Thurrock Flexible Generation Plant

Environmental Statement Volume 6
Appendix 11.4: Operational Noise Assessment Methodology and Results

Date: February 2020

Environmental Impact Assessment

Environmental Statement

Volume 6

Appendix 11.4

Copyright © RPS

The material presented in this report is confidential. This report has been prepared for the exclusive use of Thurrock Power Ltd and shall not be distributed or made available to any other company or person without the knowledge and written consent of RPS.

Report Number: OXF10872

Version: Final

Date: February 2020

Prepared by: Charlotte Birch

Contributors: Josh Wilson

Checked by: Simon Stephenson

This report is also downloadable from the Thurrock Flexible Generation Plant website at:
http://www.thurrockpower.co.uk

Thurrock Power Ltd

1st Floor

145 Kensington Church Street

London W8 7LP

Table of Contents

List of Tables

List of Figures

Summary

This Appendix provides supporting information on the assessment methodology and modelling results regarding operational noise impacts associated with Thurrock FGP. Discussion of the results presented within this Appendix, is presented in Volume 3, Chapter 11: Noise and Vibration.

Qualifications

This document has been prepared by Charlotte Birch, an Acoustic Consultant and Associate Member of the Institute of Acoustics, who has two years' experience of environmental noise impact assessment.

It has been checked by Josh Wilson, an Acoustic Consultant and Corporate Member of the Institute of Acoustics, who has four years' experience of environmental noise impact assessment.

It has been authorised by Simon Stephenson, a Technical Director within the Acoustics Team and Corporate Member of the Institute of Acoustics, who has 20 years' experience of environmental noise impact assessment.

1. Calculation and Modelling Inputs

1.1 Noise source data & noise model methodology

1.1.1 Noise source data for the assessment has been based on manufacturers' data provided to the project team by the equipment manufacturer. Where manufacturers' data are not available, measurement data obtained by RPS during operational compliance surveys on similar gas-fired engine reserve and battery storage facilities has been used to determine appropriate sound power levels for the chosen equipment.

1.1.2 Source levels have been supplied by the manufacturer for the broadband sound power level of the transformers.

1.1.3 In order to determine the specific sound levels resulting from the operation of the proposed development, a noise model has been built using SoundPlan v7.4 noise modelling software. The model predicts noise levels under light down-wind conditions based on hemispherical propagation, atmospheric absorption, ground effects, screening and directivity based on the procedure detailed in ISO 9613-2:1996 (International Organisation for Standardisation (ISO), 1996).

1.1 Description of sound sources

1.1.1 The maximum design envelope parameters are detailed in Volume 3, Chapter 11: Noise and Vibration.

1.1.2 There are two main design options proposed for the gas engines, using 48no. 12.5 MWe or 33no. 18.4 MWe models. Both models have been assessed and the noise impacts from the larger 18.4 MWe are greater, so those are the results presented in this appendix as the worst-case option. The design incorporates two enclosures housing four engines each, and four enclosures housing six engines each.

1.1.3 Each engine has an associated stack/exhaust terminating at 40 m above ground level (AGL), air inlet louvres at the ends of the enclosures and air outlet louvres on the roof. Connection from the main gas network to the facility is provided via a gas kiosk enclosure. The inverters, batteries and air cooling plant are assumed to be containerised (the worst-case assumption; a building housing them would provide greater noise attenuation).

1.1.4 The radiators for the gas engines are modelled as positioned at 5.5 m above ground level (AGL). Air coolers associated with the containerised battery and inverter units are located approximately 1.7 m AGL. The measurement data used for the assessment are representative of radiators and coolers operating at 100% cooling capacity. As such, the predicted sound levels due to the radiators and coolers are a worst case and representative of the proposed development operating at full capacity with ambient air temperatures in excess of 30ºC. These conditions are most unlikely to regularly occur, particularly during the evening and even less so during the night-time. Consequently, the assessment is precautionary for the evening and night-time periods.

1.1.5 Based on professional experience and review of available data, all sound sources associated with the engines, including the air inlets, outlets and radiators, are considered to produce sound with broadband frequency content. The containerised battery units produce broadband sound with tonal components; however, it is the air conditioning (AC) units and inverters which are dominant and as such, it is considered that the overall emissions from the containers are broadband in character. The transformers produce broadband sound with a tonal component at 100 Hz and harmonics thereof at source.

