

AQMAU Reference: AQMAU-C2483-WD01

Project Title: Lostock Sustainable Energy Plant Ltd – Process Emissions Modelling

Impact Assessment: Air Quality, Ecological and HHRA

Date Requested: 28th February 2023

AQMAU Response Date: 22nd May 2023

| AQMAU Recommendation | Conditions/Noted |
|---|--|
| <ul style="list-style-type: none"> The consultant's numerical predictions and conclusions regarding human health can be used for permit determination. | <ul style="list-style-type: none"> Contributions from the proposed variation are unlikely to exceed any Environmental Standard (ES) set for the protection of human health. Predicted risk from dioxin and furan emissions are within the screening criteria for the protection of human health. |
| <ul style="list-style-type: none"> The consultant's numerical predictions and conclusions regarding ecological impact can be used for permit determination. | <ul style="list-style-type: none"> PCs greater than 1% at Midlands Meres and Mosses Ramsar sites as well as Plumley Lime Beds SSSI. Where background pollution exceeds critical loads and levels |
| <ul style="list-style-type: none"> The Permitting Officer should check the validity of the modelled emission parameters including reduced volumetric flows and velocities relative to the original assessment in 2011. | <ul style="list-style-type: none"> If valid, consulting Natural England is not likely to be needed based on reduced impacts compared to existing permitted activity. |

Detailed response and evidence starts on Page 2.

1. Summary of Work Request

- 1.1 The Environment Agency's Installations Regime of the National Permitting Services (NPS) asked the Acoustics and Air Quality Modelling and Assessment Unit (AQMAU) to audit an air quality assessment¹ (AQA) for a permit variation application for the Lostock Sustainable Energy Plant, LSEP (the facility). The assessment includes a review of the baseline² pollution levels, dispersion modelling of emissions from the proposed plant and determination of the significance of the impact of these emissions on local air quality and ecological receptors. An Abnormal Emissions Assessment³ and a Dioxin and PCB Pathway Intake Assessment⁴ were submitted with the AQA. The air quality assessment was completed by Fichtner Consulting Engineers (the consultant).
- 1.2 The assessment supports a permit variation application to enable the increase the throughput from 600,000 tonnes/year to 728,000 tonnes/year.

2. Conclusions that Lead to AQMAU Recommendations

- 2.1 In their reports, the consultant concludes:
 - Emissions to air from the proposed facility are not expected to have a significant impact on human health or ecology.
 - Periods of abnormal operation are not predicted to give rise to unacceptable impacts on air quality or the environment.
 - The impacts of dioxins and furans, and dioxin-like PCBs are insignificant.
- 2.2 We have audited the consultant's assessment and have made several observations, which are listed below. We have undertaken detailed modelling and check calculations including sensitivity analysis to our observations. Although we do not necessarily agree with the applicant's absolute numerical predictions, we agree that they can be used as a basis for permit determination.
- 2.3 We agree with their conclusions with respect to human health impact but their conclusion with respect to ecological impact is dependent on the emission parameters they selected for modelling. They predict PCs at the Plumley Beds SSSI exceed the 1% insignificance criterion, but they state the predicted impacts are lower for this variation than those made in the original application in 2011. We can confirm the reduced impact based on the parameters used. In spite of an increase in waste feed rate by 21%, they have modelled assuming a reduced volumetric flow. The validity of this should be checked and confirmed before deciding whether it is necessary to consult Natural England.

¹ Lostock Sustainable Energy Plant Ltd, Appendix E2 – Process Emissions Modelling, dated 14th February 2022, document reference S3291-0200-0004HKL.

² Lostock Sustainable Energy Plant Ltd, Appendix E1 – Baseline Analysis, dated 14th February 2022, document reference S3219-0200-0002HKL.

³ Lostock Sustainable Energy Plant Ltd, Abnormal Emissions Assessment, dated 14th February 2020, document reference S3291-0200-0010HKL.

