of Common Ground
UKAS	United Kingdom Accreditation Service

Glossary of Terminology

Applicants	East Anglia TWO Limited / East Anglia ONE North Limited.
Cable sealing end compound	A compound which allows the safe transition of cables between the overhead lines and underground cables which connect to the National Grid substation.
Cable sealing end (with circuit breaker) compound	A compound (which includes a circuit breaker) which allows the safe transition of cables between the overhead lines and underground cables which connect to the National Grid substation.
East Anglia ONE North project	The proposed project consisting of up to 67 wind turbines, up to four offshore electrical platforms, up to one construction, operation and maintenance platform, inter-array cables, platform link cables, up to one operational meteorological mast, up to two offshore export cables, fibre optic cables, landfall infrastructure, onshore cables and ducts, onshore substation, and National Grid infrastructure.
East Anglia TWO project	The proposed project consisting of up to 75 wind turbines, up to four offshore electrical platforms, up to one construction, operation and maintenance platform, inter-array cables, platform link cables, up to one operational meteorological mast, up to two offshore export cables, fibre optic cables, landfall infrastructure, onshore cables and ducts, onshore substation, and National Grid infrastructure.
Horizontal directional drilling (HDD)	A method of cable installation where the cable is drilled beneath a feature without the need for trenching.
Landfall	The area (from Mean Low Water Springs) where the offshore export cables would make contact with land, and connect to the onshore cables.
National Grid infrastructure	A National Grid substation, cable sealing end compounds, cable sealing end (with circuit breaker) compound, underground cabling and National Grid overhead line realignment works to facilitate connection to the national electricity grid, all of which will be consented as part of the proposed East Anglia TWO / East Anglia ONE North project Development Consent Order but will be National Grid owned assets.
National Grid substation	The substation (including all of the electrical equipment within it) necessary to connect the electricity generated by the proposed East Anglia TWO / East Anglia ONE North project to the national electricity grid which will be owned by National Grid but is being consented as part of the proposed East Anglia TWO / East Anglia ONE North project Development Consent Order.
Onshore cable corridor	The corridor within which the onshore cable route will be located.
Onshore cable route	This is the construction swathe within the onshore cable corridor which would contain onshore cables as well as temporary ground required for construction which includes cable trenches, haul road and spoil storage areas.
Onshore substation	The East Anglia TWO / East Anglia ONE North substation and all of the electrical equipment within the onshore substation and connecting to the National Grid infrastructure.
Onshore substation location	The proposed location of the onshore substation for the proposed East Anglia TWO / East Anglia ONE North project.

1 Introduction

1. This clarification note has been prepared by East Anglia TWO Limited and East Anglia ONE North Limited (the Applicants) to clarify aspects of the East Anglia TWO project and East Anglia ONE North project (the Projects) Development Consent Order (DCO) applications (the Applications).

2. This clarification note relates to noise and vibration matters and addresses queries raised during the preparation of the Statement of Common Ground (SoCG) with East Suffolk Council and Suffolk County Council (the Councils) and Adrian James Acoustics Limited (AJA), who have been commissioned by East Suffolk Council to review the noise and vibration assessments included in the Applications. It also addresses comments on the Applications made by the Councils within their respective Relevant Representations (RR-002 and RR-007).

3. For ease of reference, this note has been structured to set out the different elements of the assessment (i.e. baseline noise survey, the construction phase assessment and the operation phase assessment) presented within ***Chapter 25 Noise and Vibration*** (APP-073) and addresses each matter in turn within individual sections of this document.

4. This document is applicable to both the East Anglia ONE North and East Anglia TWO DCO Applications, and therefore is endorsed with the yellow and blue icon used to identify materially identical documentation in accordance with the Examining Authority's procedural decisions on document management of 23rd December 2019 (PD-004). Whilst this document has been submitted to both Examinations, if it is read for one project submission there is no need to read it for the other project submission.

2 Baseline Survey

2.1 Monitoring Equipment and Survey Practice

5. The Applicants have noted a request from the Councils for clarification on the monitoring equipment used within the unattended baseline noise monitoring survey and the experience and competency of survey personnel.

6. Details on the baseline noise monitoring survey practice are set out in ***Section 25.5.1*** in ***Chapter 25 Noise and Vibration*** (APP-073). Baseline noise surveys were conducted in accordance with BS4142:2014+A1:2019 and BS7445:2003 *Description and measurement of environmental noise*. The methodology adopted was agreed with relevant stakeholders, including the Councils, during Expert Topic Group (ETG) meetings prior to the fieldwork being undertaken.

2.1.1 Instrumentation

7. Two models of Sound Level Meter (SLM) were used in the baseline noise monitoring: Rion NP-42 and Brűel & Kjær (B&K) Type 2250. All devices used in the baseline noise monitoring were fully calibrated prior to the survey, with both models traceable to UKAS standards and satisfying the requirements of BS EN 61672-1:2013 for a 'Class 1' SLM. The Rion NL-42 SLMs are all owned by Royal HaskoningDHV, whose experienced acousticians deployed and operated the devices. The B&K Type 2250 SLMs were hired for the duration of the monitoring campaign and were again deployed and operated by Royal HaskoningDHV specialists.

8. Calibration certificates for each of the SLMs used in the baseline noise monitoring survey are provided in ***Appendix A***.

9. Calibration of the full measurement chain was undertaken for each SLM in the field immediately prior to and following the survey period within the field. Prior to commencing the survey, the microphone of each SLM was tested using a B&K Sound Calibrator Type 4231 with a set frequency of 1000Hz (1 kHZ) and 94dB SPL. Where required, individual SLM readings were corrected to correspond with the sound calibrator such that the SLMs were standardised for the beginning of the survey. A specification sheet of the B&K Sound Calibrator Type 4231 is provided in ***Appendix B***.

10. On completion of the survey, the B&K Sound Calibrator Type 4231 was placed over each SLM microphone again and any drift detected (over the survey period) was recorded. ***Paragraph 149, Chapter 25 Noise and Vibration*** (APP-073) confirms that no significant deviation (drift) in the calibration level was observed over the duration of the survey. The significance of the drift was determined in line with Section 6 Part 1 of the BS4142:2014+A1:2019 guidance which states:

Where the difference between the initial calibration value, any subsequent calibration check, and a final calibration check on completion of measurements exceeds 0.5 dB, treat with caution the results of measurements obtained for any period to which this relates.

11. As such, no drift of greater than 0.5dB was detected in any of the SLM measurements over the survey period.

2.1.2 Personnel

12. A team comprising two experienced acoustic consultants employed by Royal HaskoningDHV, an independent engineering and environmental consultancy, were assigned to undertake the baseline noise monitoring for the Projects. Details of the surveyors comprising the baseline noise monitoring team, along with their competencies, are provided in ***Table 1.***

Table 1 Noise baseline monitoring survey team personnel

Surveyor	Qualification(s)	Years of experience	Background
Dean Curtis	Institute of Acoustics, Diploma in Acoustics and Noise Control (2010) Institute of Acoustics, Certificate of Competence in Environmental Noise Measurement (2001) University of Derby, BSc (Hons) Environmental Studies and Geography (1998)	20 years (12 years in undertaking noise assessment)	Dean is a noise and acoustic specialist with 12 years' experience conducting noise assessments for industrial, transportation, commercial and residential developments, with a total of 20 years' experience in the environmental sector. He has previously worked in Air Quality (source) emission monitoring and acoustic consultancy roles. Dean's area of expertise covers: • Acoustic Calculations; • Environmental Impact Assessment (Noise and Vibration); • Environmental Noise Surveys; • Industrial Noise; • Industrial Permitting/Licensing' • Planning and Building Control Regime' • Project Management' • Noise modelling software.

Surveyor	Qualification(s)	Years of experience	Background
Nick Fry	Institute of Sound and Vibration Research at Southampton University, BEng (Hons) Acoustical Engineering	7 years	• Acoustic Mitigation Design; • Environmental Noise and Vibration Assessments; • Noise Mapping; • Architectural Acoustic Assessments; and • Vibration Monitoring and Control.

13. The baseline noise survey was undertaken by a competent and experienced team of surveyors adhering to the latest guidance available at the time of monitoring and using reliable instrumentation.

2.2 Baseline Noise Monitoring Methodology

14. The Applicants have noted a request from the Councils for clarification regarding the integration period adopted within the baseline noise monitoring for the Projects onshore substation and National Grid substation locations (i.e. 15-minute versus 5-minute) and provided their response on this matter within this section.

15. The baseline noise monitoring methodology at the Projects onshore substation and National Grid substation locations is described within ***Section 25.3.5, Appendix 25.3*** (APP-524). A full description of the derivation of the representative background noise levels at each receptor is detailed within ***Appendix 25.3*** (APP-524).

16. At a SoCG meeting (7th February 2020) the Councils queried the rationale for using a 5-minute noise measurement integration period for the baseline monitoring. The Applicants hereby confirm their interpretation of the BS4142:2014+A1:2019, which stipulates that 15 minutes is the minimum **measurement time interval** (not integration period) over which measurements should be taken to produce a representative picture of an existing noise environment. The guidance does not specify the measurement integration period, and the Applicants position is that adopting a 5-minute integration period gives a more reliable and representative picture of the existing noise environment.

17. ***Table 2*** shows additional analysis undertaken on the measured baseline monitoring data to demonstrate that the 5-minute integration period does not make a material difference.

Table 2 Baseline Noise Data Analysis – L90 5-minute period versus L90 15-minute period

Receptor	L_{90} Modal Value			L_{90} Average Value		
	15-minute period	5-minute period	Difference (dB)	15-minute period	5-minute period	Difference (dB)
SSR1	33.0	33.0	0.0	29.5	29.5	0.0
SSR2	27.0	27.0	0.0	31.2	31.5	0.3
SSR3	30.0	24.0	-6.0	25.9	26.1	0.2
SSR4	29.0	29.0	0.0	27.6	27.9	0.3
SSR5*	29.0	29.0	0.0	27.6	27.9	0.3
SSR6	29.0	29.0	0.0	27.6	27.9	0.3
SSR7	35.0	35.0	0.0	35.6	35.6	0.0
SSR8	29.0	29.0	0.0	27.6	27.9	0.3
SSR9	19.0	18.0	-1.0	24.2	24.2	0.0
SSR10	37.0	37.0	0.0	31.3	31.3	0.0
SSR11	32.0	32.0	0.0	29.8	29.8	0.0
SSR12	29.0	29.0	0.0	25.9	25.9	0.0
MAX	37.0	37.0	0.0	35.6	35.6	0.0
MIN	19.0	18.0	-1.0	24.2	24.2	0.0
Average	29.8	29.3	-0.5	28.7	28.8	0.1

*** Baseline noise monitoring location SSR5, as opposed to the location of SSR5 NEW.**

18. The Applicants note the difference in L_{90} modal value (dB) between the analysed 15-minute period and 5-minute period background noise data for SSR3 (-6.0dB). Within the same dataset, three times more data were included in the analysis of background noise data at a 5-minute period (768 samples compared with 256). The difference in the modal background noise level is considered to be a result of the additional number of data points included within the analysis. It is considered that the use of the 5-minute integrated noise data (as logged) in the analysis of the background noise level is more appropriate because this provides the as-measured background noise with no effect from further averaging (which would be the case in analysis of the 15-minute period data). The Applicants consider this a precautionary approach.

19. Detailed statistical analysis, provided within ***Appendix 25.3*** (APP-524), was undertaken on an individual basis at each receptor in order to determine an appropriate, representative background noise level.

20. The integration period of 5-minutes adopted for the baseline noise monitoring at the Projects onshore substation and National Grid substation locations corresponds with the integration period specified within the wording of Requirement 26 of the ***draft DCO*** (APP-024), but the Applicants note that this differs from the integration period stated within BS4142:2014+A1:2019, $L_{Aeq,15min}$ at night. The guidance within BS4142:2014+A1:2019 states:

> *"8.1.3 Ensure that the measurement time interval is sufficient to obtain a representative value of the background sound level for the period of interest. This should comprise continuous measurements of normally not less than 15 min intervals, which can be contiguous or disaggregated."* and
>
> *"**3.6 measurement time interval, Tm***
> *total time over which measurements are taken*
> *NOTE This may consist of the sum of a number of non-contiguous, short-term measurement time intervals."*

21. The departure from the integration period specified within BS4142:2014+A1:2019 is common in establishing background noise levels and it is accepted within the industry that an integration period can be shorter than the interval period so long as the integration period(s) add up to the requisite interval period. Noise emanating from the Projects' onshore substations and National Grid infrastructure will be constant in nature with no temporal variation, so the $L_{Aeq,5min}$ will be identical to the $L_{Aeq,15min}$. The Applicants therefore consider that the decision to adopt a 5-minute integration period is robust and justified.

2.3 Data Omissions

22. The Applicants have noted a request from the Councils for clarification on omitted data within the baseline noise survey data analysis, as well as the weather conditions at the time of the surveys.

23. The baseline noise monitoring methodology at the Projects' onshore substations and National Grid substation, which includes reference to data omissions, is described within ***Section 25.3.5*** of ***Appendix 25.3*** (APP-524).

24. Within the analysis of data collected during the baseline noise monitoring surveys, certain data was not included due to one of the following reasons:

- Data was unable to be collected during the survey; or
- Collected data was omitted during the analysis on the grounds it was invalid.

25. The primary reason for data being unable to be collected during the survey related to surveyors being unable to access survey locations at receptors SSR4, SSR6 and SSR8 at any time.

26. All data that was collected during the baseline survey was analysed. However, some data were omitted during the subsequent analysis on the grounds it was affected by noise interference due to adverse weather conditions. As per section

6.4 of BS4142:2014+A1:2019 and section 5.4.3.3 of BS7445-2:1991, the guidance recommends:

- *'[exercising] caution when making measurements in poor weather* conditions *such as wind speeds greater than 5m/s';* and
- That it may be convenient to undertake surveys during meteorological conditions of *'no heavy precipitation'.*

27. As part of the baseline noise survey two Davis weather stations were deployed to collect weather data in the vicinity of the receptor locations during the survey period. One weather station was located at SSR7 for the initial week of the survey period before being relocated to SSR1. This approach was considered to collect weather data representative of receptors SSR1, SSR2, SSR3, SSR5, SSR7, SSR9 and SSR12. The other weather station was located at SSR10 and SSR11 during their respective survey periods. The weather data collected from this weather station is therefore considered to be representative of receptors SSR10 and SSR11. Weather measurements were collected every 15 minutes and during data analysis were synchronised with the 5-minute integration period of the SLMs. Weather data collected during the baseline noise survey period is provided in ***Appendix C***.

