Thurrock Flexible Generation Plant

Preliminary Environmental Information Report
Appendix 11.4: Operational Noise Assessment Methodology and Results

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Environmental Impact Assessment

Preliminary Environmental Information Report

Volume 6

Appendix 11.4

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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 Chapter 11: Noise and Vibration.

Qualifications

This document has been prepared by Jon Baldwin, a Senior Acoustic Consultant and full Member of the Institute of Acoustics, who has six years' experience of environmental noise impact assessment.

It has been checked by Stephen Scott, a Senior Acoustic Consultant and full member of the Institute of Acoustics, who has 20 years' experience of environmental noise impact assessment.

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

1. Calculations and Modelling

1.1 Noise source data & noise model methodology

1.1.1 Noise source data for the assessment has been based on manufacturer's data provided to the project team by the equipment manufacturer. Where other manufacturers' data are not available, measurement data obtained by RPS during operational compliance surveys on similar gas-fired engine reserve 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 on 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 v8 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 Each gas engine has been modelled housed within individual enclosures (27.8 (L) x 6.5 (W) x 7.5 (H) m). Each engine enclosure 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 containerised.

1.1.3 The radiators for the gas engines are positioned 5.5 m 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 30 ºC. These conditions are most unlikely to regularly occur at any time, particularly during the evening and even less so during the night-time. Consequently, the assessment is likely to be over precautionary for the evening and night-time periods.

1.1.4 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 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.

1.1.5 Details on the sound power levels for various plant items used within the noise model is 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 (i.e. typically 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 (NISM)) 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 demand does not occur overnight.

1.2.2 Figure 1.1 below indicates the anticipated average hours of operation per day in each month.

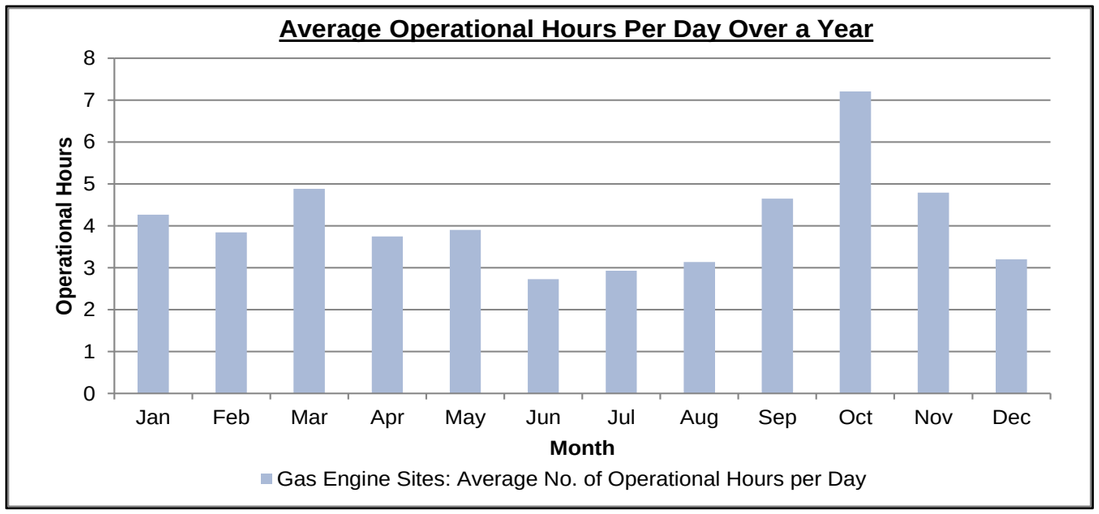

Figure 1.1: Average operational hours per day over a year.

1.2.3 A yearly breakdown of operating time for similar operational peaking plant is presented in Table 1.1.

Table 1.1: Operational breakdown of operational peaking plant facility.

Season	Period (hours)	Percentage total operational time	Approx. operational hours (assuming 1,500 hr yearly total)
Winter	0400 – 0700	1	15
	0700 – 1600	19	285
	1600 – 1900	27	405
	1900 – 2300	6	90
Summer	0400 – 0700	1	15
	0700 – 1600	22	330
	1600 – 1900	17	255
	1900 – 2300	6	90
All	2300 - 0400	0.2	2

1.2.4 As can be seen from Table 1.1, operational hours during night-time periods totalled two hours over the course of a year, assuming a 1,500 hr yearly total operating time, at an operational peaking plant facility. Whilst the maximum design envelope parameters for the proposed development have considered an operational yearly total of 4,000 hours, it is considered that the majority of additional operating hours would be during the day and evening periods and, as such, any increase in night-time operation would be minimal.

