Energy Plant, Barry

Noise Assessment

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1 INTRODUCTION

1.1 Entran Ltd have been commissioned to undertake a noise assessment for a proposed gasification energy facility at Woodham Road, Barry.

1.2 The site is located on allocated industrial/retail land in relative proximity to other industrial buildings. The site is to be used for a renewable energy facility which would receive pre-treated waste wood from recycling operations for use as a biofuel. National planning policy as set out in the National Planning Policy Framework expresses a general preference for the development of brownfield over greenfield sites.

1.3 Amenity considerations also suggest that there should be good spatial separation between such sites and residential areas. However, the availability of suitably sized and located plots for creation of renewable energy facilities is increasingly limited. The site complies with relevant locational policy in that it is a brownfield site in an industrial area with good transport links and is relatively remote from residential property.

1.4 The site will be capable of producing renewable energy on a continuous basis at any time of the day, night or year and is not dependent on natural resources such as wind or sun in order to produce this energy. There will be sufficient capacity inside the timber store building to store excess feedstock to cater for any seasonal fluctuations in timber supply. The boiler hall as well as the steam turbine hall will be fully enclosed. The enclosed plant will result in improved containment, improved robustness of plant components and improved working conditions for site personnel. Other plant such as the air cooled condensers, an economiser, ID fans, baghouse filter etc will be located externally.

1.5 The purpose of this assessment is to establish the potential noise egress from the energy plant and, if necessary, formulate mitigation measures to protect existing noise sensitive receptors. Relevant national/local guidance on noise sources is presented in Section 2. Section 3 of this report presents the results of the surveys undertaken for the site. The assessment of noise is considered in Section 4 together with our recommendations for mitigation. Our conclusions are summarised in Section 5.

1.6 This Report is necessarily technical in nature and contains terminology relating to acoustics and noise. Therefore, a glossary together with a brief introduction to the subject of noise has been provided in Appendix A.

2 NOISE ASSESSMENT CRITERIA

BS4142:2014 'Method for Rating and assessing industrial and commercial sound'

2.1 For the purposes of this assessment, external noise levels at nearby noise sensitive receptors (e.g. residential use) have been derived on the basis of the guidance given in BS4142.

2.2 BS 4142 sets out a method to assess noise from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises. The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

2.3 The procedure contained in BS 4142 for assessing the likelihood of an adverse impact is to compare the measured or predicted noise level from the source in question, the $L_{Aeq,T}$ 'specific noise level', immediately outside the dwelling with the $L_{A90,T}$ background noise level.

2.4 Where the noise contains a '*distinguishable discrete continuous note (whine, hiss, screech, hum etc.)* then a correction of +3/4 dB (depending upon the likely perception of sound as tonal) is added to the specific noise level to obtain the 'rating' $L_{Ar,Tr}$ noise level. Similar penalties are allocated for *if there are distinct impulses in the noise (bangs, clicks, clatters or thumps)*'. The likelihood of an adverse impact is assessed by subtracting the background noise level from the rating noise level. BS 4142 states:

a) Typically, the greater this difference, the greater the magnitude of the impact.

b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.

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

d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

2.5 BS4142 further qualifies the above:

The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs. An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context.

Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.

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

1) The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.

Where background sound levels and rating levels are low, 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.

Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse.

2) The character and level of the residual sound compared to the character and level of the specific sound. Consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient or residual sound, to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound. Any sound parameters, sampling periods and averaging time periods used to undertake character comparisons should reflect the way in which sound of an industrial and/or commercial nature is likely to be perceived and how people react to it.

Consideration ought to be given to evidence on human response to sound and, in particular, industrial and/or commercial sound where it is available.

3) The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:

i) Facade insulation treatment;
ii) Ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and
iii) Acoustic screening.

3 ENVIRONMENTAL NOISE MEASUREMENTS

3.1 A number of noise surveys have been conducted between 2008 and 2015. The LPA are satisfied that the original assessment includes a baseline noise study that can be used for any subsequent noise assessment studies.