28. Following the conclusion of the survey period, the collected weather data was correlated with the noise measurement data recorded by the SLMs. Where windspeeds registered above 5m/s or precipitation was recorded the noise level data recorded for the associated timeframe was removed from the dataset and not included in the subsequent analysis. Within the analysis, the number of data omitted from the dataset for each receptor is represented by the disparity between 'samples collected' and the 'total possible samples' within the measurement analysis tables presented within ***Table A25.3.8*** to ***Table A25.3.16*** (see APP-524). For all noise monitoring locations, the maximum proportion of samples omitted and therefore discounted from further analysis was 12% (i.e. a minimum proportion of 88% of total samples collected were analysed).

29. The methodology adopted for omitting specific data from analysis was conducted in line with the approach detailed within the guidance BS7445-1:2003 and BS4142:2014+A1:2019. On this basis the Applicants' position is that the approach of handling the survey data is appropriate and the subsequent analysis/modelling provides a robust and representative output for use in the noise impact assessment.

30. The total baseline noise monitoring duration was undertaken continuously for 15 days between 26th June and 12th July 2018. The Applicants consider the measurements taken within this survey period more than sufficient to capture the

representative existing environment with respect to background noise levels irrespective of the omitted data.

31. To provide the Councils with the opportunity to review the baseline noise monitoring survey measurements, the raw dataset for the baseline noise survey monitoring has been provided to the Councils via an email sent on 2nd October 2020.

32. The Applicants note a response from the Councils regarding the baseline noise survey monitoring raw dataset included within Appendix 4 to the Councils joint Local Impact Report (LIR) (REP1-132). The Applicants will submit a full response to the LIR to the Examinations at Deadline 3.

3 Construction Phase Assessment

3.1 Methodology and Criteria

33. The Applicants have noted a request from the Councils for clarification on and justification of the use of the BS5228-1:2009+A1:2014 ABC method for assessment of construction noise.

34. The Applicants maintain that the BS5228-1:2009+A1:2014 ABC Method is the appropriate guidance to use for the assessment of significance of construction phase noise impacts. BS5228-1:2009+A1:2014 is the nationally adopted methodology for construction noise assessments and does not recommend that alternative methods are used to define impacts when construction works are undertaken in otherwise quiet areas. Furthermore, the Overarching National Policy Statement (NPS) for Energy (EN-1) recommends the use of BS5228 for '*the prediction, assessment and management of construction noise*' (Department of Energy and Climate Change, 2011a).

35. Consultation undertaken with the statutory authorities, including the Councils, regarding noise and vibration is presented within ***Appendix 25.1 Noise and Vibration Consultation Responses*** (APP-522). Agreement on the assessment approach and methodology with the Noise and Vibration ETG, including the ESC Environmental Health Officer (EHO), was reached in April 2018 as per ***Paragraph 41*** of ***Chapter 25 Noise and Vibration*** (APP-073).

36. At the ETG meeting with ESC in May 2019 the EHO agreed that construction noise levels were assessed correctly due to the short-term nature of the impact, i.e. a balance needs to be drawn between longer construction duration or short-term higher noise levels. Working hours were also discussed in this meeting.

3.2 Noise Modelling Methodology

3.2.1 Representation of Source Data in the Construction Noise Model

37. The Applicants have noted a request from the Councils for clarification on and justification of the use of point/line sources within the construction noise model.

38. Within the construction noise model, plant was represented as a point source at the edge of the Order Limits at the closest distance to the identified noise sensitive receptors. Details of the number and type of plant, as well as the configuration of the Order limits, were based on data provided by the Project's engineers. As such, scenarios for construction modelling were devised based on this data.

39. Representing plant as point sources for the entire duration of the construction phase in the closest proximity to receptors is a reasonable worst-case scenario

as the modelled noise is modelled as a constant noise at that location. The use of point sources in this instance gives a higher, more conservative predicted noise level than a moving point line source as no account is taken of the reduction in time that the source would be close to the receptor. This is a reasonable and robust way of predicting construction phase noise.

3.2.2 Quantity of Source Data in the Construction Noise Model

40. The Applicants have noted a request from the Councils for clarification on plant numbers, justification of plant numbers and the definition of 'worst-case' period.

41. Construction noise modelling scenarios were devised on indicative numbers of plant, using detail (Gantt charts) provided by the Project engineers and cover a sufficient variation in plant (i.e. piling rigs, heavy excavation plant etc.) on the basis that there is variation across the study area. The Applicants' position is that this approach is comprehensive, and the Applicants consider that the noise modelling is robust.

3.2.3 Uncertainty and Assumptions within the Construction Noise Model

42. The Applicants have noted a request from the Councils for clarification on the uncertainties, challenges and assumptions made within the construction noise model.

43. Discussions have been held with the Applicants consultants (Royal HaskoningDHV) and East Suffolk Council's consultants (AJA) on this matter and the outcome shall be captured within the SoCG with the Councils.

3.2.4 Noise Prediction Methodology

44. The Applicants have noted a request from the Councils for clarification on the SoundPLAN noise prediction methodology and a justification for not using ISO 9613-2:1996.

45. The BS5228-1:2009+A1:2014 noise prediction methodology was adopted for the construction noise modelling and is considered the industry accepted standard methodology to use for predicting construction noise. Adopting the construction noise prediction methodology in BS5228-1:2009+A1:2014 represented a consistent approach to assessing significance of construction noise impacts.

46. ISO 9613-2:1996 was not used by the Applicants in calculating construction noise propagation. Whilst both BS5228-1:2009+A1:2014 and ISO 9613-2:1996 calculation methodologies take into account distance attenuation, barriers and ground absorption, ISO 9613-2:1996 also takes into account air absorption, topographical screening effects and light downwind conditions from source to receptor.

47. For the reasons stated above the Applicants consider that the BS5228-1:2009+A1:2014 calculation methodology represents a more robust worst-case calculation of construction noise propagation, and that using the ISO 9613-2:1996 calculation methodology would provide less precautionary noise levels than that of BS5228-1:2009+A1:2014.

3.2.5 Construction Phasing/Programming of Works

48. The Applicants have noted a request from the Councils for clarification on the construction phasing/programming of works adopted for the construction noise modelling.

49. ***Chapter 6 Project Description*** (APP-054) provides details of the construction programme and methodologies to be adopted and should be read in conjunction with ***Chapter 25 Noise and Vibration*** (APP-073). The information regarding the indicative construction programme contained within ***Chapter 6*** (APP-054) was used to inform the construction noise modelling scenarios. The Applicants accept that the construction programme sub-phases adopted for the noise methodology are not presented within ***Chapter 6 Project Description*** (APP-054), which may cause some confusion when reading the noise impact assessment. To address this, the Applicants have provided a separate clarification note on how the more detailed construction programme sub-phases presented within ***Appendix 25.4 Construction Phase Assessment*** (APP-525) were defined - see ***Appendix D***.

3.2.6 Noise Mitigation and Best Practice

50. The Applicants have noted a request from the Councils for clarification on construction noise mitigation and best practice.

51. The construction noise predictions generated by the construction noise model and presented within the ES do not take into account any screening (as discussed at the SoCG meeting 07/02/20), however the use of screening is recommended as a Best Practice mitigation measure within ***Chapter 25 Noise and Vibration*** (APP-073). The Applicants clarify that the construction noise model does not take into account any topsoil bunds that may be created along the onshore cable route (within the onshore cable corridor) and elsewhere (see ***Chapter 6 Project Description*** (APP-054)). The use of localised screening and the additional screening possibly provided by the topsoil bunds are likely, in themselves, to provide upwards of 5dB of attenuation (see BS5228-1:2009+A1:2014 statement on the likely attenuation provided by screens). Additional Best Practice measures such as careful placement of equipment could provide further attenuation. The noise impact assessment undertaken and presented within ***Chapter 25*** (APP-073) does not take into account noise attenuation (i.e. ≥5dB as per BS5228-1:2009+A1:2014) provided by the use of localised screening or possible bunds and is therefore conservative in nature.

3.3 Night-time Construction Noise

52. The Applicants have noted a request from the Councils for clarification on and justification of the Applicants' position in relation to construction phase night-time noise.

53. ***Chapter 25 Noise and Vibration*** (APP-073) assesses working at certain locations during the evening and night-time based on the likely activities associated with each of the onshore works, as provided by the Projects' engineers. The definitions of evening time and night time align with those stated within BS5228:2009+A1:2014, as per ***Table 25.9*** (APP-073). These are as follows:

- Evening (and weekend) times encompass:
  - 1900 – 2300 on weekdays;
  - 1300 – 2300 on Saturdays; and
  - 0700 – 2300 on Sundays.
- Night time is defined as between 2300 – 0700 every day.

54. Within the ES, an assessment of evening and night-time construction noise was undertaken for Horizontal Directional Drill (HDD) works at the landfall (being the activity considered to have the greatest amount of night-time works by virtue of the nature of the HDD construction works). Predicted evening and night time noise levels at the landfall are shown to be lower than the BS5228-1:2009+A1:2014 thresholds for evening and night time noise levels, as shown in ***Table 3*** (reproduced from ***Table 25.26*** (APP-073)). The assessment concluded that evening and night-time noise impacts at the landfall would be negligible for all receptors identified (LFR1, LFR2, LFR3 and LFR4, as shown in ***Figure 25.2*** (APP-305)).

Table 3 Predicted Noise Impacts at the Landfall during Months 1 to 24 (reproduced from Table 25.26 of the ES (APP-073))

Receptor Identifier	BS5228 Reference Period	BS5228 Derived Threshold Category dBA	Maximum Predicted Receptor Noise level dBA	Worst Cast Impact Magnitude	Worst Case Impact Significance
LFR1	Daytime	A (65)	50.3	No Impact	Negligible
	Evening	A (55)	40.4	No Impact	Negligible
	Night	A (50)	40.7	No Impact	Negligible
LFR2	Daytime	A (65)	49.9	No Impact	Negligible

Receptor Identifier	BS5228 Reference Period	BS5228 Derived Threshold Category dBA	Maximum Predicted Receptor Noise level dBA	Worst Cast Impact Magnitude	Worst Case Impact Significance
	Evening	A (55)	38.8	No Impact	Negligible
	Night	A (45)	38.9	No Impact	Negligible
LFR3	Daytime	A (65)	47.7	No Impact	Negligible
	Evening	A (55)	35.7	No Impact	Negligible
	Night	A (45)	35.8	No Impact	Negligible
LFR4	Daytime	A (65)	49.1	No Impact	Negligible
	Evening	A (55)	35.3	No Impact	Negligible
	Night	A (45)	35.7	No Impact	Negligible

55. The Applicants have committed to undertaking construction works within day time hours where practicable. Construction hours are secured though Requirement 23 and Requirement 24 of the ***draft DCO*** (APP-024), which stipulate that construction hours are between 0700 hours and 1900 hours Monday to Friday and 0700 hours and 1300 hours on Saturdays, with no activity on Sundays or bank holidays, except for essential activities including, but not limited to, those activities listed within Requirement 23(2) and Requirement 24(2) of the ***draft DCO*** (APP-024).

56. Prior to undertaking an essential activity including, but not limited to, those activities listed within Requirement 23(2) and Requirement 24(2), the time and duration of such works must be approved in writing by the relevant planning authority (except in the case of any activity necessary in an emergency where there is a risk to persons or property). Any such works must then be carried out within the approved timeframe.

4 Operation Phase Assessment

4.1 Operational Noise Limits

57. The Applicants have noted a request from the Councils for clarification on and justification of the Applicants' position in relation to a rating level of background noise +5dBA.

58. Requirement 26 and Requirement 27 of the ***draft DCO*** (APP-024) limit the emission of operational noise to 34dB LA_{eq} (5 minutes) at the noise sensitive receptors SSR2 and SSR5 NEW, representing an operational noise limit of the background noise level of the onshore substation site +5dB at any time at a free field location immediately adjacent to two specified noise sensitive receptors.

59. It is understood that the Councils' default position is to request that all projects proposed within their administrative area aim for operational noise emissions of 5dB below background noise levels (i.e. -5dB). The Applicants note that the Councils' position of requiring industrial sources to be 5dB or more below the background sound level is not supported by national planning policy, British Standards or either Councils' policies. The Applicants therefore disagree with the Councils' position and maintain that the proposed rating level limit of 34dB LA_{eq} (5 minutes) is appropriate and fully in accordance with current legislation, national policy guidance and industry guidance (BS4142:2014+A1:2019) and that this position is justified. The proposed rating level limit represents a proportionate and appropriate approach to controlling operational noise levels, which meets the relevant industry standards, tallies with other comparable NSIPs and accords with the recommendations in paragraph 5.11.6 of the Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change, 2011a).

60. The commitment in relation to operational noise limits presented within ***Chapter 25 Noise and Vibration*** (APP-073) adheres to BS4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound*, which sets out the rating levels to assess the likely effects from sound of an industrial or commercial nature on people using amenity space outside a dwelling or premises used for residential purposes upon which the sound is incident. BS4142:2014+A1:2019 states that, when the rating level is compared to the background sound level:

> *"A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context"*.

61. The Applicants have had regard to policy at a local, regional, national and international level whilst undertaking the Environmental Impact Assessment (EIA), as described in full in ***Chapter 3 Policy and Legislative Context*** (APP-051) and ***section 25.4.1.1*** to ***section 25.4.1.3*** (APP-073).

62. At this stage, the exact design specifications of the Projects' onshore substations and National Grid infrastructure are not known, with a decision on Air-Insulated or Gas-Insulated technology (for the National Grid substation) and other final design parameters to be made post-consent during the detailed design stage. These unknown factors, together with the Projects' dependency on introducing inherently noise-emitting electrical substations for the whole scheme to deliver, and the Applicants' need to develop an efficient and cost-effective design, mean the Applicants are unable to meet the Councils wish for a -5dB background operational noise rating limit.

63. However, the Applicants have committed to mitigating operational noise emissions from the Projects' onshore substations and National Grid infrastructure to no greater than 34dBA L_{Aeq} (5 minutes) at any time at the defined noise sensitive receptors (SSR2 and SSR5 NEW). This represents no more than 5dB noise level greater than the measured representative background noise level (assessed as 29dB in ***Section 25.3.5*** of ***Appendix 25.3 Baseline Noise Survey*** (APP-524)), determined from the guidance within BS4142:2014+A1:2019. It is the Applicants' position that this represents a proportionate and appropriate approach to controlling operational noise levels, which meets the relevant industry standards and in accordance with the Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change, 2011a) and the NPS for Renewable Energy Infrastructure (EN-3) (Department of Energy and Climate Change, 2011b).

