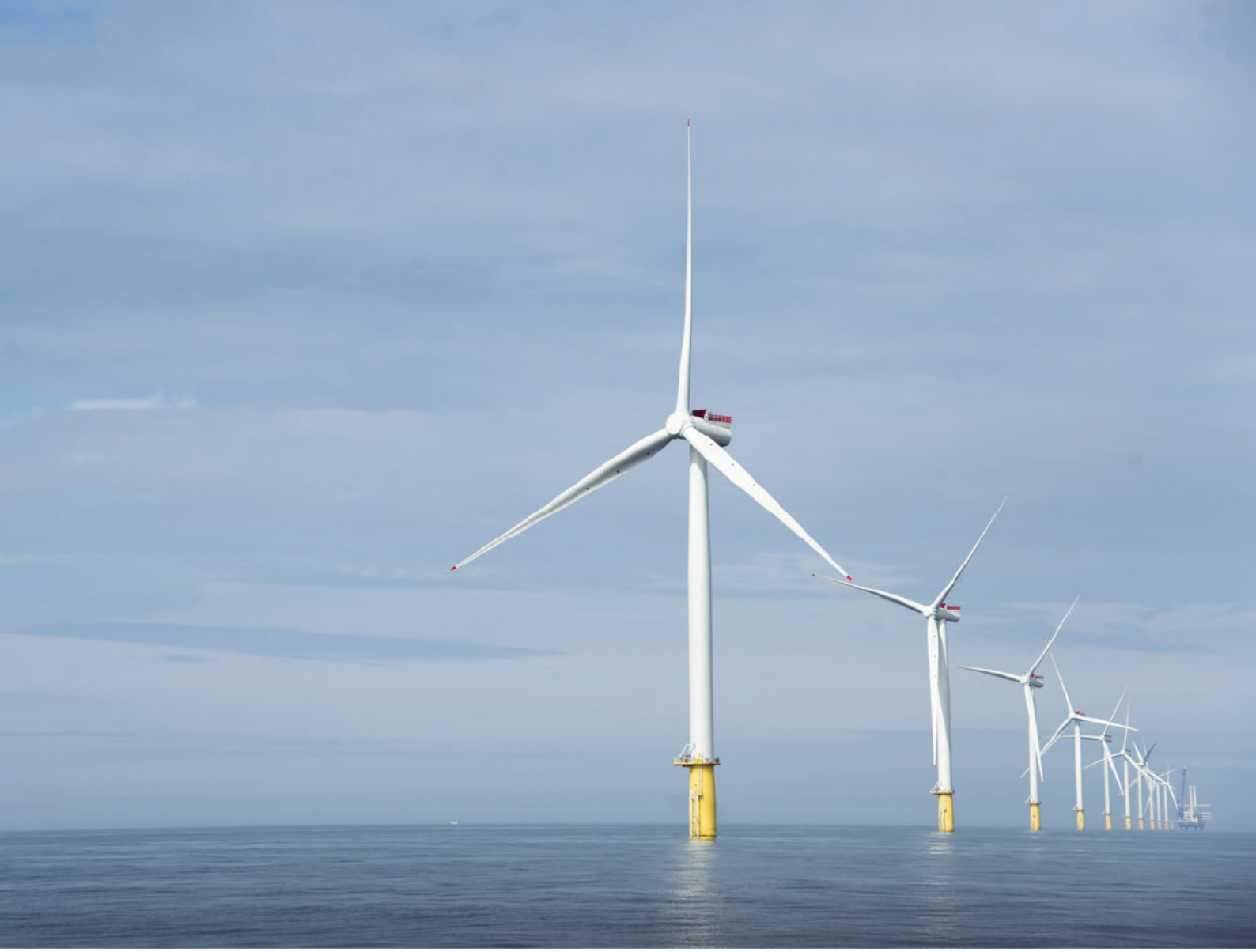

Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects

Environmental Statement

Volume 3

Appendix 23.4 - Onshore Substation Operational Noise Assessment

August 2022
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Title**:**	
Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects Environmental Statement **Appendix 23.4: Onshore Substation Operational Noise Assessment**	
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Royal HaskoningDHV	
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Johiris Rodriguez Tablante, Equinor	August 2022

