# Air Emissions Risk Assessment

## Environmental Permit

### AESC UK Plant 2 Ltd

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Making Sustainability Happen

## Revision Record

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# Appendices

# 1.0 Introduction

SLR Consulting Limited has been commissioned by AESC UK Plant 2 Ltd to conduct an Air Emissions Risk Assessment (AERA) in support of an application for a Part A2 Environmental Permit at the AESC UK No 2 Plant in Sunderland (the Site).

The Site location is illustrated in Figure 1-1.

## 1.1 Assessment Scope

The Environmental Permit aims to introduce 30 emission vent release points comprising local exhaust ventilation (LEV) extraction points (28) and process emissions (2).

The scope of this assessment is to quantitatively evaluate potential air quality impacts associated with the emission release points to air on the receiving environment. Information presented within the accompanying application documentation (prepared in response to queries received from the Local Authority) has informed the assessment (see for further details).

To facilitate the assessment, a dispersion modelling exercise has been undertaken based on the approach prescribed within the Environment Agency's (EA) Air Emissions Risk Assessment guidance[1] (herein referred to as the AERA guidance).

**Figure 1-1: Site Context**


**Aerial Imagery Source: Google Maps**

[1] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit

# 2.0 Emission Quantification

The Environmental Permit aims to introduce 30 emission vent release points comprising LEV extraction points (28) and process emissions (2).

The LEV points will connect to the extraction system serving specific plant areas where processing activities are conducted. The purpose of these vents is to ventilate internal areas and maintain occupational safety.

The only exception to this is the emissions from the cathode coater systems (Emission Points A13 and A33) which are emissions direct from the process via appropriate abatement systems. Process emissions will comprise volatile organic compounds (VOC).

Table 2-1 provides a summary of the proposed emission points.

**Table 2-1: Summary of Emission Source Processes**

| Emission Points | Number | Process |
|---|---|---|
| A13 and A33 | 2 | Direct emissions from cathode coating systems (VOCs) |
| All other | 28 | Process area LEV extraction |

## 2.1 Review of Emission Source Risk Potential

Proposed emission sources and associated pollutant risk potential have been reviewed to inform the basis of the AERA. Those sources / pollutants that represent an emissions to air risk have been considered within the modelling assessment. Design information provided by AESC UK Plant 2 Ltd has been used to inform this process.

The new emission sources have the potential to release:

- VOCs, containing:
  - Diethyl Carbonate (DEC);
  - Ethylene Carbonate (EC);
  - Ethyl Methyl Carbonate (EMC); and
  - N-methyl-2-pyrrolidone (NMP).
- Dust / particulates (containing trace metals) associated with the LEV systems.

In addition to the main process VOC materials, acetone and isopropyl alcohol are utilised as cleaning solvents. However, emissions of these VOCs are anticipated to be significantly lower compared to the VOCs used in the main production processes. Furthermore, both acetone and isopropyl alcohol are considerably less hazardous than the VOC materials employed in the main processes. Consequently, these materials have been omitted from the assessment.

There is expected to be negligible dust / particulate emission releases for the following reasons:

- There will be no direct extraction from the mixing and preparation of powered materials as these will be undertaken within closed systems;
- The points where dust / particulate emission releases are expected relate to LEV systems. These systems serve the processing areas where the mixing and preparation of powdered materials take place, providing ventilation for internal occupied areas to maintain occupational safety. As a result, they do not directly connect to process emission sources. These operational areas of the plant are not

expected to have significant levels of particulate materials present; hence, emission releases are expected to be negligible; and

- HEPA filters will be installed as a precautionary measure to minimise dust / particulate emission releases. HEPA filters are understood to achieve an abatement efficiency of around 99.99%.

Based upon the outcomes of this exercise, key risks relate to VOC emissions. All other emissions are considered insignificant. The review outcomes and associated justifications are provided in Table B-1 in Appendix B.

As per the EA's AERA guidance, VOCs are not listed as a primary or secondary pollutant that requires consideration of ecological impacts. Therefore, the objective of the assessment is to determine the extent of potential air quality effects, by comparison to relevant guidelines for the protection of human health only.

## 2.2 Emission Release Inputs

Table B-2 and Table B-3 in Appendix B details the emission release input parameters used in the modelling assessment.

### 2.2.1 Emission Concentrations

For the purposes of informing target emission limit values for each emission point, the following relevant Best Available Techniques (BAT) Conclusions (BATc) documents prepared by the European Commission have been reviewed:

- Surface Treatment Using Organic Solvents including Preservation of Wood and Wood Products with Chemicals 2020 (STS BATc); and
- Common Waste Gas Management and Treatment Systems in the Chemical Sector 2023 (WGC BATc).

These documents are the reference for establishing permit conditions. They contain BAT-associated emission levels (BAT-AELs) relevant processes are expected to meet. These documents have been reviewed to determine the relevant BAT-AELs and contextualise legislative emission limits (Table 2-2). This has considered whether the VOCs are carcinogenic, mutagenic and reprotoxic (CMR).