4.2 Noise Model Source Data

64. The Applicants have noted a request from the Councils for clarification on the source of noise data used within the operational noise model.

4.2.1 Projects' Onshore Substations

65. Information on noise sources included within the operation phase noise model is presented in ***Table 4***. The inventory of plant is based upon the Applicants' requirements for the Projects' onshore substations. All noise sources and noise emission data was received from the Projects' engineers and its suitability for modelling was reviewed by the Applicants' noise consultants in the context of their experience on similar projects. ***Table 4*** has been amended from ***Chapter 25, Table 25.30*** to remove reference to the noise source 'Main Transformer (without enclosures)' given these were not included within the model and the transformers are provided 'with enclosures'.

Table 4 Source noise data for the operational onshore substation (amended from Chapter 25, Table 25.30 of the ES (APP-073))

Noise source	Units	Sound Power Level dB(A)	Sound Pressure Level dB(A)	Drawing Item	Height (m)
Main Transformer (with enclosures)	2	-	58 at 1m from enclosure	1	2.5
Main Transformer (Forced Cooling System)	2	81 per unit	-	2	1.5
Shunt Reactor	2	-	62 at 1m from enclosure	3	2.5
STATCOM Air core reactor	6	81/phase	-	4	2
STATCOM Filter Air Core Reactor	6	70/phase 75/3 phase	-	5	At three heights: 2, 4 and 6
STATCOM Filter Capacitor Bank	6	81/phase	-	6	At three heights: 2, 4 and 6
Aux. Transformer	2	67 per unit	-	7	2
Ail Coolers	10	80 per unit	-	8	2
STATCOM High Voltage Alternating Current (HVAC) Units	4	79 per unit	-	9	2
Harmonic Filters	2 banks of 3	82 per bank	-	n/a	18
Extractors (GIS building)	15		-	10	-

4.2.2 National Grid Infrastructure

66. At the time of undertaking the assessment presented within ***Chapter 25 Noise and Vibration*** (APP-073), the Applicants were informed by National Grid that (see ***Table 25.2*** and ***section 25.3.2.1*** of the ES (APP-073)):

> *"The equipment required at the National Grid substation for operation does not include components which would contribute any significant noise contributions in the area. Normal operational noise levels are expected to be minimal as there are no transformers on the site. Diesel generators and circuit breakers would be activated only during maintenance or during a system fault."*

67. The Applicants are undertaking updated noise modelling for the Projects' revised onshore substation arrangements, which will include the relevant National Grid infrastructure. This will be submitted to the Examinations at Deadline 3.

4.3 Uncertainty Within the Operational Noise Assessment

68. The Applicants have noted a request from the Councils for clarification regarding uncertainty within the operational noise assessment.

69. The Applicants note that uncertainty 'budget' is not a requirement of BS4142:2014+A1:2019 and is not a standard inclusion within noise assessments undertaken for NSIPs.

70. In the event a ±3dB uncertainty budget is applied to the model results as suggested by the Councils, it is considered that there is an equal possibility of the results being overestimated as they are underestimated. As such, the Applicants consider that the operational noise predictions presented within the ES and assessment conclusions are robust irrespective of the application of this uncertainty budget. This position applies to all noise predictions presented within the ES that have been calculated by the noise model generated using SoundPLAN.

71. Furthermore, given that the ***draft DCO*** (APP-023) requires the Applicants to achieve a 34dB LAeq (5 min) at any time at a free field location immediately adjacent to two specified noise sensitive receptors, the Applicant must incorporate any uncertainty 'budget' within its detailed design in order to be compliant with the DCO.

4.4 Rating Noise Level Corrections

4.4.1 Position on Tonality

72. The Applicants have noted a request from the Councils for justification of the Applicants' position on tonality with regard to operational noise.

73. As per the operational noise assessment of the Projects alone (***Section 25.5*** of ***Appendix 25.5*** (APP-526)) and the Projects together (***Section 25.6*** of ***Appendix 25.5*** (APP-526)), no corrections to the modelled operational noise levels with respect to tonality have been applied. The Applicants assessed that no tonal acoustic features are present within the available noise data for the onshore substation and National Grid infrastructure, in accordance with clause 9.2 of BS4142:2014+A1:2019. This assessment was based upon octave band data for each piece of onshore substation plant where available.

74. Given that a rating level of 34dB $LA_{eq\ (5\ minutes)}$ for Work No. 30 is specified within Requirement 26 of the ***draft DCO*** (APP-024), which accounts for tonality, the application or omission of tonality corrections within the operational noise modelling exercise is considered inconsequential. In accordance with BS4142:2014+A1:2019, the rating level includes the specific sound plus any acoustic characteristic corrections. Therefore, Requirement 26 of the ***draft DCO*** (APP-023) will be inclusive of any acoustic characteristic correction.

75. This matter has been discussed extensively with the Councils during the SoCG process, but no evidence of data analysis from the Councils has been received that clarifies or justifies their use of octave band data in their conclusion that tonality is present within the operational noise.

4.4.2 Position on Impulsivity

76. The Applicants have noted a request from the Councils for clarification on 'impulsive' noise sources.

77. At the time of undertaking the assessment presented within ***Chapter 25 Noise and Vibration*** (APP-073), the Applicants were informed by National Grid that (see ***Table 25.2*** and ***section 25.3.2.1*** of the ES (APP-073)):

> *"The equipment required at the National Grid substation for operation does not include components which would contribute any significant noise contributions in the area. Normal operational noise levels are expected to be minimal as there are no transformers on the site. Diesel generators and circuit breakers would be activated only during maintenance or during a system fault."*

78. Since submission of the Applications, the Applicants have received noise data for specific pieces of plant comprising the National Grid substation including circuit breakers and relays. Further modelling of the National Grid substation is underway and will be provided at Deadline 3.

4.4.3 Position on 'Other Characteristics'

79. The Applicants have noted a request from the Councils for clarification on the use of acoustic corrections for 'other characteristics'.

80. It remains the position of the Applicants that the operational onshore substation noise, in compliance with the rating level stipulated in Requirement 26 and Requirement 27 of the ***draft DCO*** (APP-024), and National Grid infrastructure noise would not attract the +3dB correction for other characteristics. In accordance with BS4142:2014+A1:2019, to correct for 'other characteristics' a specific characteristic of the noise must be identified; the correction does not relate to noise being audible alone. Therefore, it was not deemed necessary to add any other acoustic characteristic penalty to the rating level.

4.4.4 Position on Available Mitigation

81. The Applicants have noted a request from the Councils for clarification on available operation phase noise mitigation measures.

82. The position of the Applicants regarding the approach to the necessity of consideration of acoustic feature corrections was discussed at a SoCG meeting (07/02/20). It was not acknowledged by the Councils that full consideration, based on all available data at the time, had been given to this matter within the ES.

83. The detailed design process is an iterative process involving many equipment suppliers. As the detail design of the onshore substations evolves there will be extensive liaison with the Projects' engineers and supply chain to discuss and advise on the optimal substation layout, equipment to be installed and mitigation measures to be incorporated in order to achieve compliance with the noise limits set out in the ***draft DCO*** (APP-023).

84. Numerous post consent detailed design studies for other substation sites where noise emissions have been mitigated successfully have been undertaken, therefore supporting the position that effective post-consent mitigation measures are available.

5 Other Matters

5.1 Consideration of Alternatives

85. The Applicants have noted the Councils' request within the SoCG process for further clarification on the decision-making process regarding the selection of Gas Insulated or Air Insulated technologies for the National Grid substation and on the methodology to assess the operational noise emissions of the different options.

86. National Grid Electricity Transmission (the owner of the transmission assets England and Wales) is subject to a duty under section 9(2)(a) of the Electricity Act 1989 *"to develop and maintain an efficient, co-ordinated and economical system of electricity transmission."* National Grid Electricity Transmission has internal design, design review and design approval processes which it must follow in developing the National Grid infrastructure to meet the requirements of the Projects in order to demonstrate to Ofgem that it is fulfilling its obligations under the Electricity Act 1989. It is too early in this design process for National Grid to commit to one technology over another given the regulatory environment within which National Grid Electricity Transmission must operate.

87. To ensure flexibility for National Grid to select the most efficient, co-ordinated and economical connection solution for the Projects, the Applicants have sought consent for either Air Insulated Switchgear (AIS) or Gas Insulated Switchgear (GIS) as the design basis for the National Grid substation. In doing so, the Applicants have followed the Rochdale Envelope approach to the EIA, assessing the worst case scenario within the noise assessments presented within the ES (as stated in ***Chapter 25 Noise and Vibration*** (APP-073)).

References

Department of Energy and Climate Change (2011a) Overarching National Policy Statement for Energy (EN-1). Available online at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47854/1938-overarching-nps-for-energy-en1.pdf

Department of Energy and Climate Change (2011b) National Policy Statement for Renewable Energy Infrastructure (EN-3). Available online at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/37048/1940-nps-renewable-energy-en3.pdf

IEMA (2014) Guidelines for Environmental Noise Impact Assessment. Institute of Environmental Management

Appendix A: Baseline Noise Monitoring Survey Equipment Calibration Certificates

MEASUREMENT SYSTEMS

CERTIFICATE OF CONFORMANCE

Date of Issue	**27 October 2016**
Customer	**Haskoning DHV UK Limited**
Certificate Number	**CONF101614**

	Manufacturer	**Type**	**Serial Number**
Sound Level Meter	Rion	NL-52	00864984
Preamplifier	Rion	NH-25	65111
Microphone	Rion	UC-59	09914

This is to certify that the instrument was tested and calibrated at the Manufacturer's factory according to their specification and that the product satisfied all the relevant requirements of the following Standards:

IEC 61672-1:2002 Class 1.
IEC 61672-1:2013 Class 1.

The instrument also received a functional check by ANV Measurement Systems prior to despatch in the UK, in accordance with our standard procedures.

Signed Amrat C Patel Position. Date. 27 October 2016

A Patel Lab Manager

BEAUFORT COURT, 17 ROEBUCK WAY, MILTON KEYNES, MK5 8HL
☎ 01908 642846 🖷 01908 642814
✉ info@noise-and-vibration.co.uk 💻 www.noise-and-vibration.co.uk

MEASUREMENT SYSTEMS

CERTIFICATE OF CONFORMANCE

Date of Issue	**27 October 2016**
Customer	**Haskoning DHV UK Limited**
Certificate Number	**CONF101613**

	Manufacturer	**Type**	**Serial Number**
Sound Level Meter	Rion	NL-52	00864983
Preamplifier	Rion	NH-25	65110
Microphone	Rion	UC-59	09913

This is to certify that the instrument was tested and calibrated at the Manufacturer's factory according to their specification and that the product satisfied all the relevant requirements of the following Standards:

IEC 61672-1:2002 Class 1.
IEC 61672-1:2013 Class 1.

The instrument also received a functional check by ANV Measurement Systems prior to despatch in the UK, in accordance with our standard procedures.

Sig[redacted] Position. Date. 27 October 2016

A Patel Lab Manager

BEAUFORT COURT, 17 ROEBUCK WAY, MILTON KEYNES, MK5 8HL
☎ 01908 642846 🖷 01908 642814
✉ info@noise-and-vibration.co.uk 💻 www.noise-and-vibration.co.uk

MEASUREMENT SYSTEMS

CERTIFICATE OF CONFORMANCE

Date of Issue	**27 October 2016**
Customer	**Haskoning DHV UK Limited**
Certificate Number	**CONF101612**

	Manufacturer	**Type**	**Serial Number**
Sound Level Meter	Rion	NL-52	00864982
Preamplifier	Rion	NH-25	65109
Microphone	Rion	UC-59	09912

This is to certify that the instrument was tested and calibrated at the Manufacturer's factory according to their specification and that the product satisfied all the relevant requirements of the following Standards:

IEC 61672-1:2002 Class 1.
IEC 61672-1:2013 Class 1.

The instrument also received a functional check by ANV Measurement Systems prior to despatch in the UK, in accordance with our standard procedures.

Sign[redacted] Position. Date. 27 October 2016

A Patel Lab Manager

BEAUFORT COURT, 17 ROEBUCK WAY, MILTON KEYNES, MK5 8HL
☎ 01908 642846 🖷 01908 642814
✉ info@noise-and-vibration.co.uk 💻 www.noise-and-vibration.co.uk

CERTIFICATE OF CALIBRATION

ISSUED BY	Gracey & Associates	BSI CERTIFICATE	FS 25913
DATE OF ISSUE	17 January 2018	CERTIFICATE NUMBER	2018-0106
DATE OF CALIBRATION	16 January 2018		
CALIBRATION INTERVAL	12 months		PAGE 1 OF 1

Gracey & Associates
Barn Court Shelton Road
Upper Dean PE28 0NQ
Tel: 01234 708835
Fax: 01234 252332
www.gracey.com

TEST ENGINEER	APPROVING SIGNATORY
Jamie Bishop	Greg Rice

Equipment **B&K 2250 A, s/n: 2449854**
Description Analyser without Signal Recording, Bruel & Kjaer UK Limited

Customer Gracey & Associates

Standards
BS EN 60651 Class 1
BS EN 60804 Class 1

Conditions

Atmospheric Pressure	98.7 kPa
Temperature	20.2 °C
Relative Humidity	42.0 %

Calibration Reference Sources

Equipment	S/N	Last Cal	Equipment	S/N	Last Cal
Druck DPI 141	479	29-Oct-15	HP 34401	3146A16728	25-Jan-17
Vaisala HMP23	S2430007	04-Nov-15			

Notes

We certify that the above product was duly tested and found to be within the specification at the points measured (except where indicated). Measurements are traceable to UKAS reference sources from the UK National Physical Laboratory. Where no national or international standards exist, traceability is to standards maintained by the manufacturer. Our Quality Management System has been assessed to comply with BS EN ISO 9001:2008 - BSI Certificate number FS 25913. Tests were carried out in environmental conditions controlled to the extent appropriate to the instrument's specification. All relevant test certificates are available for inspection.
The uncertainties are for a confidence probability of not less than 95%.