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Glossary of Acronyms

BS	British Standard
BSI	British Standards Institution
DEP	Dudgeon Offshore Wind Farm Extension Project
EIA	Environmental Impact Assessment
ES	Environmental Statement
IEMA	Institute of Environmental Management and Assessment
LOAEL	Lowest Observed Adverse Effect Level
NNG	Night Noise Guidance
NOAEL	No Observed Adverse Effect Level
NSR	Noise Sensitive Receptor
SEP	Sheringham Shoal Extension Project
SGT	Super Grid Transformer
SHR	Shunt Reactor
SOAEL	Significant Observed Adverse Effect Level
WHO	World Health Organisation

Glossary of Terms

Order Limits	The area subject to the application for development consent, including all permanent and temporary works for SEP and DEP.
Dudgeon Offshore Wind Farm Extension Project (DEP)	The Dudgeon Offshore Wind Farm Extension onshore and offshore sites including all onshore and offshore infrastructure.
DEP onshore site	The Dudgeon Offshore Wind Farm Extension onshore area consisting of the DEP onshore substation site, onshore cable corridor, construction compounds, temporary working areas and onshore landfall area.
Horizontal directional drilling (HDD) zones	The areas within the onshore cable route which would house HDD entry or exit points.
Jointing bays	Underground structures constructed at regular intervals along the onshore cable route to join sections of cable and facilitate installation of the cables into the buried ducts.
Landfall	The point at the coastline at which the offshore export cables are brought onshore, connecting to the onshore cables at the transition joint bay above mean high water
Onshore cable corridor	The area between the landfall and the onshore substation sites, within which the onshore cable circuits will be installed along with other temporary works for construction.
Onshore export cables	The cables which would bring electricity from the landfall to the onshore substation. 220 – 230kV.
Onshore Substation	Compound containing electrical equipment to enable connection to the National Grid.
PEIR boundary	The area subject to survey and preliminary impact assessment to inform the PEIR.
Sheringham Shoal Offshore Wind Farm Extension Project (SEP)	The Sheringham Shoal Offshore Wind Farm Extension onshore and offshore sites including all onshore and offshore infrastructure.
SEP onshore site	The Sheringham Shoal Wind Farm Extension onshore area consisting of the SEP onshore substation site, onshore cable corridor, construction compounds, temporary working areas and onshore landfall area.

Study area	Area where potential impacts from the project could occur, as defined for each individual Environmental Impact Assessment (EIA) topic.
The Applicant	Equinor New Energy Limited

23.4 ONSHORE SUBSTATION OPERATIONAL NOISE ASSESSMENT

23.4.1 Introduction

1. This appendix of the Environmental Statement (ES) of the proposed Sheringham Shoal Offshore Windfarm Extension Project (hereafter SEP) and Dudgeon Offshore Wind Farm Extension Project (hereafter DEP), provides operational noise modelling details and results, both individually and cumulatively at the identified Noise Sensitive Receptor (NSR) locations surrounding the onshore substation site.

23.4.2 Operational Noise Assessment Assumptions

23.4.2.1 Onshore Substation Layout

2. Site layout details were provided by the Applicant's onshore substation design contractor for SEP or DEP individually and SEP and DEP . The scenarios included in this assessment are:
   - SEP and DEP;
   - SEP in isolation; and
   - DEP in isolation.
3. The SEP and DEP scenario is considered a worst case for potential noise impacts.

23.4.2.2 Operational Noise Sources

4. Operational noise sources that were included in the 3D noise model are identified in **Table 23.4.1** and their respective frequency spectra are presented in **Table 23.4.2**.
5. The noise modelling assumes the same components and component quantity for SEP and DEP in isolation, regardless of footprint location, with additional plant required for SEP and DEP. The SEP and DEP scenario is stated in **Table 23.4.1** first, with the bracketed numbers attributed to the SEP and DEP in isolation scenarios.