1.1.6 The above design resulted in the most onerous noise levels at the noise-sensitive receptors (NSRs), and as such, has been the design which has been assessed in full to provide a worst-case scenario.

1.1.7 Details on the sound power levels for various plant items used within the noise model are presented in Table 1.2.

1.2 Operating conditions

1.2.1 The proposed development is planned to operate during peak periods of electricity demand or to prevent system instability. The applicant has indicated that this would most typically be for a period ranging from one to seven hours, between 08:00 and 20:00 hrs. However, there is the potential that the proposed development could be required to operate during a major power shortage or system stress events (e.g. a Notification of Inadequate System Margin) at any time of the day or night. It should be noted that the likelihood of the facility being required to start up at night is extremely low as peak electricity demand does not occur overnight.

1.2.2 Figure 1.1 shows an indicative typical pattern of average daily operating hours in each month of the year. A further breakdown of indicative typical operating hours at each time of day during the winter, summer and annual periods is presented in Table 1.1. These breakdowns are based on data from similar operational peaking plant provided by the applicant; they are indicative of likely seasonal and diurnal cycles to inform the assessment of impacts, but are not fixed operating hours of the proposed facility.

1.2.3 As can be seen from Table 1.1, operational hours during night-time periods (2300 – 0700) account for less than 2% of the total operating hours over the course of a year, at a similar peaking power facility site operated by the applicant. Significant night-time operation is therefore unlikely.

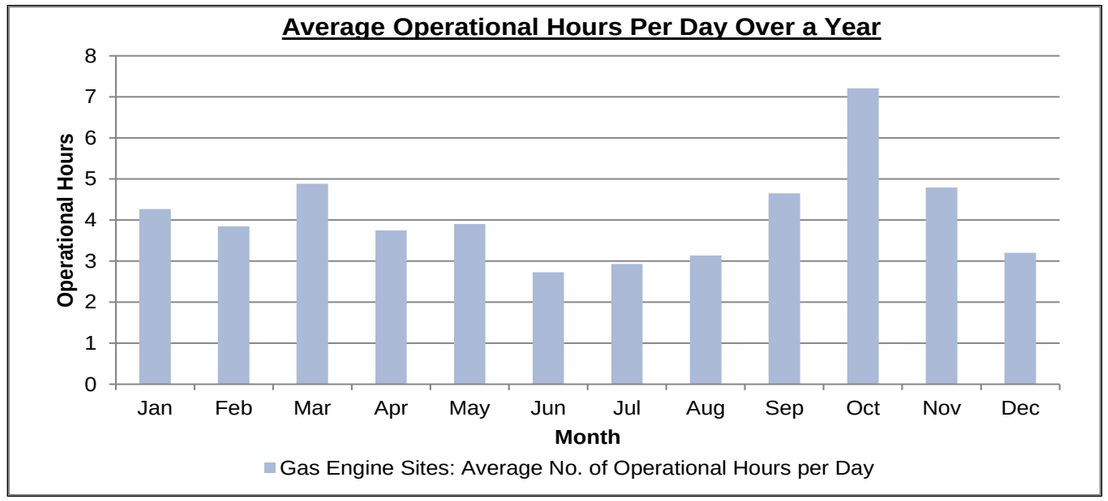

Figure 1.1: Average operational hours per day over a year.

Table 1.1: Typical daily operating times breakdown of an operational peaking plant.

Season	Period (hours)	Percentage total operational time	Approx. operational hours (assuming 4,000 hr yearly total)
Winter	0400 – 0700	1	40
	0700 – 1600	19	760
	1600 – 1900	27	1,080
	1900 – 2300	6	240
Summer	0400 – 0700	1	40
	0700 – 1600	22	880
	1600 – 1900	17	680
	1900 – 2300	6	240
All	2300 – 0400	0.2	8

Table 1.2: Noise model inputs for individual noise generating plant items.

