FICHTNER
Consulting Engineers Limited

Killoch Energy Recovery Facility

Barr Environmental Ltd

Odour Impact Assessment

ENGINEERING CONSULTING

Document approval

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Contents

1 Introduction

Barr Environmental Limited (Barr) is developing the Killoch Energy Recovery Facility (the 'Facility') to process incoming non-hazardous residual waste. The Facility will be located at the site of the existing Barr Environmental Facility in Killoch.

1.1 Background

During regular operation of the Facility, potentially odorous air from within the waste bunker and waste reception area will be drawn into the combustion system. The negative pressure this creates ensures that no odours escape from within the waste reception area or bunker, and all odours are burnt within the combustion process without being released to the atmosphere.

During periods of Facility shutdown, if waste remains within the bunker, an alternative process for removing odorous air may be required. This will be an odour extraction system, which will draw potentially odorous air from within the bunker in the same way as during operation, but instead of air being used within the combustion system, it will exit the Facility via an odour stack. The aim of this report is to assess the impact of odour from the odour extraction system and to determine if additional abatement i.e. the provision of a carbon filter is required.

2 Methodology

2.1 Odour modelling

Detailed dispersion modelling, using ADMS 5.2, has been undertaken to quantify the impact associated with the release of potentially odorous air from the odour extraction system for the Facility. This is the same model which supported the air quality assessment submitted with the PPC Permit application. For the purposes of modelling the odour impacts from the Facility, it has been assumed that the odour is caused by a substance which disperses in the atmosphere, in the same way that any other pollutant (such as dust or sulphur dioxide) disperses.

For the purpose of this analysis it has been assumed that the odour extraction system from the Facility is continually operating. However, as explained in section 1.1, the odour extraction system will only operate when the demand for process air drops below the air flow required to maintain negative pressure, such as when the Facility is offline. Assuming the odour extraction system continually operates will ensure that the model captures the operation of the odour extraction system during the worst-case atmospheric conditions for dispersion.

2.2 Sensitive receptors

The results of the odour modelling have been assessed at the point of maximum impact and the two closest residential properties, as displayed in Table 1 below. The property across the road from the site entrance has been bought by Barr and will not be residential. It is therefore not needed to be included as a sensitive receptor. The receptor locations are shown in Figure 1 and Figure 2, which show the spatial odour impact. In addition to the residential receptors, the areas of transient exposure identified by the contour plots will be considered.

Table 1: Odour receptors

ID	Receptor name	Location		Distance from site boundary (m)
		X (m)	Y (m)	
OR1	Killochside	247390	620187	305
OR2	Provost Mount	247705	619891	330

2.3 Assessment criteria

The results of the modelling have been compared to the odour exposure criteria set out in the Integrated pollution prevention and control horizontal guidance for odour regulation and permitting document (IPPC H4). This guidance recommends an indicative odour exposure criteria for ground level concentrations of mixtures of odorants for the most offensive odours (including putrescible waste) of 1.5 OU_E/m^3 as the 98th percentile of hourly averages. This has been used as the evaluation criterion for the odour assessment. It is noted that the guidance also states that a local adjustment factor for hypersensitive populations this criterion should be reduced to 1 OU_E/m^3. However, it is not considered that the local population is hypersensitive.

2.4 Model input assumptions

2.4.1 Odour release assumptions

There are no UK guidelines for odour relating specifically to the types of waste to be processed at the Facility. Therefore, the calculation of odour emissions has been derived from the Netherlands Emission Guidelines[1]. This approach has been used for other recent PPC applications where in a similar nature to this the exact odour release rate is unknown.

It is reasonable to assume that the more odorous materials found within the feedstock waste will be similar in make-up to household organic waste. Therefore, the odour calculations for the Facility have used the 'Key Odour Emission Factor' for 'Receipt of household organic waste: Storage' ($5x10^5$ $OU_E/m^2/h$) from the Netherlands Emission Guidelines. The footnote in the guidance confirms that this factor describes the number of odour units per m^2 of stored household organic waste per hour. The depth of waste is not included as a factor, but the empirical nature of the 'Key Odour Emission Factor' suggests that while the odour arising may be from the bulk of the material, the emission is assumed to be from the surface of the waste pile for the purposes of the calculation.