CERTIFICATE OF CALIBRATION

ISSUED BY	Gracey & Associates	BSI CERTIFICATE	FS 25913
DATE OF ISSUE	17 January 2018	CERTIFICATE NUMBER	2018-0109
DATE OF CALIBRATION	16 January 2018		
CALIBRATION INTERVAL	12 months		PAGE 1 OF 1

Gracey & Associates
Barn Court Shelton Road
Upper Dean PE28 0NQ
Tel: 01234 708835
Fax: 01234 252332
www.gracey.com

TEST ENGINEER	APPROVING SIGNATORY
Jamie Bishop	Greg Rice

Equipment **B&K 2250 G4, s/n: 3006738**
Description G4 Analyser, Bruel & Kjaer UK Limited

Customer Gracey & Associates

Standards
BS EN 60651 Class 1
BS EN 60804 Class 1

Conditions

Atmospheric Pressure	98.7 kPa
Temperature	20.2 °C
Relative Humidity	42.0 %

Calibration Reference Sources

Equipment	S/N	Last Cal	Equipment	S/N	Last Cal
Druck DPI 141	479	29-Oct-15	HP 34401	3146A16728	25-Jan-17
Vaisala HMP23	S2430007	04-Nov-15			

Notes

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The uncertainties are for a confidence probability of not less than 95%.

CERTIFICATE OF CALIBRATION

ISSUED BY	Gracey & Associates	BSI CERTIFICATE	FS 25913
DATE OF ISSUE	17 January 2018	CERTIFICATE NUMBER	2018-0110
DATE OF CALIBRATION	16 January 2018		
CALIBRATION INTERVAL	12 months		PAGE 1 OF 1

Gracey & Associates
Barn Court Shelton Road
Upper Dean PE28 0NQ
Tel: 01234 708835
Fax: 01234 252332
www.gracey.com

TEST ENGINEER	APPROVING SIGNATORY
Jamie Bishop	Greg Rice

Equipment **B&K 2250 G4, s/n: 3007155**
Description G4 Analyser, Bruel & Kjaer UK Limited

Customer Gracey & Associates

Standards
BS EN 60651 Class 1
BS EN 60804 Class 1

Conditions

Atmospheric Pressure	98.7 kPa
Temperature	20.2 °C
Relative Humidity	42.0 %

Calibration Reference Sources

Equipment	S/N	Last Cal	Equipment	S/N	Last Cal
Druck DPI 141	479	29-Oct-15	HP 34401	3146A16728	25-Jan-17
Vaisala HMP23	S2430007	04-Nov-15			

Notes

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CERTIFICATE OF CALIBRATION

ISSUED BY	Gracey & Associates	BSI CERTIFICATE	FS 25913
DATE OF ISSUE	17 January 2018	CERTIFICATE NUMBER	2018-0113
DATE OF CALIBRATION	04 January 2018		
CALIBRATION INTERVAL	12 months		PAGE 1 OF 2

Gracey & Associates
Barn Court Shelton Road
Upper Dean PE28 0NQ
Tel: 01234 708835
Fax: 01234 252332
www.gracey.com

TEST ENGINEER	APPROVING SIGNATORY
Jamie Bishop	Greg Rice

Equipment **B&K 4189, s/n: 2441062**
Description Microphone - 1/2" FF 0V, Bruel & Kjaer UK Limited

Customer Gracey & Associates

Standards
BS EN 61672 Class 1

Conditions

Atmospheric Pressure	98.0 kPa
Temperature	20.1 °C
Relative Humidity	43.8 %

Calibration Data

Sensitivity -25.40 dB

Calibration Reference Sources

Equipment	S/N	Last Cal	Equipment	S/N	Last Cal
B&K 4134 L	1935995	12-Mar-15	Druck DPI 141	479	29-Oct-15
HP 34401	3146A16728	25-Jan-17	Nor 1253	22456	12-Mar-15
Stanford DS36	33213	02-Nov-15	Vaisala HMP23	S2430007	04-Nov-15

Notes

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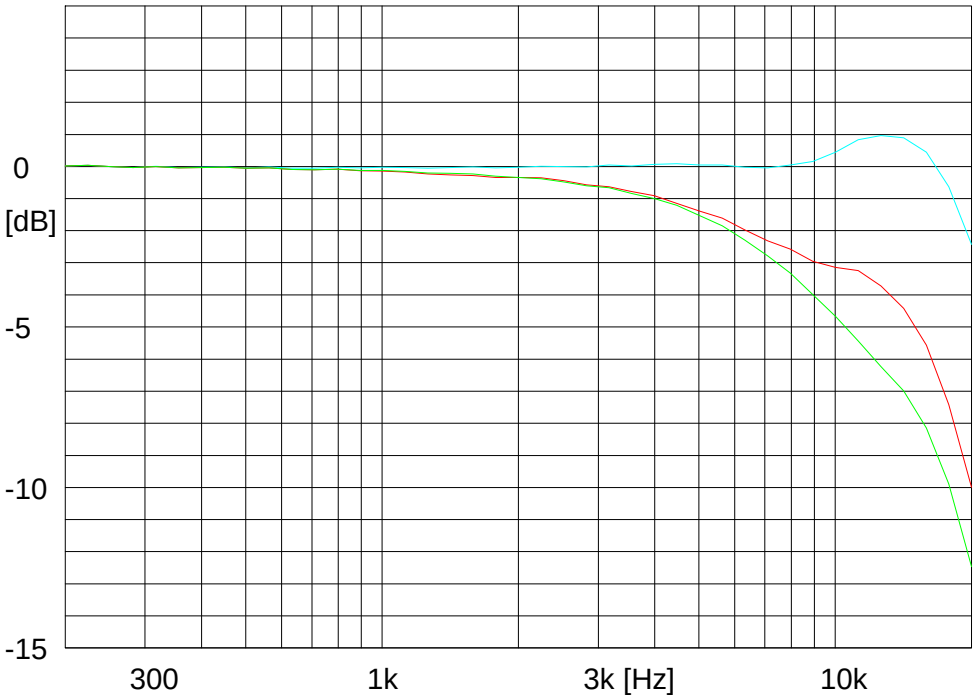
The uncertainties are for a confidence probability of not less than 95%.

Microphone Calibration Certificate



Bruel and Kjaer
Type: 4189

Serial no: 2441062

Sensitivity: 53.5 mV/Pa
-25.4 dB re. 1 V/Pa

Date: 04/01/2018

Signature:

Measurement conditions:

Polarisation voltage:	0.0 V
Pressure:	98.03 kPa
Temperature:	20.1 ℃
Relative humidity:	43.8 %RH

Results are normalised to the reference conditions.

Free field response
Diffuse field response
Pressure (Actuator) response

Gracey & Associates
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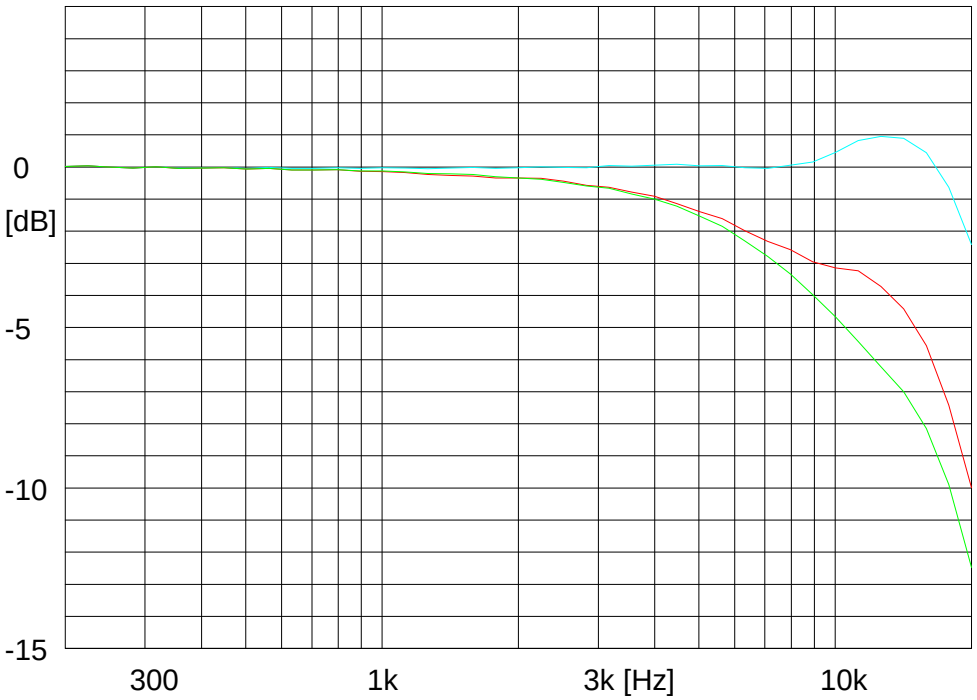
Microphone Calibration Certificate



Bruel and Kjaer
Type: 4189

Serial no: 2441062

Sensitivity: 53.5 mV/Pa
-25.4 dB re. 1 V/Pa

Date: 04/01/2018

Signature:

Measurement conditions:

Polarisation voltage:	0.0 V
Pressure:	98.03 kPa
Temperature:	20.1 ℃
Relative humidity:	43.8 %RH

Results are normalised to the reference conditions.

Free field response
Diffuse field response
Pressure (Actuator) response

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Comment:

CERTIFICATE OF CALIBRATION

ISSUED BY	Gracey & Associates	BSI CERTIFICATE	FS 25913
DATE OF ISSUE	17 January 2018	CERTIFICATE NUMBER	2018-0116
DATE OF CALIBRATION	04 January 2018		
CALIBRATION INTERVAL	12 months		PAGE 1 OF 2

Gracey & Associates
Barn Court Shelton Road
Upper Dean PE28 0NQ
Tel: 01234 708835
Fax: 01234 252332
www.gracey.com

TEST ENGINEER	APPROVING SIGNATORY
Jamie Bishop	Greg Rice

Equipment **B&K 4189, s/n: 2441194**
Description Microphone - 1/2" FF 0V, Bruel & Kjaer UK Limited

Customer Gracey & Associates

Standards
BS EN 61672 Class 1

Conditions

Atmospheric Pressure	98.0 kPa
Temperature	20.1 °C
Relative Humidity	43.8 %

Calibration Data

Sensitivity -25.10 dB

Calibration Reference Sources

Equipment	S/N	Last Cal	Equipment	S/N	Last Cal
B&K 4134 L	1935995	12-Mar-15	Druck DPI 141	479	29-Oct-15
HP 34401	3146A16728	25-Jan-17	Nor 1253	22456	12-Mar-15
Stanford DS36	33213	02-Nov-15	Vaisala HMP23	S2430007	04-Nov-15

Notes

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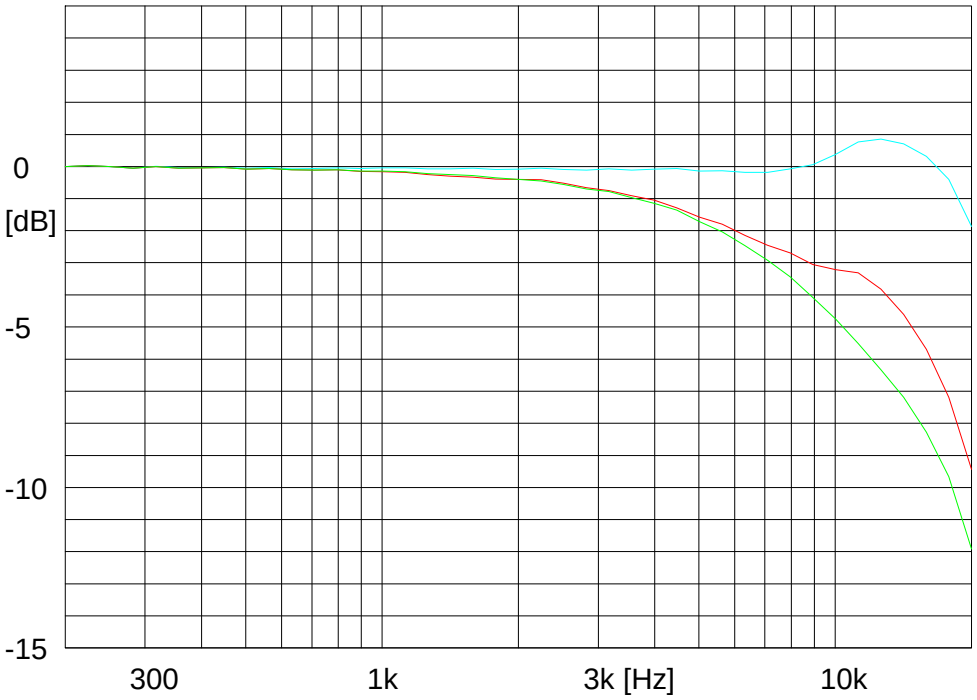
The uncertainties are for a confidence probability of not less than 95%.

Microphone Calibration Certificate



Bruel and Kjaer
Type: 4189

Serial no: 2441194

Sensitivity: 55.8 mV/Pa
-25.1 dB re. 1 V/Pa

Date: 04/01/2018

Signature:

Measurement conditions:

Polarisation voltage:	0.0 V
Pressure:	98.00 kPa
Temperature:	20.1 ℃
Relative humidity:	43.8 %RH

Results are normalised to the reference conditions.