Source	Number	Height above ground (m) (AGL)	Overall sound power level (dBA)	Linear octave band sound power levels (dB)								
				31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Engine enclosure (containing 4 engines)	2	7.5	91	-	113	106	103	96	85	76	61	-
Engine enclosure (containing 6 engines)	4	7.5	93	-	115	108	105	98	86	77	62	-
Exhaust body and ductwork	32	4.5 – 1.75	88	103	97	82	90	83	81	84	58	40
Exhaust outlet	32	40	86	108	99	89	80	83	79	76	79	76
Radiators	64	5.5	86	-	100	95	92	89	84	79	75	70
Air inlet	64	3	86	113	106	88	84	74	76	78	71	76
Air outlet	32	10	89	116	109	91	87	77	79	81	74	79
Gas kiosk building	1	5	63	-	74	56	57	60	57	58	43	30
Battery containers (walls/roof)	52	6	72	78	78	74	71	69	67	64	59	60
Battery container inverter air intakes	104	2.75 – 5.75	72	-	63	66	67	68	66	66	62	58
Battery container AC units	208	1.5	76	85	82	80	75	73	72	66	63	58
Transformer (33 kV to 132 kV & 11 kV to 132 kV)	8	2	83	-	79	84	83	83	77	72	67	60
Transformer (132 kV to 275 kV)	3	2	91	-	87	92	91	91	85	80	75	68

2. Results

2.1 Modelling outputs

2.1.1 The predicted specific sound levels at the identified most-affected NSRs, as described in Volume 3, Chapter 11: Noise and Vibration, due to the operation of Thurrock Flexible Generation Plant operating with 18.4 MWe engines are provided in Table 2.1.

Table 2.1: Predicted specific sound levels at receptors.

Receptor	Floor	Predicted Specific Sound level L_s dB(A)
Byron Gardens	Ground Floor	42
	First Floor	43
Gun Hill Farm	Ground Floor	41
	First Floor	41
Galsworthy Road	Ground Floor	42
	First Floor	42
Havers Lodge	Ground Floor	43
	First Floor	44
Buckland	Ground Floor	39
	First Floor	41
St James' Church	Ground Floor	41
	First Floor	42
Clarendon Road	Ground Floor	31
	First Floor	31

2.1.2 The model results indicating the partial sound pressure level contribution from each individual source of noise from the proposed development to the receptors listed above are presented in Table 2.2.

Table 2.2: Partial sound pressure levels at receptors.

Source	Byron Gardens	Gun Hill Farm	Galsworthy Road	Havers Lodge	Buckland	St James' Church	Clarendon Road
Gas Engines							
Air Inlets	37	36	37	31	35	36	19
Air Outlets	33	32	33	35	32	34	24
Engine enclosures	37	36	36	39	36	37	22
Exhaust ducts	23	23	22	29	23	25	8
Exhaust outlets	30	29	30	34	29	30	15
Gas kiosk building	-2	-1	-2	6	-1	1	-23
Radiators	33	30	32	36	30	32	13
Stack body	30	29	29	34	29	30	13
Battery containers							
AC units	29	26	28	30	21	27	9
Air inverter intake	24	19	23	23	13	20	1
Battery containers	21	17	20	21	12	18	0
Substation							
Transformers 33 kV – 132 kV & 11 kV to 132 kV	22	15	21	19	13	16	6
Transformers 132 kV to 275 kV	23	22	24	24	21	21	8

2.1.3 The predicted source contribution levels given in Table 2.2 indicate that the transformers make a negligible contribution to the overall noise level from the proposed development. As it is considered that the only source of tonal noise from the proposed development is from the transformer, it is most unlikely that noise levels at the nearby NSRs would be perceived or characterised as tonal.

2.1.4 Operational noise contours are provided in Figure 4.14 and Figure 4.15 of Volume 3, Chapter 11: Noise and Vibration.

2.2 Assessment

2.2.1 An initial estimate of impact undertaken in accordance with BS 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound' (British Standards Institution (BSI), 2019), is shown in Table 2.3 for the daytime, evening and night-time periods. Predicted specific sound levels for the day and evening are taken at ground floor level with night time level taken at first floor level.

2.2.2 The subjective method for determining rating penalties has been used to determine appropriate corrections for each receptor and assessment period. It is considered that the specific sound will not be characterised as intermittent or impulsive, so no penalties have been applied for intermittency or impulsivity. As it is considered that the only source of tonal noise from the proposed development is from the transformer and the contribution from this source to the overall specific sound is negligible, it is most unlikely that noise levels at the nearby NSRs would be perceived or characterised as tonal. As such, no penalties have been applied for tonality.

Table 2.3: BS 4142:2014+A1:2019 assessment of impact.