⁴ Lostock Sustainable Energy Plant Ltd, Appendix E3 – Human Health Risk Assessment, dated 14th February 2022, document reference S3291-0200-0009RSF.

3. Evidence for Recommendations

- 3.1 The consultant used air dispersion modelling software ADMS 5.2. This is commonly used software for regulatory dispersion modelling in the UK. We have tested sensitivity to the more recent version ADMS 6.0 and to USEPA AERMOD software to understand modelling uncertainties.
- 3.2 They used meteorological data observed at the Manchester Airport for the years 2016-2020. We have conducted sensitivity to the Woodford meteorological site for the years 2004-2007. Our audit of the original application confirmed using Manchester Airport resulted in lower predictions than Woodford, so we have used this station as a reasonable worst case.
- 3.3 The consultant's model set up has changed since the last AQA. They have included details of the variation of the follow parameters, presented in Tables 8 and 12 of the AQA:
- An increase of the exit moisture from 14.25% to 18.2%
 - Added a value for the exit oxygen content of 6.1%
 - A decrease of the normalised volume flow from 78.95Nm³/s to 73.6Nm³/s
 - An increase of the flue gas exit velocity from 15 m/s to 19.9 m/s
- 3.4 Note the predicted impacts are dependent on the validity of the assumed reduction in normalised flow rate. This is because all pollutant emission rates are calculated from this parameter. Compared to other energy from waste plant, the modelled values are at the lower range of values. We have evaluated the impacts based on the proposed values in this variation, but the validity of the flow rates should be checked during determination.
- 3.5 The consultant also changed the main building and the building parameters displayed in Tables 10 and 14 of the AQA.
- 3.6 The consultant has modelled a scenario in which the facility operates at maximum capacity for 8,760 hours per year.
- 3.7 The consultant's modelled emissions presented in Table 8 of the AQA correspond to the values in the current BAT conclusions for existing plant. We can replicate their emission rates for all pollutants. We have made the following specific observations:
- The modelled total VOCs as Benzene or 1,3-Butadiene and compared against the Benzene environmental standards.
 - All Polycyclic Aromatic Hydrocarbons (PAHs) are assumed to be Benzo[a]Pyrene (BaP) and emitting at the maximum recorded concentration of 0.2µg/Nm³.
 - The particulate matter (PM) emission is assumed to consist entirely of PM₁₀ or PM_{2.5}.
 - The individual heavy metals are assumed to emit at the combined metals ELV, any pollutant that is not insignificant is then subject to further analysis, this is

EA guidance, and the maximum concentrations are presented in Table A1 of the Metals Guidance⁵.

- 3.8 The consultant has modelled a main building in ADMS to account for the downwash effect. The buildings and the main building are displayed in Table 10 of the AQA.
- 3.9 Surface roughness is an input parameter relating to the height of interfering structures that is used in the model to calculate mechanical turbulence affecting atmospheric stability. The consultant used a varying surface roughness file in their modelling to represent variations in land use and roughness around the facility. We conducted surface roughness sensitivity checks and concluded that 0.5m was representative for the dispersion site and 0.3m for the meteorological site.
- 3.10 When the gradient is greater than 1 in 10, the complex terrain module within ADMS should be used. The consultant included a terrain file. We have undertaken some sensitivity to this.
- 3.11 There were twenty-nine human discrete receptors identified by the consultant. We checked them and are satisfied they are representative.
- 3.12 The consultant modelled their air quality assessment over a 6km x 6km grid with a spatial resolution of 60m. We agree this approach will ensure peak grid impacts will be established.
- 3.13 The consultant has used background data from different air quality networks and DEFRA background maps. We have reviewed the data and can confirm they are reasonably representative. We have identified some differences and therefore used the most conservative background concentrations in our model checks.
- 3.14 In tables 24 and 25 of the AQA and Tables 19 and 20 of Appendix E2¹, the consultant provides a comparison between the dispersion modelling results from the previously permitted facility and the new variation. They present their heavy metals assessment in Section 6.2.1 of Appendix E2 Table 22.
- 3.15 The consultant predicts PCs for the proposed facility can be screened out as 'insignificant' for all pollutants and averaging periods except for annual mean NO_x, annual mean volatile organic compounds (VOCs) as benzene and 1,3-butadiene, annual mean cadmium, arsenic and nickel. However, their predicted PECs do not exceed the ES.