The 'Key Odour Emission Factor' is based on household organic waste. The Facility will process a mixture of wastes from domestic municipal solid waste (MSW) and Commercial and Industrial Wastes (C&I). Whilst it is reasonable to assume that the more odorous materials found within these wastes will be similar in make-up to household organic waste, it is not reasonable to assume the entirety of waste received for processing at the Facility will be household organic waste. Therefore, an analysis of the waste composition has been conducted to determine the likely putrescible waste content of the feedstock.

The three fractions of waste which would be expected to produce odours are '*organic putrescible*', '*absorbent hygiene products*' and '*fines*'. The percentages of these fractions found in MSW and C&I waste have been summed, using data from *WRAP National Composition Estimates Scotland, 2017* and Appendix 3 of *Commercial and Industrial Waste in Wales", WRAP Cymru, 2020*. The percentages of putrescible waste found in each waste type are displayed in Table 2.

Table 2: Percentages of putrescible waste in feedstock wastes

Waste	Fines	Organics	Absorbent hygiene products	Total
MSW	2.91%	27.27%	5.80%	35.98%
C&I	3.28%	18.35%	0.61%	22.24%

Assuming an overall mix of 83% MSW and 17% C&I waste, the putrescible content of the waste has been assumed to be 34%. Therefore, the 'Key Odour Emission Factor' has been factored by 0.34 to account for the waste composition.

This adjusted 'Key Odour Emission Factor' value is then multiplied by the surface area of the waste, to give the odour emissions for the entire surface of waste. The surface area of the waste has been calculated from the engineering concept design produced to support the application, which includes consideration of the bunker dimensions to determine the maximum waste capacity. The surface area used is 1,032 m^2. This has been calculated under the conservative assumption that waste is piled within the lower dug out part of the bunker up to the level of the tipping hall floor, with some piling on the opposite side of the bunker to the tipping chutes; and piling towards the

[1] Netherlands Emissions Guidelines for Air, Nov 2007, Chapter 3.3G

back of the bunker. This conservatively assumes that bunker is full to its maximum capacity. However, in the event of a planned shutdown the waste in the bunker would be run-down. Even under normal circumstances, it is most likely that there would not be this much piling of waste and that the surface area would be lower.

Assuming the waste within the bunker has a putrescible content of 34% and the maximum surface area, the odour emissions have been calculated as:

$$Surface\ area\ of\ the\ waste\ in\ the\ bunker\ \times Key\ Odour\ Emission\ Factor\ \times 0.34$$

$$1{,}032\ m^2\ \times\ 5\ \times 10^5\ OU_E m^{-3} hr^{-1}\ \times 0.34 = 173{,}708{,}840\ OU_E hr^{-1}$$

In order to obtain the odour concentration in OU_E/m^3 this has been divided by the volumetric flow rate, assuming three air changes per hour:

$$\frac{173{,}708{,}840\ OU_E hr^{-1}}{35{,}592\ m^3 hr^{-1}} = \mathbf{1{,}627\ OU_E m^{-3}}$$

The volumetric flow rate has been calculated from the empty bunker volume, including feed hopper area and area over backloading bays.

1,627 OU_E/m^3 has been calculated as the unabated odour release concentration from the waste within the bunker and this is the value that has been used to model odour dispersion.

2.4.2 Model inputs

The model inputs for the odour modelling are as follows:

Table 3: Emission source data

Item	Unit	Facility
Height	m	48
Internal diameter	m	1.37
Location (E'ings,N'ings)	m, m	247811, 620298
Flue gas exit velocity	m/s	20
Temperature	°C	Ambient*
Volume at actual conditions	Am^3/h	106,776
	Am^3/s	29.66
Odour release	OU_E/m^3	1,627
	OU_E/s	48,252
Note: The odour release has been modelled at ambient temperature as a worst-case. However, the release temperature is likely to be greater than this.		

3 Results

Detailed results tables of modelled odour concentrations at the receptors for each year for the 98th percentile 1 hour means and 100th percentile 1 hour means are provided in Appendix B and summarised Table 4.

Table 4: Detailed receptor results (OUe/m^3)

Receptor	Maximum of 98%ile of 5 years	Maximum of 100%ile of 5 years	Total number of exceedances of 1.5 OU_E/m^3 across 5 years
Point of maximum impact	1.15	3.51	66
OR1	0.40	0.98	0
OR2	0.25	0.88	0

The maximum 98th percentile of 1-hour odour concentration modelled using the 5 years of weather data at the point of maximum impact was 1.15 OU_E/m^3. This is well below the criterion of 1.5 OU_E/m^3. Furthermore, this maximum point of impact is within the installation boundary, so all points outside the installation boundary, including both receptors, have an impact lower than this. The results are spatially displayed in Figure 1.