Table 23.4.1: Operational Noise Sources

Component ID	Component	Component quantity	Sound power level (dBA)	Equipment height (m)	Associated spectra
1	SGT Tank & Cooler (3-Phase)	2 (1)	95	6.0	SNS1
2	400kV Filter Capacitor Bank	6 (3)	79	8.5	SNS10
3	400kV Filter Air Core Reactor	6 (3)	87	4.5	SNS2
4/5	220kV Filter Capacitor Bank	12 (6)	79	8.5	SNS10
6/7	220kV Filter Air Core Reactor	12 (6)	87	4.5	SNS2
8	SVC Ph. Air Core Reactor	6 (3)	87	4.5	SNS3
9/10	MSR Air Core Reactor	9 (6)	84	5.2	SNS4
11/12	220kV SHR	6 (3)	89	12.0	SNS5
13	EPVT	3 (3)	40	4.5	SNS6
14	SVC Cooler	1 (1)	76	2.6	SNS7
15	SVC Building A/C Unit	5 (5)	80	2.0	SNS8
16	Control Room Building A/C Unit	10 (10)	80	2.0	SNS9

Table 23.4.2: Operational Noise Source Spectra

Sound levels (dBA) in octave band (Hz)							
63Hz	125	250	500	1000	2000	4000	8000
SNS1							
59.6	89.6	93.0	83.6	69.0	58.9	47.6	36.2
SNS2							
62.0	82.0	76.0	85.0	66.0	55.0	-	-

Sound levels (dBA) in octave band (Hz)							
63Hz	125	250	500	1000	2000	4000	8000
SNS3							
30.8	85.8	59.8	74.8	79.8	52.8	-	-
SNS4							
19.8	81.8	65.8	79.8	25.8	-	-	-
SNS5							
-	89.0	-	-	-	-	-	-
SNS6							
-	-	-	-	40.0	-	-	-
SNS7							
-	-	-	-	76.0	-	-	-
SNS8 (each)							
58.8	73.9	68.4	73.8	76.0	74.2	67.0	63.9
SNS9 (each)							
51.8	62.9	61.4	76.8	73.0	72.2	71.0	55.9

Sound levels (dBA) in third-octand band (Hz)																				
63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300
SNS10																				
30	30	65	30	49	70	57	77	61	66	60	51	50	30	30	30	30	30	30	30	30

23.4.2.3 Noise Modelling Assumptions and Methodology

6. Noise levels associated with SEP and DEP onshore substation were predicted at the identified NSR locations using SoundPLAN 3D modelling software. The software implements accepted national and international acoustic calculation standards.
7. Operational noise modelling predictions were undertaken in accordance with the methodology provide in ISO 9613-2; energy loss due to geometrical spreading, air absorption, ground absorption, acoustic screening and reflections due to intervening buildings and structures between the NSR locations and noise sources at the onshore substation site options.
8. A three-dimensional model was created using geo-referenced OS mapping data, topographical data of the local area incorporating buildings, plans and elevations of the site. Modelling assumptions are detailed in **Annex 23.4.1.1**
9. Daytime predictions were undertaken at the ground floor level and night-time predictions were undertaken at first floor level, 1.5m and 4.0m respectively.
10. Ground surfaces within the study area are generally considered 'soft' such as the agricultural and grassland areas in the intervening area between the onshore substation sites and the NSRs. To consider a potential worst-case, an assumed ground factor (G) of 0.5 was employed outside the onshore substation site options, areas of acoustically absorptive (G=1) and reflective (G=0) ground were also identified from the mapping data. Inside the onshore substation site options, a ground factor of 0 was implemented into the model to account for hard ground within the substation compound.

23.4.3 Predicted Operational Noise Levels

11. This section outlines the predicted noise levels and the respective magnitude of effect at each NSR for each scenario.
12. For the IEMA sound level change assessment, predicted *specific sound levels* ($L_{Aeq,T}$) were added to the measured $L_{Aeq,T}$ for the daytime and night time reference periods to identify the likely change in ambient sound level.
13. For the WHO NNG assessment, predicted *specific sound levels* ($L_{Aeq,T}$) were compared with the LOAEL and SOAEL criteria in **Table 23-17** of the main ES Noise and Vibration Chapter. As the onshore substation will operate continuously, with very little fluctuation in its sound emissions, the predicted *specific sound level* (identified as an $L_{Aeq,T}$) is equal to the $L_{night,outside}$ parameter used in the WHO NNG.

23.4.3.1 SEP and DEP

14. The predicted noise level at each NSR for the unmitigated noise levels are presented in **Table 23.4.3**. The *rating level* has been calculated by adding a 2dB character correction for tonality to the predicted *specific sound level*.