⁵ Releases from Waste Incinerators – Guidance on assessing group 3 metal stack emissions from incinerators. Version 4. Environment Agency, June 2016.

3.16 With respect to hexavalent chromium (CrVI), the consultant referred to PCs from another currently permitted facility and state that exceedances are unlikely. We have checked this by applying our metals guidance.

Ecological Assessment

3.17 The consultant has used a screening distance of 10km for European sites and 2km for SSSI's are local sites. Note that specific habitats outside of these ranges were included for completeness for example Midland Meres and Mosses (Phase 2) Ramsar site. The site is characterised by bogs which is a sensitive habitat type.

3.18 The consultant has used APIS⁶ to identify the habitat features, background concentrations and critical levels and loads. The consultant has provided a comparison against the lower daily critical level of 75µg/m³ and the less stringent critical level of 200µg/m³.

3.19 The results for the PCs for ecological receptors are presented in Tables 28,30,31 and 39 of Appendix 5.2⁷ Process Emissions Modelling.

3.20 The consultant predicts PCs for annual and daily NO_x, weekly and daily HF and annual NH₃ are mostly below the insignificance threshold of the critical levels for the habitat sites.

3.21 For the sites where the insignificance threshold is exceeded, they predict PECs that do not exceed the relevant Environmental Standards with some notable exceptions

- Plumley Lime Beds Site of Special Scientific Interest (SSSI), also referred to as E8. At this site they predict exceedances of the ammonia critical level, nutrient nitrogen and acid critical loads with PCs of greater than 1%.
- At Midlands Meres and Mosses referred to as E3, the applicant predicts PCs of >1% for acid deposition where the background is already exceeded.
- They conclude overall that “no likely significant effects are predicted because there are no significant changes to existing baseline conditions as a consequence of the variation. We have checked this in our modelling assessment.

⁶ Air Pollution Information System [Air Pollution Information System | Air Pollution Information System \(apis.ac.uk\)](https://apis.ac.uk).

⁷ Lostock Sustainable Energy Plant – Ecological Interpretation of Air Quality Assessment, dated 30th July 2021, document reference 21-007-01.

Abnormal Emissions Assessment

- 3.22 In accordance with Article 46 (6) of the Industrial Emissions Directive (IED)⁸ a plant may be permitted to operate above the ELVs unabated for a period of no more than 4 hours uninterrupted, for up to 60 hours per year. Short-term impacts are of most concern when considering abnormal operations.
- 3.23 Emissions during abnormal operation provided by the consultant are derived from assumptions made to flue gas treatment plant efficiencies. We are satisfied that their modelled values are consistent with values quoted for raw gas in the Waste Incineration BREF.
- 3.24 They have assumed all abnormal emissions coincide with worst-case meteorological conditions, which is conservative.
- 3.25 The consultant has presented their emission limits and results in Tables 1 – 2 of the Abnormal Emissions Assessment report. We note that they devised their abnormal emission by multiplying 30 times the emission concentration, we find this to be reasonably conservative.
- 3.26 The consultant reports ST PCs and PECs in Tables 3 and 6 of the Abnormal Emissions Assessment report. They predict that all short-term PECs are below the ES.