3.2 The critical issue will be night-time operational noise egress from the plant affecting the nearby residential receptors on, for example Cory Way.

3.3 The summary night-time results of the noise survey are presented below in Table 3.1.

Table 3.1: Noise Measurement Results

Location	**Lowest measured background sound level**	**Time**
	L*A90,*5min dB	
1. Dock View Road/Castleland Street	41.6	00:35
2. Cory Way	40.1	01:05
3. Estrella House Cei Dafydd	40.1	00:50

4 NOISE ASSESSMENT

4.1 The scheme promoter has identified the major sources of noise generators both internally (e.g. within the boiler house and the steam turbine hall) as well as externally located plant (e.g. economiser, baghouse filter, ID fans, the outlet stack, scrubber and ancillary equipment). The noise source data of all plant are referenced in Appendix B. It should be noted that air cooled condenser fans will be acoustically treated (large, slow moving with lagging) and the ID fan outlet will have a silencer within the stack or just outside the stack.

4.2 The sound reduction indices of the process buildings is shown in Table 4.1. For the boiler house, the walls will be single sheet steel cladding, louvers will be Colt Type R and the roller shutter door will be steel. The roof of the boiler builder will be Kingspan KS1000/Rw. The Steam Turbine hall will comprise of hollow cinder concrete blocks with an acoustic roller shutter door.

Table 4.1 Process Building SRI Data, Rw dB

Freq	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Boiler house								
West Façade	9	12	15	16	18	27	29	20
North Façade	9	12	15	16	18	27	29	20
East Façade	9	12	15	16	18	27	29	20
South Façade	9	12	15	16	18	27	29	20
Roof	20	18	20	24	20	29	39	47
Door	8	10	12	15	18	18	18	18
Louvre	5	7	11	12	13	14	12	9
Weather Louvre	3	4	4	4	4	4	4	4
Steam Turbine Hall								
West Façade	22	27	32	37	40	41	45	48
North Façade	22	27	32	37	40	41	45	48
East Façade	22	27	32	37	40	41	45	48
South Façade	22	27	32	37	40	41	45	48
Roof	22	27	32	37	40	41	45	48
Door	8	10	15	20	28	30	30	30
Louvre	5	7	11	12	13	14	12	9
Weather Louvre	3	4	4	4	4	4	4	4

4.3 The internal finishes of the process buildings are presented below in Table 4.2.

Table 4.2 Internal Sound Absorption Data

Freq	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Boiler House								
Walls	0.25	0.25	0.15	0.1	0.1	0.1	0.1	0.1
Ceiling	0.25	0.25	0.15	0.1	0.1	0.1	0.1	0.1
Floor	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Steam Turbine Hall								
Walls	0.20	0.30	0.35	0.40	0.40	0.40	0.30	0.25
Ceiling	0.20	0.30	0.35	0.40	0.40	0.40	0.30	0.25
Floor	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30

4.4 Taking into account the above internal finishes, the reverberant internal noise levels are calculated as follows:

Table 4.4 Internal Noise Levels, dB

Freq	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Boiler House								
Walls absorption	0.25	0.25	0.15	0.1	0.1	0.1	0.1	0.1
Ceiling absorption	0.25	0.25	0.15	0.1	0.1	0.1	0.1	0.1
Floor absorption	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Average absorption	0.31	0.31	0.23	0.19	0.19	0.19	0.19	0.19
10 log(4/Rc)	-27	-27	-25	-24	-24	-24	-24	-24
T60 (Norris-Eyring), secs	3.7	3.7	5.2	6.5	6.5	6.5	6.5	6.5
Reverberant Lp	**81.7**	**84.3**	**85.0**	**82.9**	**82.7**	**81.0**	**78.4**	**76.4**
Steam Turbine Hall								
Walls absorption	0.20	0.30	0.35	0.40	0.40	0.40	0.30	0.25
Ceiling absorption	0.20	0.30	0.35	0.40	0.40	0.40	0.30	0.25
Floor absorption	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Average absorption	0.220347826	0.3	0.339826087	0.379652174	0.379652174	0.379652174	0.3	0.260173913
10 log(4/Rc)	-19.09845725	-20.90661064	-21.70236205	-22.45388475	-22.45388475	-22.45388475	-20.90661064	-20.04771957
T60 (Norris-Eyring), secs	1.992150053	1.390231857	1.194120439	1.038506567	1.038506567	1.038506567	1.390231857	1.645518824
Lp	**90.4**	**88.8**	**83.9**	**81.7**	**83.1**	**86.7**	**88.2**	**87.1**