Table 23.4.3: Operational Noise Assessment - SEP and DEP, Unmitigated

NSR identifier	BS4142 Assessment					IEMA Assessment		WHO NNG Assessment
	Predicted *specific sound level* (dB $L_{Aeq,T}$)	*Background sound level* (dB L_{A90})	Rating level (dB $L_{Ar,T}$)	Difference between $L_{Ar,T}$ and L_{A90} (dB)	Magnitude of effect (BS 4142 criteria)	Change in Ambient Sound Level (dB $L_{Aeq,T}$)	Magnitude of effect	Magnitude of effect
Daytime (07:00 – 23:00)								
SSR1	30	37	32	-6	Negligible	0.0	Negligible	NOAEL
SSR2	32	38	34	-4	Negligible	0.1	Negligible	NOAEL
SSR3	35	38	37	-2	Negligible	0.1	Negligible	NOAEL
SSR4	26	36	28	-8	Negligible	0.0	Negligible	NOAEL
SSR5	31	45	33	-12	Negligible	0.0	Negligible	NOAEL
SSR6	34	43	36	-7	Negligible	0.1	Negligible	NOAEL
SSR7	29	42	31	-11	Negligible	0.0	Negligible	NOAEL
SSR8	28	39	30	-9	Negligible	0.0	Negligible	NOAEL
SSR9	32	37	34	-4	Negligible	0.0	Negligible	NOAEL
SSR10	31	37	33	-4	Negligible	0.0	Negligible	NOAEL
Night-time (23:00 – 07:00)								
SSR1	31	30	33	3	Low	0.7	Negligible	NOAEL
SSR2	34	31	36	5	Medium	1.0	Minor	NOAEL
SSR3	36	31	38	7	Medium	1.3	Minor	NOAEL
SSR4	28	29	30	1	Low	0.5	Negligible	NOAEL
SSR5	32	35	34	-1	Negligible	0.4	Negligible	NOAEL
SSR6	35	35	37	3	Low	0.8	Negligible	NOAEL

NSR identifier	BS4142 Assessment					IEMA Assessment		WHO NNG Assessment
	Predicted *specific sound level* (dB $L_{Aeq,T}$)	*Background sound level* (dB L_{A90})	Rating level (dB $L_{Ar,T}$)	Difference between $L_{Ar,T}$ and L_{A90} (dB)	Magnitude of effect (BS 4142 criteria)	Change in Ambient Sound Level (dB $L_{Aeq,T}$)	Magnitude of effect	Magnitude of effect
SSR7	30	36	32	-3	Negligible	0.1	Negligible	NOAEL
SSR8	30	34	32	-3	Negligible	0.2	Negligible	NOAEL
SSR9	33	29	35	6	Moderate	1.2	Minor	NOAEL
SSR10	32	29	34	5	Medium	1.0	Minor	NOAEL

15. **Table 23.4.3** shows that the predicted daytime *rating levels* are below the existing daytime *background sound level* at all NSRs; indicating a magnitude of effect of negligible during the daytime.

16. During the night-time the highest predicted rating level is +7dB above the existing background sound level at SSR3; indicating a magnitude of effect of moderate when using the BS 4142 criteria. Assessing the effect using the IEMA noise level change criteria, an effect of negligible magnitude is predicted at most receptors, except for SSR2, SSR3, SSR9 and SSR10, where the effect is low. The predicted noise levels are below the NNG LOAEL criteria at all NSRs.

17. Detailed analysis of the predicted noise levels at NSRs indicate that noise associated with Super Grid Transformer (SGT) and Shunt Reactor Air Core Reactor (SHR) components are the dominant contributors of noise from the onshore substation.

18. To reduce the magnitude of effect, noise attenuation would be introduced at the SGT to reduce source noise levels from 95 dB L_{WA} to 80 dB L_{WA}. SHRs would reduce noise levels from 89 dB L_{WA} to 80 dB L_{WA}, 220kV, Air Core Reactor and 440kV Filter Reactor components from 87 dB L_{WA} to 82 dB L_{WA}.