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

Source	Number	Height above ground m	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	60	7.5	90	-	80	65	57	45	37	26	15	16
Exhaust body and ductwork	60	4.5 – 1.75	85	-	95	86	88	79	76	72	78	72
Exhaust outlet	60	40	80	117	101	80	70	40	41	44	36	25
Radiators	120	5.5	75	-	94	85	75	73	65	59	45	50
Air inlet	240	3	77	-	86	84	79	71	63	62	72	65
Air outlet	120	10	80	-	91	84	78	79	66	71	74	69
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	8	2	83	-	79	84	83	83	77	72	67	60
Transformer (132 kV – 275 kV)	3	2	91	-	87	92	91	91	85	80	75	68

1.3 Results

1.3.1 The predicted specific sound levels at the identified worst affected noise sensitive receptors (NSRs), as described in Volume 3, Chapter 11: Noise and Vibration, due to the operation of Thurrock Flexible Generation Plant are provided in Table 1.3.

Table 1.3: Predicted specific sound levels at receptors.

Receptor	Floor	Predicted Specific Sound level L_s dB(A)
Byron Gardens	Ground Floor	36
	First Floor	37
Gun Hill Farm	Ground Floor	35
	First Floor	35
Galsworthy Road	Ground Floor	35
	First Floor	36
Havers Lodge	Ground Floor	38
	First Floor	39
Buckland	Ground Floor	33
	First Floor	35
St James' Church	Ground Floor	36
	First Floor	37

1.3.2 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 is presented in Table 1.4.

Table 1.4: Partial sound pressure levels at receptors.

Source	Byron Gardens	Gun Hill Farm	Galsworthy Road	Havers Lodge	Buckland	St James' Church
Gas Engines						
Air Inlets	26	24	25	19	24	24
Air Outlets	26	25	25	28	26	28
Engine enclosures	30	29	29	32	28	30
Exhaust ducts	23	21	22	28	22	24
Exhaust outlets	29	28	27	31	27	29
Gas kiosk building	-5	-5	-6	1	-4	-2
Radiators	22	21	21	26	21	24
Stack body	29	28	28	31	28	29
Battery containers						
AC units	29	24	27	26	18	26
Air inverter intake	21	17	20	19	10	18
Battery containers	19	15	18	17	9	16
Substation						
Transformers 33 kV – 132 kV & 11 kV to 132 kV	20	16	18	17	15	16
Transformers 132 kV to 275 kV	24	19	23	20	18	20

1.3.3 The predicted source contribution levels given in Table 1.4, indicate that the transformer, provides 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.

1.3.4 Operational noise contours are provided in Figure 4.18 and Figure 4.19, Volume 3, Chapter 11: Noise and Vibration.

1.4 Assessment

BS 4142:2014 assessment

1.4.1 An initial estimate of impact undertaken in accordance with BS 4142:2014 'Methods for rating and assessing industrial and commercial sound' (British Standards Institution (BSI), 2014), is shown in Table 1.5 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.

1.4.2 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, therefore 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 1.5: BS 4142:2014 assessment of impact.

Location	Representative baseline sound levels		Specific sound level	Rating penalty	Rating level	Rating level difference
	Background dB $L_{A90,T}$	Residual dB $L_{Aeq,T}$	dB L_s	dB	dB $L_{Ar,Tr}$	dB
Day						
Byron Gardens	40	61	36	0	36	**-4**
Gun Hill Farm	39	48	35	0	35	**-4**
Galsworthy Road	40	61	35	0	35	**-5**
Havers Lodge	42	57	38	0	38	**-4**
Buckland	38	48	33	0	33	**-5**
St James' Church	39	48	36	0	36	**-3**
Evening						
Byron Gardens	36	55	36	0	36	**0**
Gun Hill Farm	33	44	35	0	35	**+2**
Galsworthy Road	36	55	35	0	35	**-1**
Havers Lodge	36	49	38	0	38	**+2**
Buckland	34	42	33	0	33	**-1**
St James' Church	33	44	36	0	36	**+3**
Night						
Byron Gardens	35	49	37	0	37	**+2**
Gun Hill Farm	34	41	35	0	35	**+1**
Galsworthy Road	35	49	36	0	36	**+1**
Havers Lodge	33	45	39	0	39	**+6**
Buckland	32	39	35	0	35	**+3**
St James' Church	34	41	37	0	37	**+3**