4.5 By taking into account the reverberant noise levels within the building, the sound reduction index of the building elements, the area of building element 'radiating' to the receptor and the external noise sources, a noise model was constructed using proprietary software IMMI2016 using the methodology outlined in ISO9613. Global parameters for the model are:

- Temperature 10°C; relative Humidity 70%;

- Light downwind propagation towards the receptor;

- No soft ground attenuation;

4.6 It has previously by others that location 2 (Cory Way) will be the key location for demonstrating compliance with the planning conditions. The results of the noise modelling including the external noise sources at this receptor is as follows:

Table 4.5 Receptor Noise Levels, dB

Cory Way									
	63 Hz	**125 Hz**	**250 Hz**	**500 Hz**	**1000 Hz**	**2000 Hz**	**4000 Hz**	**8000 Hz**	**dB(A)**
First Floor (4.5m)									
Spectrum (linear)	49.2	49.7	47.1	43.5	42.4	39.6	37.1	36.0	46.9

Initial Cumulative Noise Levels and BS4142 Assessment

4.7 The following cumulative noise levels have been calculated for the purposes of the BS4142 assessment:

Table 4.12 Initial Cumulative BS4142 Assessment, Cory Way (unmitigated)

Night	**First Floor**	**Comment**
Calculated Noise Level at Receptor from all sources, dB(A)	47	
Specific Noise Levels, dB(A)	47	
Tonal, dB(A)	3	The maximum penalty has been applied for a worst-case assessment though due to the high noise climate and design of the plant, a more realistic figure would be +3 dB
Impulsive	0	All processes are within the building and any start-up or shut-down of machinery will be on a gradual basis
Intermittency	0	Intermittency will not readily distinctive against the residual acoustic environment
Rating Level, dB(A)	50	
Mean Background L90 dB(A)	40	
Excess over Background, dB(A)	+10	
Initial BS4142 Assessment	**Significant Adverse effect**	

4.8 The above assessment shows that further mitigation measures will be necessary.

Mitigation Measures

4.9 In order to reduce the noise egress at the Cory Way, a combination of measures will be necessary, for example:

- For the boiler house, the single sheet steel cladding should be upgraded to higher insulated panels (e.g. Europanels); Louvers and any apertures such as doors should not be located on the western façade;

- For the Steam Turbine Hall, Louvers and any apertures such as doors should not be located on the western façade; any conduits should be acoustically sealed;

- For externally located plant: Although this assessment includes quieter ACC and ID Fan units, further treatment will be required to both the ACC/ID fan discharge unit (e.g. stack silencer). Further mitigation will also be required for the baghouse filter and lime slurry pumps.

4.10 Should the above be incorporated within the design, the noise egress can be controlled so that the BS4142 assessment shows a ‘low adverse impact’.

5 CONCLUSIONS

5.1 This report has assessed the potential noise egress from the proposed facility during the night-time periods and therefore the noise effects on nearby noise sensitive receptors.

5.2 An initial BS4142 assessment shows that unmitigated noise egress from the Plant could have an adverse impact on a nearby receptor on Cory Way. Further mitigation measures to reduce the impact may include the following:

- For the boiler house, the single sheet steel cladding should be upgraded to higher insulated panels (e.g. Europanels); Louvers and any apertures such as doors should not be located on the western façade;

- For the Steam Turbine Hall, Louvers and any apertures such as doors should not be located on the western façade; any conduits should be acoustically sealed;

- For externally located plant: Although this assessment includes quieter ACC and ID Fan units, further treatment will be required to both the ACC/ID fan discharge unit (e.g. stack silencer). Further mitigation will also be required for the baghouse filter and lime slurry pumps.