19. The predicted noise level at each NSR for the mitigated night-time noise levels are presented in **Table 23.4.4**. The *rating level* has been calculated by adding a 2dB character correction for tonality to the predicted *specific sound level*.

Table 23.4.4: Operational Noise Assessment – SEP and DEP Mitigated

NSR identifier	BS4142 Assessment					IEMA Assessment		WHO NNG Assessment
	Predicted *specific sound level* (dB $L_{Aeq,T}$)	*Background sound level* (dB L_{A90})	*Rating level* (dB $L_{Ar,T}$)	Difference between $L_{Ar,T}$ and L_{A90} (dB)	Magnitude of effect (BS 4142 criteria)	Change in Ambient Sound Level (dB $L_{Aeq,T}$)	Magnitude of effect	Magnitude of effect
Night-time (23:00 - 07:00)								
SSR1	25	30	27	-2	Negligible	0.2	Negligible	NOAEL
SSR2	30	31	32	1	Low	0.4	Negligible	NOAEL
SSR3	30	31	32	1	Low	0.1	Negligible	NOAEL
SSR4	22	29	24	-5	Negligible	0.1	Negligible	NOAEL
SSR5	27	35	29	-6	Negligible	0.1	Negligible	NOAEL
SSR6	30	35	32	-3	Negligible	0.2	Negligible	NOAEL
SSR7	25	36	27	-8	Negligible	0.0	Negligible	NOAEL
SSR8	24	34	26	-8	Negligible	0.0	Negligible	NOAEL
SSR9	28	29	30	0	Negligible	0.4	Negligible	NOAEL
SSR10	26	29	28	-1	Negligible	0.3	Negligible	NOAEL

20. **Table 23.4.4** shows that a low magnitude of effect, at worst, is predicted at all NSRs during the night-time using the BS4142 criteria. Using the IEMA noise level change criteria, an effect of negligible magnitude is predicted at each receptor. The predicted noise level is below the NNG LOAEL criteria.

23.4.3.1 SEP in isolation

21. The predicted noise level at each NSR for the unmitigated noise levels are presented in **Table 23.4.5**.

Table 23.4.5: Operational Noise Assessment - SEP in Isolation Unmitigated

NSR identifier	BS4142 Assessment					IEMA Assessment		WHO NNG Assessment
	Predicted *specific sound level* (dB $L_{Aeq,T}$)	*Background sound level* (dB L_{A90})	*Rating level* (dB $L_{Ar,T}$)	Difference between $L_{Ar,T}$ and L_{A90} (dB)	Magnitude of effect (BS 4142 criteria)	Change in ambient sound level (dB $L_{Aeq,T}$)	Magnitude of effect	Magnitude of effect
Daytime (07:00 - 23:00)								
SSR1	27	37	29	-8	Negligible	0.0	Negligible	NOAEL
SSR2	29	38	31	-7	Negligible	0.0	Negligible	NOAEL
SSR3	31	38	33	-6	Negligible	0.0	Negligible	NOAEL
SSR4	24	36	26	-10	Negligible	0.0	Negligible	NOAEL
SSR5	27	45	29	-17	Negligible	0.0	Negligible	NOAEL
SSR6	31	43	33	-11	Negligible	0.0	Negligible	NOAEL
SSR7	27	42	29	-13	Negligible	0.0	Negligible	NOAEL
SSR8	25	39	27	-12	Negligible	0.0	Negligible	NOAEL
SSR9	29	37	31	-6	Negligible	0.0	Negligible	NOAEL
SSR10	28	37	30	-7	Negligible	0.0	Negligible	NOAEL
Night-time (23:00 - 07:00)								
SSR1	28	30	30	1	Low	0.4	Negligible	NOAEL
SSR2	31	31	33	2	Low	0.5	Negligible	NOAEL
SSR3	32	31	34	3	Low	0.6	Negligible	NOAEL
SSR4	25	29	27	-2	Negligible	0.3	Negligible	NOAEL
SSR5	28	35	30	-5	Negligible	0.1	Negligible	NOAEL