Free field response
Diffuse field response
Pressure (Actuator) response

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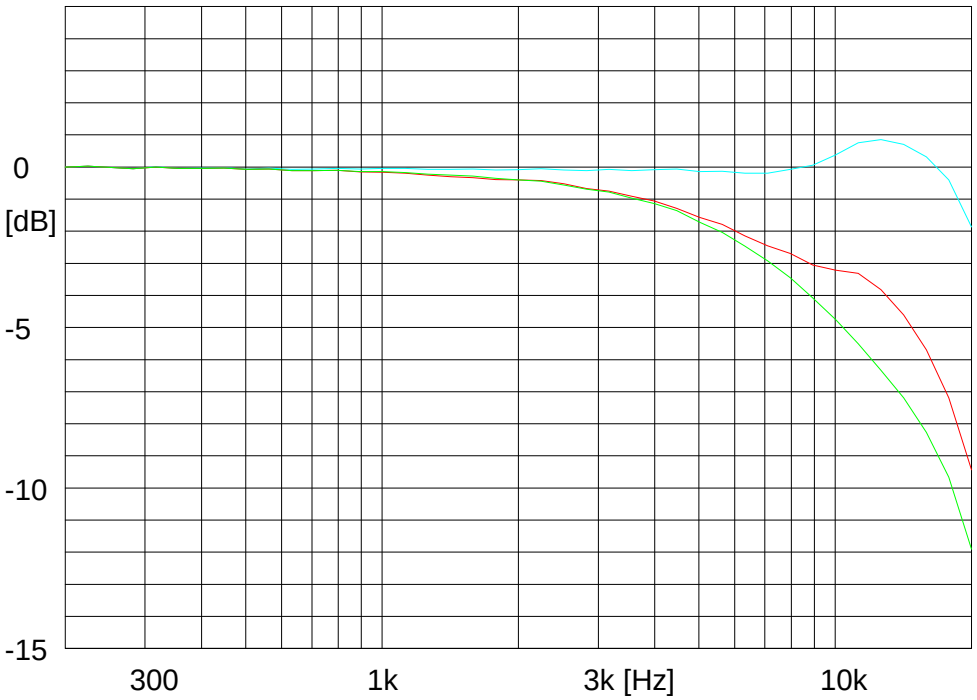
Microphone Calibration Certificate



Bruel and Kjaer
Type: 4189

Serial no: 2441194

Sensitivity: 55.8 mV/Pa
-25.1 dB re. 1 V/Pa

Date: 04/01/2018

Signature:

Measurement conditions:

Polarisation voltage:	0.0 V
Pressure:	98.00 kPa
Temperature:	20.1 ℃
Relative humidity:	43.8 %RH

Results are normalised to the reference conditions.

Free field response
Diffuse field response
Pressure (Actuator) response

Gracey & Associates
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Comment:

CERTIFICATE OF CALIBRATION

ISSUED BY	Gracey & Associates	BSI CERTIFICATE	FS 25913
DATE OF ISSUE	17 January 2018	CERTIFICATE NUMBER	2018-0117
DATE OF CALIBRATION	04 January 2018		
CALIBRATION INTERVAL	12 months		PAGE 1 OF 2

Gracey & Associates
Barn Court Shelton Road
Upper Dean PE28 0NQ
Tel: 01234 708835
Fax: 01234 252332
www.gracey.com

TEST ENGINEER	APPROVING SIGNATORY
Jamie Bishop	Greg Rice

Equipment **B&K 4189, s/n: 2643143**
Description Microphone - 1/2" FF 0V, Bruel & Kjaer UK Limited

Customer Gracey & Associates

Standards
BS EN 61672 Class 1

Conditions

Atmospheric Pressure	98.0 kPa
Temperature	20.1 °C
Relative Humidity	43.8 %

Calibration Data

Sensitivity -25.10 dB

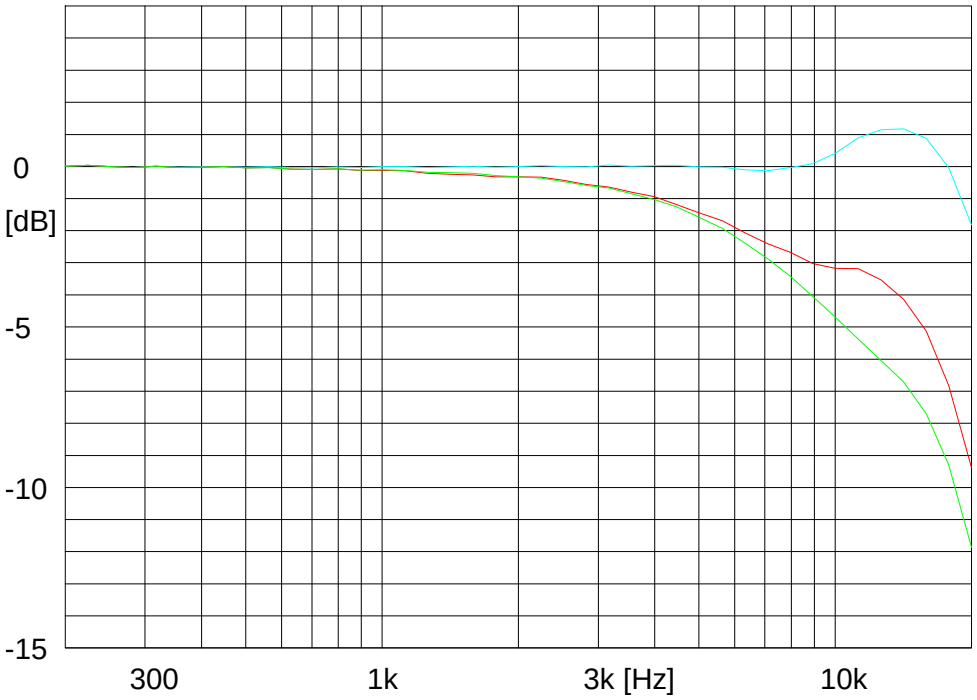
Calibration Reference Sources

Equipment	S/N	Last Cal	Equipment	S/N	Last Cal
B&K 4134 L	1935995	12-Mar-15	Druck DPI 141	479	29-Oct-15
HP 34401	3146A16728	25-Jan-17	Nor 1253	22456	12-Mar-15
Stanford DS36	33213	02-Nov-15	Vaisala HMP23	S2430007	04-Nov-15

Notes

We certify that the above product was duly tested and found to be within the specification at the points measured (except where indicated). Measurements are traceable to UKAS reference sources from the UK National Physical Laboratory. Where no national or international standards exist, traceability is to standards maintained by the manufacturer. Our Quality Management System has been assessed to comply with BS EN ISO 9001:2008 - BSI Certificate number FS 25913. Tests were carried out in environmental conditions controlled to the extent appropriate to the instrument's specification. All relevant test certificates are available for inspection.
The uncertainties are for a confidence probability of not less than 95%.

Microphone Calibration Certificate



Bruel and Kjaer
Type: 4189

Serial no: 2643143

Sensitivity: 55.6 mV/Pa
-25.1 dB re. 1 V/Pa

Date: 04/01/2018

Signature:

Measurement conditions:

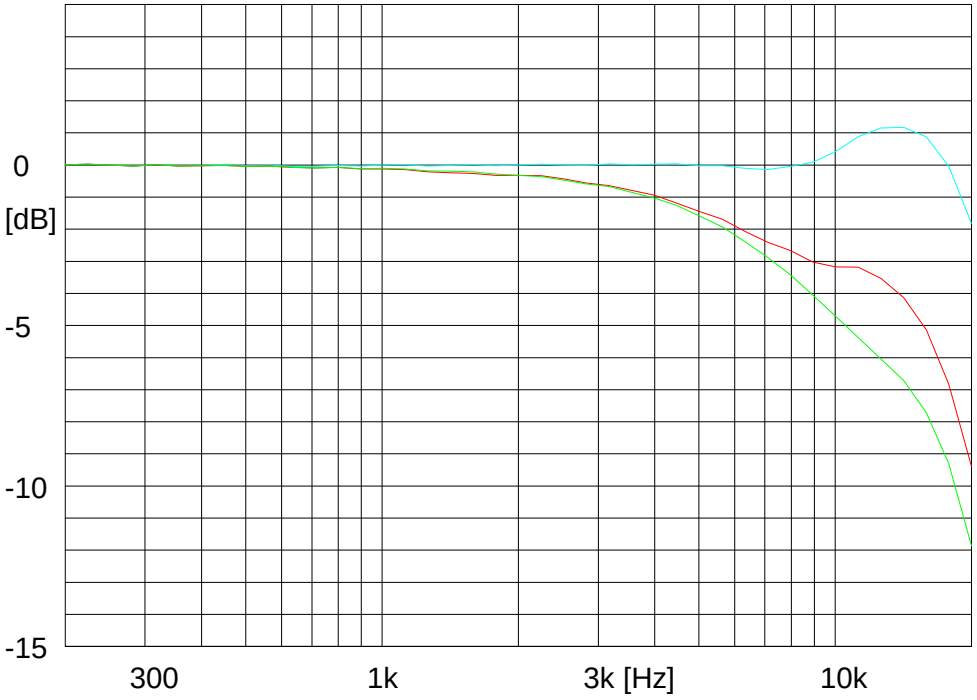
Polarisation voltage:	0.0 V
Pressure:	98.00 kPa
Temperature:	20.1 ℃
Relative humidity:	43.8 %RH

Results are normalised to the reference conditions.

Free field response
Diffuse field response
Pressure (Actuator) response

Gracey & Associates
www.gracey.com

Microphone Calibration Certificate



Bruel and Kjaer
Type: 4189

Serial no: 2643143

Sensitivity: 55.6 mV/Pa
-25.1 dB re. 1 V/Pa

Date: 04/01/2018

Signature:

Measurement conditions:

Polarisation voltage:	0.0 V
Pressure:	98.00 kPa
Temperature:	20.1 ℃
Relative humidity:	43.8 %RH

Results are normalised to the reference conditions.

Free field response
Diffuse field response
Pressure (Actuator) response

Gracey & Associates
www.gracey.com

Comment:

CERTIFICATE OF CONFORMANCE

ISSUED BY	Gracey & Associates	BSI CERTIFICATE	FS 25913
DATE OF ISSUE	17 January 2018	CERTIFICATE NUMBER	2018-0120
DATE OF CALIBRATION	16 January 2018		
CALIBRATION INTERVAL	12 months		PAGE 1 OF 1

Gracey & Associates
Barn Court Shelton Road
Upper Dean PE28 0NQ
Tel: 01234 708835
Fax: 01234 252332
www.gracey.com

TEST ENGINEER	APPROVING SIGNATORY
Jamie Bishop	Greg Rice

Equipment **B&K ZC 0032, s/n: 21475**
Description Preamplifier - 2250, Bruel & Kjaer UK Limited

Customer Gracey & Associates

Standards
Manufacturer's Original Specifications

Conditions

Atmospheric Pressure	98.7 kPa
Temperature	20.2 °C
Relative Humidity	42.0 %

Calibration Reference Sources

Equipment	S/N	Last Cal	Equipment	S/N	Last Cal
Druck DPI 141	479	29-Oct-15	HP 34401	3146A16728	25-Jan-17
Vaisala HMP23	S2430007	04-Nov-15			

Notes

We certify that the above product was duly tested and found to be within the specification at the points measured (except where indicated). Measurements are traceable to UKAS reference sources from the UK National Physical Laboratory. Where no national or international standards exist, traceability is to standards maintained by the manufacturer. Our Quality Management System has been assessed to comply with BS EN ISO 9001:2008 - BSI Certificate number FS 25913. Tests were carried out in environmental conditions controlled to the extent appropriate to the instrument's specification. All relevant test certificates are available for inspection.
The uncertainties are for a confidence probability of not less than 95%.

CERTIFICATE OF CONFORMANCE

ISSUED BY	Gracey & Associates	BSI CERTIFICATE	FS 25913
DATE OF ISSUE	17 January 2018	CERTIFICATE NUMBER	2018-0122
DATE OF CALIBRATION	16 January 2018		
CALIBRATION INTERVAL	12 months		PAGE 1 OF 1

Gracey & Associates
Barn Court Shelton Road
Upper Dean PE28 0NQ
Tel: 01234 708835
Fax: 01234 252332
www.gracey.com

TEST ENGINEER	APPROVING SIGNATORY
Jamie Bishop	Greg Rice

Equipment **B&K ZC 0032, s/n: 15063**
Description Preamplifier - 2250, Bruel & Kjaer UK Limited

Customer Gracey & Associates

Standards
Manufacturer's Original Specifications

Conditions

Atmospheric Pressure	98.7 kPa
Temperature	20.2 °C
Relative Humidity	42.0 %

Calibration Reference Sources

Equipment	S/N	Last Cal	Equipment	S/N	Last Cal
Druck DPI 141	479	29-Oct-15	HP 34401	3146A16728	25-Jan-17
Vaisala HMP23	S2430007	04-Nov-15			

Notes

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The uncertainties are for a confidence probability of not less than 95%.

CERTIFICATE OF CONFORMANCE

ISSUED BY	Gracey & Associates	BSI CERTIFICATE	FS 25913
DATE OF ISSUE	17 January 2018	CERTIFICATE NUMBER	2018-0123
DATE OF CALIBRATION	16 January 2018		
CALIBRATION INTERVAL	12 months		PAGE 1 OF 1

Gracey & Associates
Barn Court Shelton Road
Upper Dean PE28 0NQ
Tel: 01234 708835
Fax: 01234 252332
www.gracey.com

TEST ENGINEER	APPROVING SIGNATORY
Jamie Bishop	Greg Rice

Equipment **B&K ZC 0032, s/n: 10917**
Description Preamplifier - 2250, Bruel & Kjaer UK Limited

Customer Gracey & Associates

Standards
Manufacturer's Original Specifications

Conditions

Atmospheric Pressure	98.7 kPa
Temperature	20.2 °C
Relative Humidity	42.0 %

Calibration Reference Sources

Equipment	S/N	Last Cal	Equipment	S/N	Last Cal
Druck DPI 141	479	29-Oct-15	HP 34401	3146A16728	25-Jan-17
Vaisala HMP23	S2430007	04-Nov-15			

Notes

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The uncertainties are for a confidence probability of not less than 95%.

CERTIFICATE OF CALIBRATION

ISSUED BY	Gracey & Associates	BSI CERTIFICATE	FS 25913
DATE OF ISSUE	15 February 2018	CERTIFICATE NUMBER	2018-0166
DATE OF CALIBRATION	08 February 2018		
CALIBRATION INTERVAL	12 months		PAGE 1 OF 2

Gracey & Associates
Barn Court Shelton Road
Upper Dean PE28 0NQ
Tel: 01234 708835
Fax: 01234 252332
www.gracey.com

TEST ENGINEER	APPROVING SIGNATORY
Jamie Bishop	Greg Rice

Equipment **B&K 4231, s/n: 2564312**
Description Calibrator - Acoustic - Class 1, Bruel & Kjaer UK Limited

Customer Gracey & Associates

Standards
BS EN 60942 Class 1

Conditions

Atmospheric Pressure	101.0 kPa
Temperature	20.2 °C
Relative Humidity	34.0 %

Calibration Data

Output Level	94.11 dB
Frequency	999.96 Hz

Calibration Reference Sources

Equipment	S/N	Last Cal	Equipment	S/N	Last Cal
B&K 4134 L	1935995	12-Mar-15	Druck DPI 141	479	29-Oct-15
HP 34401	3146A16728	25-Jan-17	Nor 1253	22456	12-Mar-15
Stanford DS36	33213	02-Nov-15	Vaisala HMP23	S2430007	04-Nov-15

Notes

We certify that the above product was duly tested and found to be within the specification at the points measured (except where indicated). Measurements are traceable to UKAS reference sources from the UK National Physical Laboratory. Where no national or international standards exist, traceability is to standards maintained by the manufacturer. Our Quality Management System has been assessed to comply with BS EN ISO 9001:2008 - BSI Certificate number FS 25913. Tests were carried out in environmental conditions controlled to the extent appropriate to the instrument's specification. All relevant test certificates are available for inspection.
The uncertainties are for a confidence probability of not less than 95%.