5.3 Should the above noise mitigation measures be incorporated within the design, the noise egress can be controlled so that the BS4142 assessment shows a ‘low adverse impact’

APPENDIX A – INTRODUCTION TO NOISE

In order to assist the understanding of acoustic terminology and the relative change in noise, the following background information is provided.

The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0 dB (the threshold of hearing) to over 120 dB.

The ear is less sensitive to some frequencies than to others. The A-weighting scale is used to approximate the frequency response of the ear. Levels weighted using this scale are commonly identified by the notation dB(A).

A noise impact on a community is deemed to occur when a new noise is introduced that is out of character with the area, or when a significant increase above the pre-existing ambient noise level occurs. For levels of noise that vary with time, it is necessary to employ a statistical index that allows for this variation. These statistical indices are expressed as the sound level that is exceeded for a percentage of the time period of interest.

In the UK, traffic noise is measured as the L_{A10}, the noise level exceeded for 10% of the measurement period. The L_{A90} is the level exceeded for 90% of the time and has been adopted to represent the background noise level in the absence of discrete events. An alternative way of assessing the time varying noise levels is to use the equivalent continuous sound level, L_{Aeq}. This is a notional steady level that would, over a given period of time, deliver the same sound energy as the actual fluctuating sound.

To put these quantities into context, where a receiver is predominantly affected by continuous flows of road traffic, a doubling or halving of the flows would result in a just perceptible change of 3dB, while an increase of more than 25%, or a decrease of more than 20%, in traffic flows represent changes of 1dB in traffic noise levels (assuming no alteration in the mix of traffic or flow speeds).

Note that the time constant and the period of the noise measurement should be specified. For example, BS 4142 specifies background noise measurement periods of 1 hour during the day and 5 minutes during the night. The noise levels are commonly symbolised as $_{A90(1hour)}$ and $L_{A90(5mins)}$. The noise measurement should be recorded using a 'FAST' time response equivalent to 0.125 ms.

Table A1: Glossary of Terms

Term	Definition
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 (s1/s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20μPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
$L_{eq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level during the period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{90,T}$	A noise level index. The noise level exceeded for 90% of the time over the period T. L_{90} can be considered to be the "average minimum" noise level and is often used to describe the background noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m
Ambient Noise Level	The totally encompassing sound in a given situation at a given time, usually composed of a sound from many sources both distant and near ($L_{Aeq,T}$).
Residual Noise Level	The ambient noise remaining at a given position in a given situation when specified sources are suppressed to a degree such that they do not contribute to the ambient noise level ($L_{Aeq,T}$)
Specific Noise Level	The equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source (the noise source under investigation) over a given time interval ($L_{Aeq,T}$)
Rating Noise Level	The specific noise level plus any adjustment for the characteristic features of the noise ($L_{Ar,Tr}$).