NSR identifier	BS4142 Assessment					IEMA Assessment		WHO NNG Assessment
	Predicted *specific sound level* (dB $L_{Aeq,T}$)	*Background sound level* (dB L_{A90})	*Rating level* (dB $L_{Ar,T}$)	Difference between $L_{Ar,T}$ and L_{A90} (dB)	Magnitude of effect (BS 4142 criteria)	Change in ambient sound level (dB $L_{Aeq,T}$)	Magnitude of effect	Magnitude of effect
SSR6	32	35	34	-1	Negligible	0.4	Negligible	NOAEL
SSR7	29	36	31	-5	Negligible	0.1	Negligible	NOAEL
SSR8	27	34	29	-6	Negligible	0.1	Negligible	NOAEL
SSR9	30	29	32	3	Low	0.7	Negligible	NOAEL
SSR10	29	29	31	2	Low	0.5	Negligible	NOAEL

22. **Table 23.4.5** shows that the predicted rating levels are of low magnitude of effect, at worst, during the daytime at all NSRs using the BS 4142 assessment criteria.

23. During the night-time the predicted rating level is +3dB above the existing background sound level at SSR3 and SSR9; indicating a low magnitude of effect when using the BS 4142 criteria. The IEMA and NNG criteria are of negligible impact significance and below LOAEL, respectively.

24. Detailed analysis of the predicted noise levels at NSRs indicate that noise associated with the SGT and SHRs are the dominant contributors of noise from the onshore substation.

25. Mitigation measures to reduce the predicted night-time rating level include attenuating the SGT to achieve a source noise level of 85 dB $L_{WA,}$ and attenuating the SHRs to achieve a source noise level of 84 dB L_{WA}.

26. The predicted noise level at each NSR for the mitigated noise levels are presented in **Table 23.4.6**Error! Reference source not found..

Table 23.4.6: Operational Noise Assessment - SEP in Isolation Mitigated

NSR identifier	BS4142 Assessment					IEMA Assessment		WHO NNG Assessment
	Predicted *specific sound level* (dB $L_{Aeq,T}$)	*Background sound level* (dB L_{A90})	*Rating level* (dB $L_{Ar,T}$)	Difference between $L_{Ar,T}$ and L_{A90} (dB)	Magnitude of effect (BS 4142 criteria)	Change in Ambient Sound Level (dB $L_{Aeq,T}$)	Magnitude of effect	Magnitude of effect
Night-time (23:00 - 07:00)								
SSR1	26	30	28	-2	Negligible	0.2	Negligible	NOAEL
SSR2	28	31	30	-1	Negligible	0.3	Negligible	NOAEL
SSR3	29	31	31	0	Negligible	0.1	Negligible	NOAEL
SSR4	22	29	24	-5	Negligible	0.1	Negligible	NOAEL
SSR5	26	35	28	-7	Negligible	0.1	Negligible	NOAEL
SSR6	29	35	31	-4	Negligible	0.2	Negligible	NOAEL
SSR7	26	36	28	-8	Negligible	0.0	Negligible	NOAEL
SSR8	24	34	26	-9	Negligible	0.0	Negligible	NOAEL
SSR9	27	29	29	0	Negligible	0.4	Negligible	NOAEL
SSR10	26	29	28	-2	Negligible	0.3	Negligible	NOAEL

27. **Table 23.4.6** shows a negligible magnitude of effect is predicted at all NSRs during the night-time using the BS4142 criteria. The IEMA and NNG criteria are of negligible impact significance and below LOAEL, respectively.