1.4.3 The results of the initial estimate of impact in Table 1.5 are described in the following paragraphs.

1.4.4 During the daytime, when the proposed development is most likely to operate, the rating level is 3 dB below the background sound level at the most affected receptor, St James' Church. This is 8 dB below the threshold level at which a moderate impact is likely. At the other receptors, predicted rating levels are between 4 dB and 5 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.

1.4.5 During the evening, the rating level is 3 dB above the background sound level at the most affected receptor, St James' Church. This is 2 dB below the threshold level at which a moderate impact is likely. At the other receptors, predicted rating levels are between 2 dB above and 1 dB below background sound levels. This is indicative of negligible or minor impacts at all receptors, depending on the context.

1.4.6 During the night-time, when the proposed development is least likely to operate, the rating level is 6 dB above the background sound level at the most affected receptor, Havers Lodge. This is indicative of a moderate impact at this receptor, depending on the context. At the other receptors, predicted rating levels are between 1 dB and 3 dB above background sound levels. This is indicative of minor impacts at all other receptors, depending on the context.

1.4.7 To accord with the guidance contained within BS 4142:2014 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

1.4.8 Data which are currently available on the likely operating regime of the proposed development indicates that it will only ever run during the night-time in exceptional circumstances when there is insufficient generation from alternative sources and there are significant unplanned outages in baseload generation. As can be seen from Table 1.1, night-time operating hours of similar peaking plant developments are minimal.

1.4.9 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.

1.4.10 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. Recent projections undertaken by the applicant, indicate substantial increases in the proportion of energy which will be delivered by renewable energy sources 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. The proposed development will be providing critical support to meet local demand and to balance the national grid.

Noise change and absolute noise level assessment

1.4.11 The ambient sound levels, with and without the proposed development in operation, are shown in Table 1.6. For steady sources of a similar character, a 3 dB change is generally taken as the minimum change which is perceptible to most people.

Table 1.6: 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	36	61	**0**
Gun Hill Farm	48	35	48	**0**
Galsworthy Road	61	35	61	**0**
Havers Lodge	57	38	57	**0**
Buckland	48	33	48	**0**
St James' Church	48	36	48	**0**
Evening				
Byron Gardens	55	36	55	**0**
Gun Hill Farm	44	35	45	**+1**
Galsworthy Road	55	35	55	**0**
Havers Lodge	49	38	49	**0**
Buckland	42	33	43	**+1**
St James' Church	44	36	45	**+1**
Night				
Byron Gardens	49	37	49	**0**
Gun Hill Farm	41	35	42	**+1**
Galsworthy Road	49	36	49	**0**
Havers Lodge	45	39	46	**+1**
Buckland	39	35	40	**+1**
St James' Church	41	37	42	**+1**

1.4.12 Increases of 1 dB above baseline residual sound levels are predicted during the evening and night-time periods at Gun Hill Farm, Buckland and St James' Church, as a result of the operation of the proposed development. An increase of 1 dB above baseline residual sound levels is predicted at Havers Lodge during the night-time only. 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 1 dB, as presented in Table 1.6, is unlikely to be noticeable.

1.4.13 It has been demonstrated above that 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}. It is therefore considered that the site will not result in adverse effects to amenity during the daytime.

1.4.14 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} (façade), equivalent to a free-field level of 42 dB L_{Aeq}. Whilst this threshold level is exceeded at a number of receptors, the contribution from the proposed development to the overall sound level is negligible. It is therefore considered that, whilst WHO guideline levels may be exceeded, the impact from the operation of the proposed development during the night on sleep disturbance will be minimal.

1.5 Summary of Results

1.5.1 The determination of magnitude of impact at the identified receptors from the operation of the proposed development and corresponding significance is detailed Volume 3, Chapter 11: Noise and Vibration.

2. References

British Standards Institution (BSI) (2014) British Standard 4142:2014. Methods for rating and assessing industrial and commercial sound.

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