APPENDIX B NOISE SOURCES

Noise Source Data

Boiler House	Sound Power Level, dB								
Source	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	no of
Inlet screen (vibratory)	106	106	101	96	91	88	84	81	2
Metering bin fuel transport	83	88	88	85	85	83	80	78	2
Fuel auger drive	89	94	94	91	91	89	86	84	1
Diesel fuel pump	89	94	94	91	91	89	86	84	1
Diesel burner	94	99	99	96	96	94	91	89	3
Gasifier casing	89	94	94	91	91	89	86	84	1
Bed reinjection bucket elevator and drive	89	94	94	91	91	89	86	84	1
Urea storage mixer and transfer pumps	89	94	94	91	91	89	86	84	1
Urea mixing	85	90	90	87	87	85	82	80	1
FD underfire: Inlet aperture	95	95	90	85	80	77	73	70	1
- Inlet ductwall	94	99	99	96	96	94	91	89	1
- Fan case	91	96	96	93	93	91	88	86	1
- Fan motor	86	91	91	88	88	86	83	81	1
- Discharge ductwall	94	99	99	96	96	94	91	89	1
FD overfire: Inlet aperture	95	95	90	85	80	77	73	70	1
- Inlet ductwall	94	99	99	96	96	94	91	89	1
- Fan case	91	96	96	93	93	91	88	86	1
- Fan motor	86	91	91	88	88	86	83	81	1
- Discharge ductwall	94	99	99	96	96	94	91	89	1
Boiler feed pump	95	100	100	97	97	95	92	90	2
Deaerator	76	76	76	81	84	88	88	86	1
Boiler wall	87	92	92	89	89	87	84	82	1
Ash conveyor	94	99	99	96	96	94	91	89	1

Ash transfer blower	89	94	94	91	91	89	86	84	1
Economizer ash transfer blower	89	94	94	91	91	89	86	84	1
Scrubber and baghouse filter ash transfer blower	89	94	94	91	91	89	86	84	1
Steam piping	81	81	81	86	89	93	93	91	4
Blowdown tank and outlet	76	76	76	81	84	88	88	86	1
Multiclone	86	91	91	88	88	86	83	81	1
Total	**108.8**	**111.4**	**110.3**	**107.1**	**106.9**	**105.2**	**102.6**	**100.6**	
Steam Turbine Hall	**Sound Power Level, dB**								
Source	**63 Hz**	**125 Hz**	**250 Hz**	**500 Hz**	**1000 Hz**	**2000 Hz**	**4000 Hz**	**8000 Hz**	**no of**
Steam Turbine	94	94	94	99	102	106	106	104	1
ST Generator	108	108	103	98	93	90	86	83	1
Turbine bypass and desuperheater									
Feed water preheater and desuperheater	94	94	94	99	102	106	106	104	1
Condensate auxiliary pumps	87	92	92	89	89	87	84	82	1
Condensate pumps	87	92	92	89	89	87	84	82	1
Water treatment pumps	85	90	90	87	87	85	82	80	1
Firewater pumps									
Compressed air compressor	103	103	98	93	88	85	81	78	1
Nitrogen system	82	87	87	84	84	82	79	77	1
External Sources	**Sound Power Levels, dB**								
	63 Hz	**125 Hz**	**250 Hz**	**500 Hz**	**1000 Hz**	**2000 Hz**	**4000 Hz**	**8000 Hz**	**Label**
Active Carbon Blower	84	89	89	86	86	84	81	79	EZQi001
Lime Slurry Mixer	85	90	90	87	87	85	82	80	EZQi002
Lime Slurry Pump	87	92	92	89	89	87	84	82	EZQI003
ID Inlet	79	82	79	76	76	74	71	69	EZQi004
ID Fan case	86	88	88	85	75	73	80	78	EZQi005

ID Fan Motor	77	82	82	79	79	77	74	72	EZQi006
ID discharge Silencer	84	87	85	82	82	80	77	75	EZQi007
Stack Outlet	76	77	77	74	74	72	69	67	EZQi008
Aux Dry/air	83	88	88	85	85	83	80	78	EZQi009
ST Mech Inlet	80	78	75	70	69	69	67	62	EZQi010
ST Mech Outlet	80	78	75	70	69	69	67	62	EZQi011
ACC1	78	83	83	80	80	78	75	73	EZQi012
ACC2	78	83	83	80	80	78	75	73	EZQi013
ACC3	78	83	83	80	80	78	75	73	EZQi014
Flue Gas Recirculate	86	87	87	84	84	82	79	77	LIQi001
ACC Steam Header	80	84	84	81	81	79	76	74	LIQi002
Economiser	76	81	81	78	78	76	73	71	
Baghouse Filter	101	101	96	91	86	83	79	76	
Scrubber	73	78	78	75	75	73	70	68	