23.4.3.2 DEP in isolation

28. The predicted noise level at each NSR for the unmitigated noise levels are presented in **Table 23.4.7**.

Table 23.4.7: Operational Noise Assessment - DEP in Isolation Unmitigated

NSR identifier	BS4142 Assessment					IEMA Assessment		WHO NNG Assessment
	Predicted *specific sound level* (dB $L_{Aeq,T}$)	*Background sound level* (dB L_{A90})	*Rating level* (dB $L_{Ar,T}$)	Difference between $L_{Ar,T}$ and L_{A90} (dB)	Magnitude of effect (BS 4142 criteria)	Change in Ambient Sound Level (dB $L_{Aeq,T}$)	Magnitude of Effect	Magnitude of effect
Daytime (07:00 - 23:00)								
SSR1	26	37	28	-9	Negligible	0.0	Negligible	NOAEL
SSR2	29	38	31	-7	Negligible	0.0	Negligible	NOAEL
SSR3	32	38	34	-4	Negligible	0.1	Negligible	NOAEL
SSR4	23	36	25	-11	Negligible	0.0	Negligible	NOAEL
SSR5	29	45	31	-14	Negligible	0.0	Negligible	NOAEL
SSR6	32	43	34	-10	Negligible	0.1	Negligible	NOAEL
SSR7	25	42	27	-15	Negligible	0.0	Negligible	NOAEL
SSR8	25	39	27	-12	Negligible	0.0	Negligible	NOAEL
SSR9	28	37	30	-7	Negligible	0.0	Negligible	NOAEL
SSR10	28	37	30	-8	Negligible	0.0	Negligible	NOAEL
Night-time (23:00 - 07:00)								
SSR1	28	30	30	0	Negligible	0.3	Negligible	NOAEL
SSR2	31	31	33	2	Low	0.5	Negligible	NOAEL
SSR3	33	31	35	4	Low	0.8	Negligible	NOAEL
SSR4	25	29	27	-2	Negligible	0.3	Negligible	NOAEL
SSR5	30	35	32	-3	Negligible	0.2	Negligible	NOAEL

NSR identifier	BS4142 Assessment					IEMA Assessment		WHO NNG Assessment
	Predicted *specific sound level* (dB $L_{Aeq,T}$)	*Background sound level* (dB L_{A90})	*Rating level* (dB $L_{Ar,T}$)	Difference between $L_{Ar,T}$ and L_{A90} (dB)	Magnitude of effect (BS 4142 criteria)	Change in Ambient Sound Level (dB $L_{Aeq,T}$)	Magnitude of Effect	Magnitude of effect
SSR6	33	35	35	0	Negligible	0.5	Negligible	NOAEL
SSR7	26	36	28	-8	Negligible	0.0	Negligible	NOAEL
SSR8	27	34	29	-6	Negligible	0.1	Negligible	NOAEL
SSR9	30	29	32	2	Low	0.6	Negligible	NOAEL
SSR10	29	29	31	1	Low	0.5	Negligible	NOAEL

29. **Table 23.4.7** shows that the predicted rating levels are of negligible magnitude of effect, at worst, during the daytime at all NSRs using the BS 4142 assessment criteria.

30. During the night-time the predicted rating level is +4dB above the existing background sound level at SSR3; indicating a magnitude of effect of low when using the BS 4142 criteria. The IEMA and NNG criteria are of negligible impact significance and below LOAEL, respectively.

31. Detailed analysis of the predicted noise levels at NSRs indicate that noise associated with the SGT and SHRs are the dominant contributors of noise from the onshore substation.

32. Mitigation measures to reduce the predicted night-time rating level include attenuating the SGT to achieve a source noise level of 85 dB L_{WA} and attenuating the SHRs to achieve a source noise level of 84 dB L_{WA}.

33. The predicted noise level at each NSR for the mitigated noise levels are presented in **Table 23.4.8**.

Table 23.4.8: Operational noise assessment - DEP in Isolation mitigated

NSR identifier	BS4142 Assessment					IEMA Assessment		WHO NNG Assessment
	Predicted *specific sound level* (dB $L_{Aeq,T}$)	*Background sound level* (dB L_{A90})	Rating level (dB $L_{Ar,T}$)	Difference between $L_{Ar,T}$ and L_{A90} (dB)	Magnitude of effect (BS 4142 criteria)	Change in Ambient Sound Level (dB $L_{Aeq,T}$)	Magnitude of Effect	Magnitude of effect
Night-time (23:00 - 07:00)								
SSR1	24	30	26	-3	Negligible	0.2	Negligible	NOAEL
SSR2	29	31	31	0	Negligible	0.3	Negligible	NOAEL
SSR3	30	31	32	1	Low	0.1	Negligible	NOAEL
SSR4	21	29	23	-6	Negligible	0.1	Negligible	NOAEL
SSR5	27	35	29	-6	Negligible	0.1	Negligible	NOAEL
SSR6	30	35	32	-3	Negligible	0.3	Negligible	NOAEL
SSR7	24	36	26	-10	Negligible	0.0	Negligible	NOAEL
SSR8	23	34	25	-10	Negligible	0.0	Negligible	NOAEL
SSR9	26	29	28	-1	Negligible	0.3	Negligible	NOAEL
SSR10	25	29	27	-2	Negligible	0.2	Negligible	NOAEL

34. **Table 23.4.8** shows that, using the BS 4142 criteria, magnitudes of negligible effect are predicted at all NSRs except SSR3, at which an effect of low magnitude is predicted. The assessments against the IEMA and WHO NNG criteria, at all identified NSRs, predict a negligible magnitude of effect and below LOAEL, respectively.