Sound Calibrator Certificate

Calibrator: Bruel and Kjaer 4231

Serial no: 2564312

Level: 94.11 dB
Frequency: 999.96 Hz

The stated level is valid at reference conditions.
Frequency stability: 0.00 %

Measured according to IEC 60942.
The stated level is relative to 20µPa.
All results quoted are directly traceable to the National Physical Laboratory, London
with a calculated uncertainty less than 0.10 dB (2×sd).

Reference conditions:
Pressure: 101.325 kPa
Temperature: 23.0 ℃
Relative humidity: 50 %RH

Measurement conditions:
Pressure: 101.04 kPa
Temperature: 20.2 ℃
Relative humidity: 34 % RH

Date: 08/02/2018

Signature:

Sound Calibrator Certificate

Calibrator: Bruel and Kjaer 4231

Serial no: 2564312

Level: 94.11 dB
Frequency: 999.96 Hz

The stated level is valid at reference conditions.
Frequency stability: 0.00 %

Measured according to IEC 60942.
The stated level is relative to 20µPa.
All results quoted are directly traceable to the National Physical Laboratory, London
with a calculated uncertainty less than 0.10 dB (2×sd).

Reference conditions:
Pressure: 101.325 kPa
Temperature: 23.0 ℃
Relative humidity: 50 %RH

Measurement conditions:
Pressure: 101.04 kPa
Temperature: 20.2 ℃
Relative humidity: 34 % RH

Date: 08/02/2018

Signature:

Comment:

CERTIFICATE OF CALIBRATION

ISSUED BY	Gracey & Associates	BSI CERTIFICATE	FS 25913
DATE OF ISSUE	22 June 2018	CERTIFICATE NUMBER	2018-0305
DATE OF CALIBRATION	22 June 2018		
CALIBRATION INTERVAL	12 months		PAGE 1 OF 1

Gracey & Associates
Barn Court Shelton Road
Upper Dean PE28 0NQ
Tel: 01234 708835
Fax: 01234 252332
www.gracey.com

TEST ENGINEER	APPROVING SIGNATORY
Jamie Bishop	Greg Rice

Equipment **B&K 2250 A, s/n: 2488353**
Description Analyser without Signal Recording, Bruel & Kjaer UK Limited

Customer Gracey & Associates

Standards
BS EN 60651 Class 1
BS EN 60804 Class 1

Conditions

Atmospheric Pressure	102.4 kPa
Temperature	24.1 °C
Relative Humidity	39.0 %

Calibration Reference Sources

Equipment	S/N	Last Cal	Equipment	S/N	Last Cal
Druck DPI 141	479	29-Oct-15	HP 34401	3146A16728	25-Jan-17
Vaisala HMP23	S2430007	04-Nov-15			

Notes

We certify that the above product was duly tested and found to be within the specification at the points measured (except where indicated). Measurements are traceable to UKAS reference sources from the UK National Physical Laboratory. Where no national or international standards exist, traceability is to standards maintained by the manufacturer. Our Quality Management System has been assessed to comply with BS EN ISO 9001:2008 - BSI Certificate number FS 25913. Tests were carried out in environmental conditions controlled to the extent appropriate to the instrument's specification. All relevant test certificates are available for inspection.
The uncertainties are for a confidence probability of not less than 95%.

CERTIFICATE OF CALIBRATION

ISSUED BY	Gracey & Associates	BSI CERTIFICATE	FS 25913
DATE OF ISSUE	22 June 2018	CERTIFICATE NUMBER	2018-0306
DATE OF CALIBRATION	20 June 2018		
CALIBRATION INTERVAL	12 months		PAGE 1 OF 2

Gracey & Associates
Barn Court Shelton Road
Upper Dean PE28 0NQ
Tel: 01234 708835
Fax: 01234 252332
www.gracey.com

TEST ENGINEER	APPROVING SIGNATORY
Jamie Bishop	Greg Rice

Equipment **B&K 4189, s/n: 2470185**
Description Microphone - 1/2" FF 0V, Bruel & Kjaer UK Limited

Customer Gracey & Associates

Standards
BS EN 61672 Class 1

Conditions

Atmospheric Pressure	101.2 kPa
Temperature	25.1 °C
Relative Humidity	47.6 %

Calibration Data

Sensitivity -26.10 dB

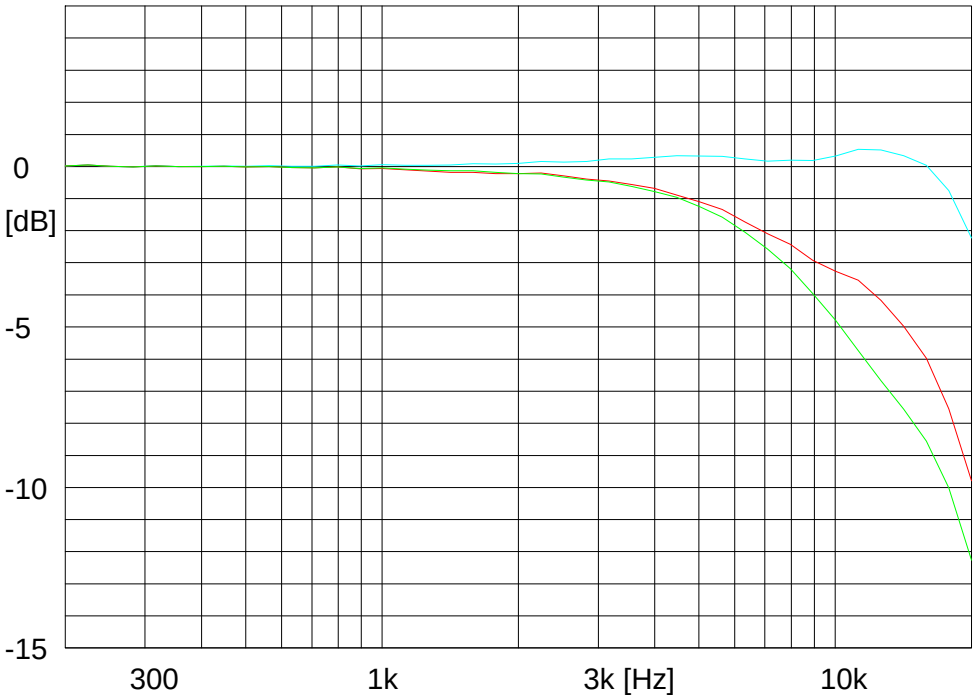
Calibration Reference Sources

Equipment	S/N	Last Cal	Equipment	S/N	Last Cal
B&K 4134 L	1935995	10-Jul-17	Druck DPI 141	479	29-Oct-15
HP 34401	3146A16728	25-Jan-17	Nor 1253	22456	14-Jul-17
Stanford DS36	33213	02-Nov-15	Vaisala HMP23	S2430007	04-Nov-15

Notes

We certify that the above product was duly tested and found to be within the specification at the points measured (except where indicated). Measurements are traceable to UKAS reference sources from the UK National Physical Laboratory. Where no national or international standards exist, traceability is to standards maintained by the manufacturer. Our Quality Management System has been assessed to comply with BS EN ISO 9001:2008 - BSI Certificate number FS 25913. Tests were carried out in environmental conditions controlled to the extent appropriate to the instrument's specification. All relevant test certificates are available for inspection.
The uncertainties are for a confidence probability of not less than 95%.

Microphone Calibration Certificate



Bruel and Kjaer
Type: 4189

Serial no: 2470185

Sensitivity: 49.4 mV/Pa
-26.1 dB re. 1 V/Pa

Date: 20/06/2018

Signature:

Measurement conditions:

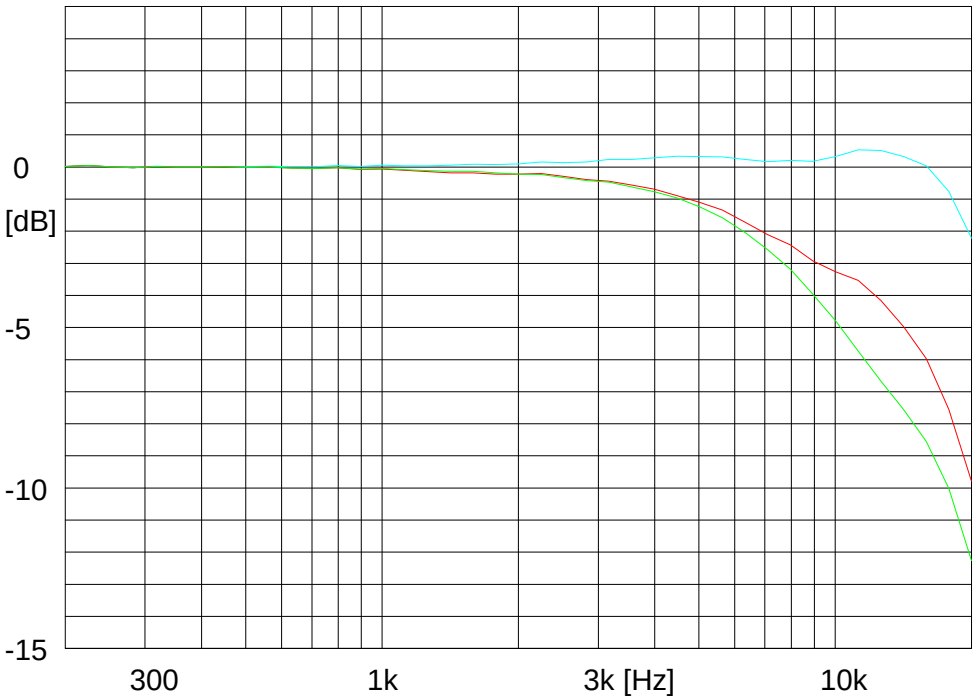
Polarisation voltage:	0.0 V
Pressure:	101.15 kPa
Temperature:	25.1 ℃
Relative humidity:	47.6 %RH

Results are normalised to the reference conditions.

Free field response
Diffuse field response
Pressure (Actuator) response

Gracey & Associates
www.gracey.com

Microphone Calibration Certificate



Bruel and Kjaer
Type: 4189

Serial no: 2470185

Sensitivity: 49.4 mV/Pa
-26.1 dB re. 1 V/Pa

Date: 20/06/2018

Signature:

Measurement conditions:

Polarisation voltage:	0.0 V
Pressure:	101.15 kPa
Temperature:	25.1 ℃
Relative humidity:	47.6 %RH

Results are normalised to the reference conditions.

Free field response
Diffuse field response
Pressure (Actuator) response

Gracey & Associates
www.gracey.com

Comment:

CERTIFICATE OF CONFORMANCE

ISSUED BY	Gracey & Associates	BSI CERTIFICATE	FS 25913
DATE OF ISSUE	22 June 2018	CERTIFICATE NUMBER	2018-0307
DATE OF CALIBRATION	22 June 2018		
CALIBRATION INTERVAL	12 months		PAGE 1 OF 1

Gracey & Associates
Barn Court Shelton Road
Upper Dean PE28 0NQ
Tel: 01234 708835
Fax: 01234 252332
www.gracey.com

TEST ENGINEER	APPROVING SIGNATORY
Jamie Bishop	Greg Rice

Equipment **B&K ZC 0032, s/n: 03024**
Description Preamplifier - 2250, Bruel & Kjaer UK Limited

Customer Gracey & Associates

Standards
Manufacturer's Original Specifications

Conditions

Atmospheric Pressure	102.4 kPa
Temperature	24.1 °C
Relative Humidity	39.0 %

Calibration Reference Sources

Equipment	S/N	Last Cal	Equipment	S/N	Last Cal
Druck DPI 141	479	29-Oct-15	HP 34401	3146A16728	25-Jan-17
Vaisala HMP23	S2430007	04-Nov-15			

Notes

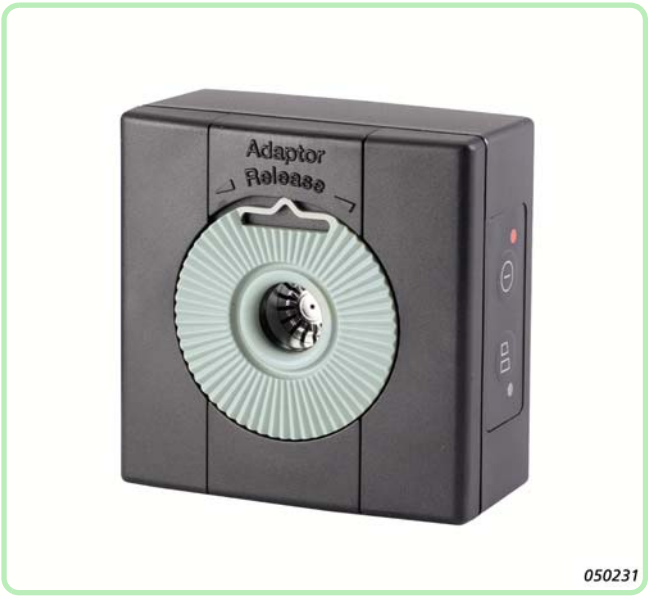
We certify that the above product was duly tested and found to be within the specification at the points measured (except where indicated). Measurements are traceable to UKAS reference sources from the UK National Physical Laboratory. Where no national or international standards exist, traceability is to standards maintained by the manufacturer. Our Quality Management System has been assessed to comply with BS EN ISO 9001:2008 - BSI Certificate number FS 25913. Tests were carried out in environmental conditions controlled to the extent appropriate to the instrument's specification. All relevant test certificates are available for inspection.
The uncertainties are for a confidence probability of not less than 95%.

Appendix B: Sound Level Meter Calibration Device Specification

PRODUCT DATA

Sound Calibrator Type 4231

Sound Calibrator Type 4231 is a handy, portable sound source for calibration of sound level meters and other sound measurement equipment. The calibrator is very robust and stable, and conforms to EN/IEC 60942 (2003) Class LS and Class 1, and ANSI S1.40–2006.