Location	Representative baseline sound levels		Specific sound level (dB L_s)	Rating penalty (dB)	Rating level (dB $L_{Ar,Tr}$)	Rating level difference (dB)
	Background (dB $L_{A90,T}$)	Residual dB ($L_{Aeq,T}$)				
Day						
Byron Gardens	40	61	42	0	42	**+2**
Gun Hill Farm	39	48	41	0	41	**+2**
Galsworthy Road	40	61	42	0	42	**+2**
Havers Lodge	42	57	43	0	43	**+1**
Buckland	38	48	39	0	39	**+1**
St James' Church	39	48	41	0	41	**+2**
Clarendon Road	42	57	31	0	28	**-11**
Evening						
Byron Gardens	36	55	42	0	42	**+6**
Gun Hill Farm	33	44	41	0	41	**+8**
Galsworthy Road	36	55	42	0	42	**+6**
Havers Lodge	36	49	43	0	43	**+7**
Buckland	34	42	39	0	39	**+5**
St James' Church	33	44	41	0	41	**+8**
Clarendon Road	36	49	31	0	28	**-5**
Night						
Byron Gardens	35	49	43	0	43	**+8**
Gun Hill Farm	34	41	41	0	41	**+7**
Galsworthy Road	35	49	42	0	42	**+7**
Havers Lodge	33	45	44	0	44	**+11**
Buckland	32	39	41	0	41	**+9**
St James' Church	34	41	41	0	41	**+8**
Clarendon Road	33	45	31	0	28	**-2**

2.2.3 The results of the initial estimate of impact in Table 2.3 are described in the following paragraphs.

2.2.4 During the daytime, when the proposed development is most likely to operate, the rating level is 2 dB above the background sound level at the most affected receptors, Byron Gardens, Gun Hill Farm, Galsworthy Road and St James' Church. This is 3 dB below the threshold level at which a moderate impact is likely. At the other receptors, predicted rating levels are between 1 dB above and 14 dB below background sound levels. The results of the initial estimate of impact during the daytime are therefore indicative of negligible impacts at all receptors, depending on the context.

2.2.5 During the evening, the rating level is 8 dB above the background sound level at the most affected receptor, St James' Church. This is 3 dB above the threshold level at which a minor to moderate adverse impact is likely, depending on the context. At the other receptors, predicted rating levels are between 8 dB below and 7 dB above background sound levels. This is indicative of minor to moderate impacts at all other receptors, depending on the context, with the exception of Clarendon Road which experiences no change.

2.2.6 During the night-time, when the proposed development is least likely to operate, the rating level is 11 dB above the background sound level at the most affected receptor, Havers Lodge. This is, initially, indicative of a moderate to major impact at this receptor, depending on the context. At the other receptors, predicted rating levels are between 5 dB below and 7 dB above background sound levels. This is indicative of minor to moderate impacts at all other receptors, depending on the context, with the exception of Clarendon Road which experiences no change.

2.2.7 To accord with the guidance contained within BS 4142:2014+A1:2019 and provide a thorough assessment, consideration of the context of the scenario has been undertaken. Consideration of the context is provided in terms of the assessment of the absolute noise levels and the change in ambient sound due to the specific sound as addressed further on in this section.

Likely operating conditions and national demand

2.2.8 Based on the applicant's experience of operating other flexible generation facilities, knowledge of electricity market conditions and times of peak electricity demand, the proposed development is expected to operate during the night-time only in exceptional circumstances when there is insufficient generation from alternative sources and there are significant unplanned outages in baseload generation.

2.2.9 Local and national demand for energy infrastructure of this type is being driven by changes in how energy is generated, stored and distributed. Large, centralised, fossil fuel-based energy generation is in decline and the decline is projected to continue. Substantial increases in the proportion of energy which will be delivered by renewable energy sources are expected in the near future; however, renewable energy generation can be intermittent. As such, the demand for developments of this type which are able to step-in and provide support to the network in periods of high demand has increased.

2.2.10 As can be seen from Table 1.1, night-time operating hours of similar peaking plant developments are minimal.

2.2.11 The average operational hours per day provided in Figure 1.1 indicate that, during the more sensitive warmer months (April to September) when people are more likely to have windows open or to be outside, the proposed development will operate for fewer hours on any given day. The cooler months (from October to March) are less sensitive because people are more likely to have windows closed or to be inside.

Noise change and absolute noise level assessment

2.2.12 The ambient sound levels, with and without the proposed development in operation, are shown in Table 2.4. For steady sources of a similar character, a 3 dB change is generally taken as the minimum change that is perceptible to most people.

Table 2.4: Ambient noise level change assessment.