23.4.4 Summary

35. Operational noise effects were assessed in accordance with the guidance provided in BS 4142:2014+A1:2019 for the proposed SEP and DEP onshore substations, under the proposed SEP and DEP and in isolation scenarios.

36. An unmitigated effect of medium magnitude was predicted for the SEP and DEP scenario at SSR3 when assessing against the BS 4142 criteria.

37. BS 4142 considers in section 11 that:

"*Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration*".

38. This is referring to the context and the guidance suggests:

"*Where background sound levels and rating levels are minor, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night*."

39. Assessing against the IEMA and WHO NNG criteria, magnitudes of effect were negligible or low for all scenarios. Therefore, any mitigation measures would only be recommended to demonstrate application of Best Practicable Means.

40. Mitigation could involve a combination of attenuation and design refinement of components to achieve the required levels. Mitigation measures were provided in order to minimise potential noise effects at nearby NSRs and include:

- Attenuation of the Super Grid Transformer (SGT) components to achieve a source noise level of 80 dB L_{WA} (SEP and DEP only)
- Attenuation of the 220kV and 400kV Filter Reactor Air Core Reactors to achieve a source noise level of 82 dB L_{WA} (SEP and DEP only)
- Attenuation of the Shunt Reactor (SHR) Air Core Reactor components to achieve a source noise level of 80 dB L_{WA} (SEP and DEP only)
- Attenuation of the Super Grid Transformer (SGT) components to achieve a source noise level of 85 dB L_{WA} (SEP or DEP in isolation)
- Attenuation of the 220kV Shunt Reactor (SHR) Air Core Reactor components to achieve a source noise level of 84 dB L_{WA} (SEP or DEP in isolation).

41. After implementation of the proposed mitigation measures, a negligible to low magnitude of effect, at worst, is predicted at all identified NSRs using the BS 4142 criteria. Using the IEMA and WHO NNG criteria, effects are of negligible magnitude and below LOAEL, respectively.

References

BSI (2019). British Standards Institution [BS] 4142: 2014+A1:2019 Methods for rating and assessing industrial and commercial sound, BSI, London. Available at: https://shop.bsigroup.com/products/methods-for-rating-and-assessing-industrial-and-commercial-sound/standard

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

International Organization for Standardization (1996). ISO9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation. ISO, Switzerland.

World Health Organization (2009). Night Noise Guidelines for Europe

ANNEX 23.4.1.1 MODELLING ASSUMPTIONS

Table A23.4.1 Data sources

Data	Source file	Origin
Nearby building locations	Base Mapping FEB22.geo	Ordnance Survey Vectormap
Site topography	Excel worksheet PM780-EQ-Z-FD-00001_09	Equinor
Wider area topography	Lidar DTM 2m TG10SE.tif, DTM 2m TG20SW.tif Ordnance Survey Vector Map Ordnance Survey Map Ground effects Ordnance Survey Map Attenuation Area	Defra LiDAR survey data (available at Defra Survey Data Download) Ordnance Survey
Site layout	Drawing named DEPSEP-SIE-02-XX-LY-EP-0003 (OPTION 2)-200Mx225M PLOT	Equinor
Site Noise Data	Excel workbook DEP_SEP_noise_data Excel worksheet DEP_SEP_Substation Equipment List	Equinor

Acoustic model settings

Acoustic modelling has been undertaken using the following model settings:

- Maximum search radius of 5000m.
- Maximum number of reflections: 3
- Noise predictions carried out at each floor level of sensitive receptors, ground floor level is 1.5m above ground, each storey is 2.5m major.
- Side diffraction enabled.
- Ground absorption has been set as:
  - Onshore Substation site G = 0 (hard ground);
  - Outside Onshore Substation site G = 0.5, except Quarry G = 0