Uses and Features

Uses

- Calibration of sound level meters and other sound measurement equipment

Features

- Conforms to EN/IEC 60942 (2003) Class LS and Class 1, and ANSI S1.40–2006
- Robust, pocket-sized design with highly stable level and frequency
- Calibration accuracy ±0.2 dB
- 94 dB SPL or 114 dB SPL for calibration in noisy environments
- Extremely small influence of static pressure and temperature
- Sound pressure independent of microphone equivalent volume
- 1 kHz calibration frequency for correct calibration level independent of weighting network
- Fits Brüel & Kjær 1″ microphones (1/2″, 1/4″ and 1/8″ microphones with adaptor)
- Switches off automatically when removed from the microphone

Sound Calibrator Type 4231

Sound Calibrator Type 4231 is a pocket-sized, battery operated sound source for quick and direct calibration of sound level meters and other sound measuring systems. It fits Brüel & Kjær 1″ microphones and using the removable adaptor, 1/2″ microphones. With optional adaptors, it can be used for 1/4″ and 1/8″ microphones as well.

The calibration frequency is 1000 Hz (the reference frequency for the standardized international weighting networks), so the same calibration value is obtained for all weighting networks (A, B, C, D and Linear). The calibration pressure of 94 ±0.2 dB re 20 µPa is equal to 1 Pa or 1 N/m^2. The +20 dB level step gives 114 dB SPL, which is convenient for calibration in noisy environments, or for checking linearity.

The design of Type 4231 is based on a feed-back arrangement to ensure a highly stable sound pressure level and ease of use. The feed-back loop uses a condenser microphone (see Fig. 1), which is specially developed for this purpose.

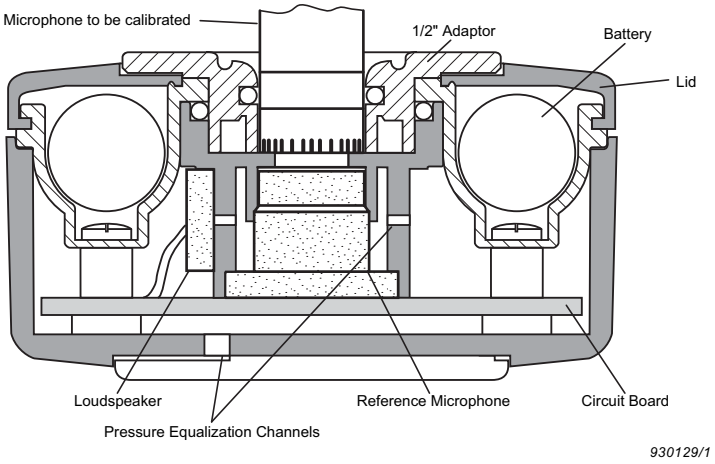


Fig. 1
Cross-sectional view of Sound Calibrator Type 4231. The feed-back loop is based on a high-quality condenser microphone to ensure a very stable sound pressure level

This microphone is optimized to have extremely high stability and independence of variations in static pressure and temperature around the 1 kHz calibration frequency. The result of this is a user-friendly calibrator where exact fitting of the microphone is not critical and the effects of changes in temperature and static pressure are negligible.

Fig. 2
Type 4231 fitted to Hand-held Analyzer Type 2250. The calibrator's centre of gravity is positioned very close to the microphone, giving a stable set-up

The calibrator gives a continuous sound pressure level when fitted on a microphone (see Fig. 2) and activated.

The sensitivity of the sound measuring equipment can then be adjusted until it indicates the correct sound pressure level.

The calibrator is automatically switched off when removed from the microphone.

A leather protection case, which does not need to be removed to use the calibrator, is supplied.

Compliance with Standards

	The CE marking is the manufacturer's declaration that the product meets the requirements of the applicable EU directives RCM mark indicates compliance with applicable ACMA technical standards – that is, for telecommunications, radio communications, EMC and EME China RoHS mark indicates compliance with administrative measures on the control of pollution caused by electronic information products according to the Ministry of Information Industries of the People's Republic of China WEEE mark indicates compliance with the EU WEEE Directive
Safety	EN/IEC 61010–1: Safety requirements for electrical equipment for measurement, control and laboratory use. ANSI/UL 61010–1: Safety requirements for electrical equipment for measurement, control and laboratory use.
EMC Emission	EN/IEC 61000–6–3: Generic emission standard for residential, commercial and light industrial environments. EN/IEC 61000–6–4: Generic emission standard for industrial environments. CISPR 22: Radio disturbance characteristics of information technology equipment. Class B Limits. FCC Rules, Part 15: Complies with the limits for a Class B digital device. EN/IEC 60942: Instrumentation Standard – Electroacoustics – Sound Calibrators.
EMC Immunity	EN/IEC 61000–6–1: Generic standards – Immunity for residential, commercial and light industrial environments. EN/IEC 61000–6–2: Generic standards – Immunity for industrial environments. EN/IEC 61326: Electrical equipment for measurement, control and laboratory use – EMC requirements. EN/IEC 60942: Instrumentation Standard – Electroacoustics – Sound Calibrators. **Note:** The above is only guaranteed using accessories listed in this Product Data sheet.
Temperature	IEC 60068–2–1 & IEC 60068–2–2: Environmental Testing. Cold and Dry Heat. Operating Temperature: –10 to +50°C (14 to 122°F) Storage Temperature: –25 to +70°C (–13 to +158°F)
Humidity	IEC 60068–2–78: Damp Heat: 90% RH (non-condensing at 40°C (104°F)).
Mechanical	Non-operating: IEC 60068–2–6: Vibration: 0.3 mm (10 to 58 Hz), 20 m/s^2 (58–500 Hz) IEC 60068–2–27: Shock: 1000 m/s^2 IEC 60068–2–29: Bump: 3000 bumps at 400 m/s^2
Enclosure	IEC 60529: Protection provided by enclosures: IP 50 with leather protection case.

Specifications – Sound Calibrator Type 4231

STANDARDS SATISFIED
EN/IEC 60942 (2003), Class LS and Class 1, Sound Calibrators
ANSI S1.40 – 2006, Specification for Acoustic Calibrators Class LS and Class 1

SOUND PRESSURE LEVELS
94.0 dB ±0.2 dB (Principal SPL) or
114.0 dB ±0.2 dB re 20 µPa at reference conditions

FREQUENCY
1 kHz ±0.1%

SPECIFIED MICROPHONE
Size according to IEC 61094-4:
- 1″ without adaptor
- 1/2″ with adaptor UC 0210 (supplied)
- 1/4″ with adaptor DP 0775 (optional)
- 1/8″ with adaptor DP 0774 (optional)

EQUIVALENT FREE-FIELD LEVEL
(0° incidence, re Nominal Sound Pressure Level)
–0.15 dB for 1/2″ Brüel & Kjær microphones. See the Type 4231 User Manual for other microphones

EQUIVALENT RANDOM INCIDENCE LEVEL
(re Nominal Sound Pressure Level)
+0.0 dB for 1″, 1/2″, 1/4″ and 1/8″ Brüel & Kjær microphones

NOMINAL EFFECTIVE COUPLER VOLUME
> 200 cm^3 at reference conditions

DISTORTION
< 1%

LEVEL STABILITY
Short-term: Better than 0.02 dB (as specified in IEC 60942)
One Year: Better than 0.05 dB (σ = 96%)
Stabilization Time: < 5 s

REFERENCE CONDITIONS
Temperature: 23°C ±3°C (73° ±5°F)
Pressure: 101 ±4 kPa
Humidity: 50%, –10% +15% RH
Effective Load Volume: 0.25 cm^3

ENVIRONMENTAL CONDITIONS
Pressure: 65 to 108 kPa
Humidity: 10 to 90% RH (non-condensing)
Effective Load Volume: 0 to 1.5 cm^3

INFLUENCE OF ENVIRONMENTAL CONDITIONS (Typical)
Temperature Coefficient: ±0.0015 dB/°C
Pressure Coefficient: $+8 \times 10^{-4}$ dB/kPa
Humidity Coefficient: 0.001 dB/% RH

POWER SUPPLY
Batteries: 2 × 1.5 V IEC Type LR6 (“AA” size)
Lifetime: Typically 200 hours continuous operation with alkaline batteries at 23°C (73°F)
Battery Check: When Type 4231 stops working continuously, and only operates when the On/Off button is held in, the batteries should be replaced

DIMENSIONS AND WEIGHT
(Without case)
Height: 40 mm (1.5″)
Width: 72 mm (2.8″)
Depth: 72 mm (2.8″)
Weight: 150 g (0.33 lb), including batteries

Note: All values are typical at 25°C (77°F), unless measurement uncertainty or tolerance field is specified. All uncertainty values are specified at 2σ (that is, expanded uncertainty using a coverage factor of 2)

Ordering Information

Type 4231 Sound Calibrator
includes the following accessories:
- KE-0317: Leather Case
- 2 × QB-0013: Alkaline Battery Type LR6
- UC-0210: Adaptor for 1/2″ microphones

Optional Accessories

DP-0775	Adaptor for 1/4″ microphones
DP-0774	Adaptor for 1/8″ microphones
DP-0887	Adaptor for Head and Torso Simulator Type 4128

BP 1311 – 17 2014 – 04

HEADQUARTERS: Brüel & Kjær Sound & Vibration Measurement A/S · DK-2850 Nærum · Denmark
Telephone: +45 7741 2000 · Fax: +45 4580 1405 · www.bksv.com · info@bksv.com

Local representatives and service organisations worldwide

Brüel & Kjær

Appendix C: Baseline Noise Monitoring Survey Period Weather Data

Table 1 Periods of adverse weather conditions during the baseline noise monitoring survey collected by the weather station representative of receptors SSR1, SSR2, SSR3, SSR5, SSR7, SSR9 and SSR12. Text formatted red identifies the meteorological parameter considered to adversely influence the respective baseline noise monitoring samples.

Date	Time	Temp (˚C) Out	Wind (m/s) Speed	Wind Direction	Wind Run	High wind Speed	High wind Direction	Pressure Bar	Rain (mm)	Rain Rate
27/06/2018	09:45	15.2	1.3	ESE	1.21	5.4	E	1025.4	0	0
27/06/2018	10:15	16.1	1.8	ESE	1.61	5.4	ESE	1025.1	0	0
27/06/2018	14:30	16.9	1.8	ESE	1.61	5.8	ESE	1024.1	0	0
27/06/2018	16:00	16.4	1.8	ESE	1.61	5.8	NNE	1023.6	0	0
27/06/2018	17:15	16	1.3	ESE	1.21	5.8	ENE	1023.2	0	0
27/06/2018	19:45	14.2	1.3	E	1.21	5.4	N	1023.4	0	0
28/06/2018	13:15	20.9	1.8	ESE	1.61	6.7	E	1022.7	0	0
28/06/2018	13:45	20.9	1.8	ESE	1.61	5.4	ESE	1022.8	0	0
29/06/2018	15:30	20.3	1.8	ESE	1.61	5.4	E	1018.4	0	0
29/06/2018	15:45	18.8	2.2	ENE	2.01	5.4	ENE	1018.5	0	0
29/06/2018	16:00	18.7	2.2	E	2.01	6.3	ESE	1018.4	0	0
29/06/2018	17:15	17.2	1.8	E	1.61	5.4	E	1018.2	0	0
29/06/2018	17:45	16.9	1.3	ESE	1.21	5.8	E	1018.2	0	0
30/06/2018	12:30	21.3	1.8	ESE	1.61	5.4	ENE	1014.6	0	0
30/06/2018	14:15	21.1	1.8	E	1.61	6.7	E	1014.3	0	0
30/06/2018	14:30	20.6	1.8	E	1.61	6.7	ENE	1014.2	0	0
30/06/2018	15:15	20.5	1.8	ESE	1.61	5.4	ENE	1013.9	0	0
30/06/2018	15:30	20.4	1.8	E	1.61	5.8	ESE	1013.8	0	0
30/06/2018	15:45	20.3	1.8	E	1.61	5.4	E	1013.8	0	0
30/06/2018	16:00	20.2	1.8	ESE	1.61	6.3	ESE	1013.8	0	0
30/06/2018	16:45	19.9	1.8	ESE	1.61	6.3	E	1013.6	0	0
30/06/2018	17:00	19.9	1.8	E	1.61	5.8	E	1013.5	0	0
30/06/2018	18:00	19.1	1.8	ESE	1.61	5.8	E	1013.1	0	0
30/06/2018	18:15	19.1	1.8	E	1.61	5.8	ESE	1013.1	0	0
30/06/2018	18:30	18.9	1.3	E	1.21	5.8	E	1013	0	0

Date	Time	Temp (˚C) Out	Wind (m/s) Speed	Wind Direction	Wind Run	High wind Speed	High wind Direction	Pressure Bar	Rain (mm)	Rain Rate
30/06/2018	18:45	18.7	1.8	ESE	1.61	5.8	ESE	1012.9	0	0
01/07/2018	11:45	21.3	1.8	ENE	1.61	5.8	E	1012.6	0	0
01/07/2018	12:00	21.6	1.8	ENE	1.61	5.8	ENE	1012.7	0	0
01/07/2018	13:15	22.2	1.8	E	1.61	5.4	E	1012.6	0	0
02/07/2018	10:30	21.3	1.8	ESE	1.61	5.4	ENE	1015	0	0
02/07/2018	12:15	21.8	1.8	ESE	1.61	6.3	ENE	1015.3	0	0
02/07/2018	13:30	22.7	1.8	ESE	1.61	5.4	ESE	1015.5	0	0
02/07/2018	14:15	22.3	2.2	E	2.01	5.4	E	1015.4	0	0
02/07/2018	14:30	22.1	2.2	E	2.01	6.3	ENE	1015	0	0
02/07/2018	14:45	21.9	2.2	E	2.01	5.8	E	1015.1	0	0
02/07/2018	15:30	21.3	1.8	ESE	1.61	5.4	ESE	1015.4	0	0
02/07/2018	15:45	21	2.2	ESE	2.01	5.4	E	1015.4	0	0
02/07/2018	16:00	20.7	2.2	E	2.01	6.7	ENE	1015.2	0	0
02/07/2018	16:15	20.6	2.2	E	2.01	5.4	ENE	1015.2	0	0
02/07/2018	16:30	20.5	2.2	E	2.01	5.8	E	1015.2	0	0
02/07/2018	17:00	20.2	2.2	ESE	2.01	6.3	E	1015.3	0	0
02/07/2018	17:30	20	2.2	ESE	2.01	5.8	ENE	1015.2	0	0
02/07/2018	17:45	19.6	1.8	ESE	1.61	5.4	NNE	1015.4	0	0
02/07/2018	18:00	19.2	1.8	ESE	1.61	5.8	ENE	1015.6	0	0
02/07/2018	18:15	18.9	1.8	ESE	1.61	6.3	ENE	1015.7	0	0
02/07/2018	18:45	18.4	1.8	E	1.61	5.4	ENE	1015.9	0	0
03/07/2018	00:45	16.1	1.3	E	1.21	5.4	ESE	1016.9	0	0
03/07/2018	07:30	18.6	1.8	E	1.61	5.8	ESE	1017.1	0	0
03/07/2018	08:15	19.2	1.8	ESE	1.61	6.3	NNE	1017.1	0	0
03/07/2018	08:45	19.4	1.3	ESE	1.21	5.8	NNE	1017	0	0
03/07/2018	09:15	19.2	1.8	ESE	1.61	6.3	E	1017	0	0
03/07/2018	09:45	19.3	1.8	ESE	1.61	5.4	E	1017.1	0	0

Date	Time	Temp (˚C) Out	Wind (m/s) Speed	Wind Direction	Wind Run	High wind Speed	High wind Direction	Pressure Bar	Rain (mm)	Rain Rate
03/07/2018	10:00	19.8	1.3	E	1.21	5.8	E	1017	0	0
03/07/2018	10:15	19.3	1.3	ESE	1.21	6.7	WSW	1016.9	0	0

Appendix D: Construction Programme Phasing Clarification Note

Note / Memo

HaskoningDHV UK Ltd.
Industry & Buildings

To:	Naomi Gould
From:	Blair Davies
Date:	10 July 2020
Copy:	Graham Gunby
Our reference:	PB4842-RHD-ZZ-XX-NT-Z-0002
Classification:	Confidential
Checked by	Paolo Pizzolla

Subject: **Construction Noise Modelling: Construction Programme Phasing Clarification Note**

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1 Introduction

1. East Suffolk Council (ESC) provided their relevant representation (Section 56 response) on the proposed East Anglia ONE North and East Anglia TWO windfarm projects (the Projects) to the Planning Inspectorate on 23rd January 2020.