Figure 1 shows that for the 98th percentile of 1-hour means, there are no areas which exceed the 1.5 OU_E/m^3 criterion.

The maximum 100th percentile of 1-hour odour concentration modelled at the point of maximum impact was 3.15 OU_E/m^3. Although this is in exceedance of 1.5 OU_E/m^3, there were only 66 hours where exceedances were predicted across the five years modelled. This is well within the 98th percentile criteria, which would allow 175 exceedences of 1.5 OU_E/m^3 per year.

Figure 2 shows the spatial impact of odour at the 100th percentile of 1 hour means. It shows the extent of the areas which exceed 1.5 OU_E/m^3, and shows there are some predicted exceedences outside of the installation boundary. To the north of the site, it is not expected to be any public access and so also no exposure. To the south of the site, there will be transient exposure along the A70. Figure 2 shows that the residential receptors are at least 200 m away from any areas of exceedances.

The 100th percentile results show that some exceedances are predicted, but the number of hours of exceedances are less than 175 per year at each point, and therefore are within the 98th percentile allowance and the criterion is not exceeded.

This analysis has conservatively assumed that the odour extraction system is running for the whole year across five years, and so provides the results under the very worst-case weather conditions. In reality, the extraction system will only be required to be used in periods when the air cannot be drawn into the combustion system, such as periods of shut down, and it is unlikely that this would coincide with the worst weather conditions over five years.

4 Conclusions

During regular operation of the Facility, potentially odorous air from with the waste bunker and waste reception area will be drawn into the combustion system and is not released to the atmosphere. During periods of shut down, an odour extraction system will be in place to draw the potentially odorous air from with the waste bunker and waste reception area and release it to the atmosphere via the odour stack. This assessment considers the impact of odour emissions released from the odour stack during these shut-down periods when the extraction system is in place.

The results of this assessment show that when the odour extraction system is in use, odour emissions from the odour stack do not cause any exceedance of the IPPC H4 criteria of 1.5 OU_E/m^3 for 98th percentile of 1-hour means.

When assessing the 100th percentile results, the model has predicted some exceedances of 1.5 OU_E/m^3, which cover areas of potential transient exposure along the A70, but are well away from the residential receptors. However, because the number of hours of exceedances is well below the 98th percentile allowance, the criterion is not exceeded. This is clarified by the assessment of the 98th percentile results, which show the maximum point of impact and therefore all surrounding areas, are predicted to have an odour impact below 1.5 OU_E/m^3.

Furthermore, the results are for a worst-case scenario as they based on conservative model assumptions; using the largest surface area of waste and assuming the odour extraction system is running constantly throughout the year.

The modelling and results as described in this assessment are for an odour extraction system without any additional abatement such as a carbon filter. This assessment has shown that the extraction system is suitable to ensure that the predicted impact of odour is below the IPPC H4 criteria of 1.5 OU_E/m^3. Therefore, no additional carbon filtration is deemed necessary.

Appendices

A Figures

Figure 1: Results -98%ile of 1 hour means

Figure 2: Results -100%ile of 1 hour

B Detailed results tables

Table 5: Detailed receptor results 98th percentile of 1-hour means (OU_E/m^3)

Receptor	Year of modelled meteorological data					Maximum
	2015	2016	2017	2018	2019	
Point of maximum impact	0.84	0.85	1.15	0.89	0.82	1.15
OR1	0.14	0.33	0.30	0.31	0.40	0.40
OR2	0.01	0.16	0.00	0.07	0.25	0.25

Table 6:Detailed receptor results 100th percentile of 1-hour means (OU_E/m^3)

Receptor	Year of modelled meteorological data					Maximum
	2015	2016	2017	2018	2019	
Point of maximum impact	3.40	3.51	3.37	3.51	3.14	3.51
OR1	0.79	0.97	0.75	0.97	0.98	0.98
OR2	0.88	0.87	0.87	0.87	0.88	0.88

Table 7: Detailed receptor results: number of exceedences of the 1.5 OU_E/m criteria.

Receptor	Year of modelled meteorological data					Total
	2015	2016	2017	2018	2019	
Point of maximum impact	8	14	17	18	9	66
OR1	0	0	0	0	0	0
OR2	0	0	0	0	0	0

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