Location	Baseline residual sound level (dB $L_{Aeq,T}$)	Specific sound level (dB $L_{Aeq,T}$)	Combined sound level (dB $L_{Aeq,T}$)	Change in sound level (dB)
Day				
Byron Gardens	61	42	61	**0**
Gun Hill Farm	48	41	49	**+1**
Galsworthy Road	61	42	61	**0**
Havers Lodge	57	43	57	**0**
Buckland	48	39	49	**+1**
St James' Church	48	41	49	**+1**
Clarendon Road	57	31	57	**0**
Evening				
Byron Gardens	55	42	55	**0**
Gun Hill Farm	44	41	46	**+2**
Galsworthy Road	55	42	55	**0**
Havers Lodge	49	43	50	**+1**
Buckland	42	39	44	**+2**
St James' Church	44	41	46	**+2**
Clarendon Road	49	31	49	**0**
Night				
Byron Gardens	49	43	50	**+1**
Gun Hill Farm	41	41	44	**+3**

Location	Baseline residual sound level (dB $L_{Aeq,T}$)	Specific sound level (dB $L_{Aeq,T}$)	Combined sound level (dB $L_{Aeq,T}$)	Change in sound level (dB)
Galsworthy Road	49	42	50	**+1**
Havers Lodge	45	44	47	**+3**
Buckland	39	41	43	**+4**
St James' Church	41	42	45	**+4**
Clarendon Road	45	31	45	**0**

2.2.13 A maximum increase of 4 dB above baseline residual sound levels is predicted during the night-time periods at Buckland and St James' Church as a result of the operation of the proposed development, with an increase of 3 dB above baseline residual sound levels predicted at Gun Hill Farm and Havers Lodge during the night-time. For a steady sound source with no discernible impulsive or tonal characteristics, a 3 dB change is generally taken as the minimum change which is perceptible to most people. As such, an increase above baseline residual sound levels of 4 dB, as presented in Table 2.4, is likely to be just noticeable. Noise changes during other time periods are all below this threshold of perception.

2.2.14 With regard to absolute sound levels presented in Table 2.4, the specific sound level is significantly below the existing ambient noise level during the day and will not contribute to or cause any change to ambient noise levels. It is therefore considered that sound from the proposed development is most unlikely to cause, or significantly contribute to, any exceedance of the World Health Organisation (WHO) criterion for the onset of annoyance during the daytime, of 55 dB L_{Aeq} (Berglund et al., 1999)[1]. Furthermore, at receptors where the combined sound level exceeds the 55 dB L_{Aeq} threshold level, the baseline residual level already exceeds 55 dB before the specific sound is added. It is therefore considered that the site will not result in adverse effects to amenity during the daytime.

2.2.15 The level for the onset of sleep disturbance during the night-time (i.e. lowest observed adverse effect level) contained in the WHO Guidance is 45 dB L_{Aeq} (at the façade), equivalent to a free-field level of 42 dB L_{Aeq}. While this threshold level is exceeded at all receptors, the baseline residual sound level already exceeds the WHO level at the majority of receptors, including Havers Lodge where the change in sound level is at the threshold of perception. It is therefore considered that while WHO guideline levels may be exceeded, the additional impact from the operation of the proposed development during the night on any sleep disturbance will be minimal.

2.2.16 Through this stage of the assessment it is shown that although Havers Lodge experiences the highest rating level difference (Table 2.3), the impact of the sound is found to be lower than initially predicted after consideration of the context of the sound, and the initial estimate of a moderate to major impact can be reduced to a moderate impact. However, after consideration of the context, the receptors Buckland and St James' Church are found to experience a +4 dB noise change at night, and also experience a night-time sound level above the threshold of sleep disturbance. Therefore the initial estimate of a minor to moderate impact must remain a moderate impact.

[1] Although there has since been an update to the WHO guidance in the form of the 2018 Environmental Noise Guidelines for the European Region, these specifically do not apply to industrial noise sources.

3. References

Bergland, B., Lindvall, T., Schwela, D. H. (1999) Guidelines for Community Noise. Geneva, World Health Organisation.

British Standards Institution (BSI) (2019) British Standard 4142:2014+A1:2019. Methods for rating and assessing industrial and commercial sound. London, BSI.

International Organisation for Standardisation (ISO) (1996) ISO 9613-2:1996. Acoustics: Attenuation of sound during propagation outdoors – Part 2: General method of calculation. Geneva, ISO.