2. On page 1 of their relevant representation (RR-002), ESC commented that "*Further information is required before the Council can determine whether the construction noise assessment is a representative assessment of construction noise and vibration*".

3. Following receipt of ESC's relevant representation, East Anglia ONE North Limited and East Anglia TWO Limited (the Applicants) have continued to engage with ESC and their consultants, Adrian James Acoustics Limited (AJA), regarding the construction noise assessment. Engagement has primarily been undertaken via the Statement of Common Ground (SoCG) process. However, a response to ESC's relevant representation is also provided within ***Section 2.1, Volume 3*** of the ***Applicant's Comments on Relevant Representations*** submitted to the Examining Authority (ExA) on 11th June 2020 (document reference ExA.RR3.D0.V1).

4. A meeting was held on 13th May 2020 between the Applicant's consultants, Royal HaskoningDHV, and AJA. During the meeting AJA identified a difference between the information regarding the construction programme phasing presented within ***Chapter 6 Project Description*** of the Environmental Statement (ES) (APP-054) and the information used to inform the construction phase noise modelling presented within ***Appendix 25.4*** of the ES (APP-525).

5. Specifically, AJA requested for the Applicants to define the construction programme phasing periods adopted for the noise modelling presented in ***Chapter 25 Noise and Vibration*** (APP-073) and supported by ***Appendix 25.4*** (APP-525) to ascertain whether the time periods used within the construction noise modelling (and by extension the assessment) represent the worst-case scenario for the construction phase of the Projects.

6. Indicative onshore construction sequencing is provided in ***section 6.10*** of ***Chapter 6 Project Description*** of the ES. This clarification note provides further information regarding the construction activities, duration and how they were incorporated into the worst-case scenario assessments for the construction phase.

7. This clarification note provides further information regarding information which was used to inform the construction noise modelling and assessment and draws upon the following existing information from the ES:

   - ***Appendix 25.4 Construction Phase Assessment*** (APP-525); and
   - ***Chapter 25 Noise and Vibration*** (APP-073).

2 Construction Programme Phasing Clarification Note

2.1 Introduction

8. The assessment of noise and vibration presented within ***Chapter 25*** of the ES (APP-073), and by extension the construction noise modelling, was undertaken for three construction scenarios associated with the Projects:

   - East Anglia TWO / East Anglia ONE North project assessment (project alone);
   - Construction Scenario 1: the East Anglia TWO project and East Anglia ONE North project constructed simultaneously; and
   - Construction Scenario 2: the East Anglia TWO project and East Anglia ONE North project constructed sequentially.

9. As described in ***Chapter 5 Environmental Impact Assessment (EIA) Methodology*** of the ES (APP-053), the onshore substation for each Project is co-located with the other Project's onshore substation. It should be noted that the draft Development Consent Orders (DCOs) for both Projects have the flexibility for either Project to use either onshore substation location.

2.2 Construction Phasing

10. For the construction noise assessment, the worst case phase is considered to be represented by months 1 to 24 of the construction programme under Construction Scenario 1 (simultaneous construction of the Projects). This is therefore presented in the assessment within ***Chapter 25 Noise and Vibration*** of the ES (APP-073).

11. *Error! Reference source not found.* shows the total construction period (for each of the three construction scenarios) divided into different construction phases upon which the assessment has been based (reproduced from ***Table A25.4.1, Appendix 25.4*** of the ES (APP-525)). The groups of months referred to in the 'Construction phase' column of ***Table 2.1*** have been aggregated based on construction activities of a similar nature, reflected by the more detailed breakdown of the construction programme presented in

12. ***Table*** 2.2 to

13. Table 2.8.

Table 2.1 Construction Phasing

Study Area	Construction phase	Proposed East Anglia TWO project (project alone)	Construction Scenario 1	Construction Scenario 2
Landfall location and onshore cable route (sections 1 to 4)	Month 1 to 6	✓	✓	✓
	Month 7 to 10	✓	✓	✓
	Month 11 to 12	✓	✓	✓
	Month 13 to 15	✓	✓	✓
	Month 16 to 17	✓	✓	✓
	Month 18 to 20	✓	✓	✓
	Month 21 to 24	✓	✓	✓
Onshore substation and National Grid infrastructure	Month 1 to 6	✓	✓	✓
	Month 7 to 10	✓	✓	✓
	Month 11 to 12	✓	✓	✓
	Month 13 to 15	✓	✓	✓
	Month 16 to 17	✓	✓	✓
	Month 18 to 20	✓	✓	✓

Study Area	Construction phase	Proposed East Anglia TWO project (project alone)	Construction Scenario 1	Construction Scenario 2
	Month 21 to 24	✓	✓	✓

14. The construction programme will only be confirmed as the Project is developed, following detailed design and when a main contractor is appointed for the construction. Details from the preliminary programme used to inform the aggregated sub-phases used within the construction noise model are presented in

15. ***Table*** 2.2 to

16. Table 2.8 below. It should be noted that the actual construction programme will vary from the preliminary programme.

17. The estimated total build time for the onshore construction works is estimated to be 36 months, comprising:

- 24 months of construction and mechanical and electrical fit-out works;
- An estimated 9 months of testing, commissioning and energisation; and
- 3 months of reinstatement.

18. It has been assumed that the landfall and onshore horizontal directional drilling (HDD) works will require continuous operation and therefore works and material movements will be undertaken over a seven-day working week during drilling activities.

Table 2.2 Construction Scenario 1 - HDD at Landfall from Access on Thorpeness Road

Activity	Construction Phase
HDD at Landfall	
Establish landfall HDD construction compound / topsoil strip in landfall laydown area	Month 3 to 5
Mobilisation of HDD kit and welfare to landfall compound	Month 5
HDD drilling works & ducting (assume working 24/7 during drilling activities)	Month 6 to 13
Demobilisation of HDD kit and welfare	Month 14

Activity	Construction Phase
Establish Construction Consolidation Site (CCS) within Landfall Laydown Area	
Construction of CCS	Month 3 to 5
Mobilisation of welfare and operation plant to CCS	Month 5
Transition Bays at Landfall	
Excavation of transition bays	Month 10 to 11
Construction of transition bay bases	Month 11 to 12
Connection of cables in transition bays	Month 12 to 14
Construction of transition bay walls	Month 13 to 14
Construction of transition roof and backfill	Month 13 to 14

Table 2.3 Construction Scenario 1 - Section 1 Onshore Cable Route

Activity	Construction Phase
Establish construction consolidation site and site accesses	Month 1 to 2
Mobilisation of welfare and operation plant to CCS	Month 1 to 2
Site preparation including fencing, temporary drainage and haul road construction	Month 1 to 2
Onshore Export Cable Installation East of SPA	
Trench route clearance / topsoil strip	Month 5 to 6
Trench excavation	Month 7 to 16
Duct installation	Month 7 to 16
Trench backfill	Month 8 to 16
Jointing bay excavation	Month 8 to 18
Jointing bay base construction	Month 10 to 18
Pulling and connection of cables	Month 11 to 19
Jointing bay walls and roof	Month 12 to 20
Medium Length HDD crossing of Obstacle 2.1	
Establish onshore HDD entry pit compound	Month 5 to 7
Mobilisation of HDD kit and welfare to onshore drilling compound	Month 8

Activity	Construction Phase
HDD drilling works & ducting (assume working 24/7 during drilling activities)	Month 8 to 11
HDD drilling risk programme 'float' (total HDD heavy goods vehicle (HGV) movements included in HDD drilling works	Month 12
Demobilisation of HDD kit and welfare	Month 13
Removal of onshore HDD entry pit compound	Month 15 to 17
Other	
Movement of fence line to minimum extents	Month 21 to 24
Construction consolidation site and access road removal	Month 21 to 24

Table 2.4 Construction Scenario 1 - Section 2A and 2B Onshore Cable Route

Activity	Construction Phase
Establish construction consolidation sites and site accesses (month 6 construction of Hundred River CCS)	Month 1 to 4, Month 6
Mobilisation of welfare and operation plant to CCS	Month 1 to 4, Month 6
Site preparation including fencing, temporary drainage and haul road construction	Month 4 to 6
Onshore Export Cable Installation Section 2A and 2B	
Trench route clearance / topsoil strip	Month 5 to 6
Trench excavation	Month 7 to 16
Duct installation	Month 7 to 16
Trench backfill	Month 8 to 16
Jointing bay excavation	Month 8 to 18
Jointing bay base construction	Month 10 to 18
Pulling and connection of cables	Month 11 to 19
Jointing bay walls and roof	Month 12 to 20
Medium Length Onshore HDD Crossing of Obstacle 2.1 and 2.2	
Establish onshore HDD entry pit compound	Month 6 to 7
Mobilisation of HDD kit and welfare to onshore drilling compound	Month 8
HDD drilling works & ducting (assume working 24/7 during drilling activities)	Month 8 to 11
HDD drilling risk programme 'float' (total HDD HGV movements included in HDD drilling works	Month 12
Demobilisation of HDD kit and welfare	Month 13
Removal of onshore HDD entry pit compound	Month 15 to 16
Other	
Movement of fence line to minimum extents	Month 21 to 24
Construction consolidation site and access road removal	Month 21 to 24

Table 2.5 Construction Scenario 1 - Section 3A and 3B Onshore Cable Route

Activity	Construction Phase
Establish construction consolidation site compound at Aldeburgh Road crossing	Month 6
Mobilisation of welfare and operation plant to CCS	Month 6
Site preparation including fencing, temporary drainage, haul road construction and access construction.	Month 5 to 6
Onshore Export Cable Installation Section 3A and 3B	
Trench route clearance / topsoil strip	Month 5 to 6
Trench excavation	Month 7 to 16
Duct installation	Month 7 to 16
Trench backfill	Month 8 to 16
Jointing bay excavation	Month 8 to 18
Jointing bay base construction	Month 10 to 18
Pulling and connection of cables	Month 11 to 19
Jointing bay walls and roof	Month 12 to 20
Other	
Movement of fence line to minimum extents	Month 21 to 24
Construction consolidation site and access road removal	Month 21 to 24

Table 2.6 Construction Scenario 1 - Section 4A and 4B Onshore Cable Route

Activity	Construction Phase
Establish construction consolidation site compound and site accesses	Month 1 to 4
Mobilisation of welfare and operation plant to CCS	Month 1 to 4
Construction of tarmac haul road from access to CCS	Month 1 to 2
Site preparation including fencing, temporary drainage and haul road construction	Month 2 to 4
Onshore Export Cable Installation Section 4A and 4B	
Trench route clearance / topsoil strip	Month 5 to 6
Trench excavation	Month 7 to 16

Duct installation	Month 7 to 16
Trench backfill	Month 8 to 16
Jointing bay excavation	Month 8 to 18
Jointing bay base construction	Month 10 to 18
Pulling and connection of cables	Month 11 to 19
Jointing bay walls and roof	Month 12 to 20
Other	
Movement of fence line to minimum extents	Month 21 to 24
Construction consolidation site and access road removal	Month 21 to 24

Table 2.7 Construction Scenario 1 - Substation Construction (Both Project Substations)

Activity	Construction Phase
Permanent access road	Month 4 to 8
Construction compound construction	Month 4 to 7
Welfare mobilisation	Month 4 to 6
Site clearance works	Month 5 to 8
Development platform earthworks	Month 8 to 11
Foundation works	Month 9 to 18
Sub-structure works	Month 14 to 18
Super-structure works	Month 16 to 20
Mechanical and electrical kit installation	Month 18 to 22
Wiring up	Month 19 to 24
Commissioning	Month 19 to 24

Table 2.8 Construction Scenario 1 - National Grid Works

Activity	Construction Phase
Construction of access roads for National Grid overhead line works	Month 1 to 2
Construction of tarmac access road to sealing end compound	Month 7
Project substation - National Grid connection	Month 8 to 9

3 Summary

19. The construction sequencing and timing provided in ***section 6.10*** of ***Chapter 6 Project Description*** of the ES (APP-054) is for indicative purposes only and relates to the onshore cable route. This clarification note has summarised the anticipated construction phasing 'sub phases' associated with construction activities for landfall, the onshore cable route, onshore substations and the National Grid substation.

20. It should be noted that the actual construction programme will vary from the preliminary programme. While the full construction programme may be longer, for the construction noise assessment the worst case phase is considered to be represented by months 1 to 24 as presented here and within ***Chapter 25 Noise and Vibration*** and ***Appendix 25.4*** of the ES.