Human Health Risk Assessment (HHRA)

- 3.27 The consultant has completed an HHRA of the potential effects on human health due to intake from diet and inhalation of dioxins, furans, and dioxin-like polychlorinated biphenyls (PCBs). The HHRA applies approaches to quantify intakes from predicted pollutant concentrations published by the United States Environmental Protection Agency (US EPA) Human Health Risk Assessment Protocol⁹ (HHRAP). The TDI value published by the UK Committee on Toxicity¹⁰(COT) has also been used to assess the predicted health effects at selected receptors. The consultant has assessed twenty-two resident receptors and eight short-term receptors and the point of maximum impact in their Dioxin Pathway Intake Assessment.
- 3.28 The consultant considers the following pathways: direct inhalation and ingestion of soil, home grown produce, drinking water, eggs from home-grown chickens, home grown poultry, beef, pork, milk and breast milk. The consultant disregards the ingestion of fish stating that the closest fishing site is the River Dane, 10km to the south-east and Mill Farm Trout Lakes, 16km to the north-east. We agree that given the distances, a significant impact from the ingestion of fish is an unlikely pathway.
- 3.29 The consultant's congener profile is presented in Table 6 of their HHRA report. The mass emissions for each congener in terms of toxic equivalent (I-TEQ) have been based on a standard congener profile for municipal waste

⁸ Directive 2010/77/EU of the European Parliament and of the Council on industrial emissions.

⁹ Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, EPA, 2005.

¹⁰ Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment.

incinerators¹¹. For dioxin-like PCBs, it has been assumed that the entire PCB emissions will comprise either Aroclor 1254 or Aroclor 1016, depending on which substance gives rise to the highest exposure. This is a conservative approach.

- 3.30 The consultant has used proprietary software IRAP-h Version 5.0 "IRAP". The IRAP model outputs were used to calculate the exposure concentrations.
- 3.31 We were able to replicate the consultant's emission rates presented in Table 6 of the HHRA report. We conducted our own HHRA screening checks based on the US EPA HHRAP.
- 3.32 The COT has published a TDI of 2pg WHO-TEQ/kg(BW)/day. The consultant has assessment impacts against this TDI. Their predicted maximum contribution presented in Table 8 is 1.87% for adult receptors and 2.58% for child receptors. Their predictions are below the TDI and they conclude that the impact of dioxins and dioxin-like PCBs from the LSEP on human health is predicted to be negligible and the effect not significant. Note that these predictions are below the UKHSA screening threshold of 10%. They have calculated combined intakes without adjusting for lifetime exposure. Had they done so, predictions would have been substantially lower. Their predictions therefore cannot be directly compared with the TDI over a long-term exposure period. We have considered this in our check modelling.

AQMAU Check Modelling and Assessment

- 3.33 We conducted our own check modelling and sensitivity analysis using air dispersion modelling software ADMS 6.0.
- 3.34 We completed sensitivity checks in a previous audit and the outcomes were used to compare and complete the modelling for this proposed variation. The meteorological files are from Woodford and dated 2004-2007, this is consistent with the previous audit.
- 3.35 We do not entirely agree with the consultant's absolute numerical values and predictions, we do, however, agree with the consultant's conclusions that the proposed variation to the facility will not cause any breaches of the Environmental Standards for the protection of human health. This applies to both normal operation and abnormal operation.
- 3.36 Our HHRA check modelling indicates that the intakes predicted by the consultant are likely to be well below the 10% insignificant threshold agreed by the UKHSA. This also applies to dioxins, furans and dioxin-like PCBs during worst case abnormal emissions.
- 3.37 At ecological receptors, we also agree with the following potentially significant contributions to background exceedances:

¹¹ Table 7.2a DOE (1996) Risk Assessment of Dioxin Releases from Municipal Waste Incineration Processes. HMIP/CPR2/41/1/181.

- Receptor E8 Plumley Lime Beds, SSSI NH₃, nutrient nitrogen and acid deposition PCs greater than 1% where the background pollution is already exceeded.
- Receptor E3-5 and E6, West Midlands and Midlands Meres and Mosses - NH₃ PCs greater than 1% where the background pollution is already exceeded.

3.38 We are also satisfied that based on the emission parameters used by the applicant, impacts at human and ecological receptors are likely to be reduced relative to the original application in 2011. Any reductions however are likely to be small and within expected modelling uncertainties.