**Table 2-2: Review of BAT-AELS for VOCs**

| Pollutant | Source | BAT-AEL (mg/Nm$^3$) |
|---|---|---|
| Total VOC | STS BATc | 1 – 20 |
| | WGC BATc | < 1 – 20 (1) |
| Sum of VOCs classified as CMR 1A or 1B | WGC BATc | < 1 - 5 (2) |
| Sum of VOCs classified as CMR 2 | WGC BATc | < 1 - 10 (3) |

**Table Notes:**

Reference Conditions: Temperature: 237.15K

(1) The BAT-AEL does not apply to minor emissions (i.e. when the VOC mass flow is below e.g. 100gC/h) if no CMR substances are identified as relevant in the waste gas stream.

(2) The BAT-AEL does not apply to minor emissions (i.e. when the mass flow of the sum of the VOCs classified as CMR 1A or 1B is below e.g. 1g/h).

(3) The BAT-AEL does not apply to minor emissions (i.e. when the mass flow of the sum of the VOCs classified as CMR 2 is below e.g. 50g/h).

The maximum total VOC BAT-AEL is prescribed as 20mg/Nm$^3$ in both BATc documents.

#### 2.2.1.1 Applied Emission Concentrations

Emission release concentrations used in this assessment are based on the analysis presented within the accompanying permit application documentation. These are based on the following sources:

- Maximum BAT-AELs prescribed within the STS and WGC BATc documents (Table 2-2). This has considered the CMR rating of the VOC species and mass emission rate; and
- Maximum design guarantees (these comply with the relevant BAT-AELs i.e. below the maximum BAT-AELs detailed in Table 2-2).

With respect to emission release points associated with the glue modules (A16-A19 and A36-A39), there may be trace VOC emissions. This is associated with the thermal glue resin which contains 1-5% of petroleum which could be a VOC, but only present at very low concentrations. Furthermore, the VOC mass emission rate is <100g/h, no BAT-AEL applies. To provide a conservative assessment, 2mg/Nm$^3$ has been adopted as the total VOC emission concentration at each of these emission release points. In reality, VOC emissions at these release points are likely to be negligible.

A summary of the applied emission concentrations is provided in Table 2-3.

**Table 2-3: Summary of Applied Emission Concentrations**

| Emission ID | VOC Species | CMR Rating | Applied Emission Concentration (mg/Nm$^3$) | Justification |
|---|---|---|---|---|
| A10, A12, A13, A30, A32, A33 | NMP | CMR1 | 2 | Design guarantee (CMR 1A or 1B VOC WGC BAT-AEL = 1-5mg/Nm$^3$) |
| A15, A20, A21, A35, A40, A41 | DEC, EC, EMC | No | 20 | Maximum Total VOC BAT-AEL WGC BREF (1-20mg/Nm$^3$) |
| A16, A17, A18, A19, A36, A37, A38, A39 | Trace | - | 2 | Worst-case assumption. No BAT AEL applies (VOC emission rate is <100g/h). |
| **Table Notes:**<br>Reference Conditions: Temperature: 237.15K | | | | |

# 3.0 Environmental Standards

The AERA guidance provides environmental ambient thresholds for the protection of health. These are based on relevant legislation and environmental assessment levels (EALs) defined by the EA. These are collectively termed Air Quality Assessment Levels (AQAL) throughout this report.

## 3.1 Derivation of EALs

There are no relevant AQALs for total VOCs. There are no legislated environmental ambient air quality thresholds currently operable within the UK for any of the potential VOC process emissions. Similarly, no EALs are provided within the EA's AERA guidance.

The EA guidance has been used to derive EALs for consideration in this assessment. A review of available research / information for each substance has been conducted for the purposes of deriving EALs (Table 3-1).

**Table 3-1: Sources of Information Reviewed to Inform EALs**

| Source | NMP | DEC | EC | EMC |
|---|---|---|---|---|
| AERA Guidance | - | - | - | - |
| H1 Annex F | Yes (2003) | - | - | - |
| Expert Panel on Air Quality Standards | - | - | - | - |
| World Health Organisation Air Quality Guidelines for Europe | - | - | - | - |
| UK Health and Safety Occupational Exposure limits (UK EH40/200) | Yes | - | - | - |
| Other Health and Safety Occupational Exposure limits | Yes (EU / Ireland) | Yes (Romania) | - | - |
| US Department of Labor | - | - | - | - |
| ECHA European Chemicals Agency | - | - | - | - |
| Derived No Effect Level (DNEL) REACH | Yes | Yes | Yes | Yes |

Where a published environmental threshold has been identified, it has been included within Table 3-2 for the purpose of facilitating comparison of toxicities across each VOC. The VOC which has the lowest environmental threshold is highlighted in orange.

**Table 3-2: Comparison of Published Environmental VOC Thresholds**

| Source | Period | Unit | NMP | DEC | EC | EMC |
|---|---|---|---|---|---|---|
| H1 Annex F | ST | µg/m³ | 30,900 | - | - | - |
| | LT | | 1,030 | - | - | - |
| UK EH40/200 | 15 Min STEL | mg/m³ | 80 | - | - | - |
| | 8 Hour TWA | | 40 | - | - | - |
| Other Health and Safety Occupational Exposure limits | 15 Min STEL | mg/m³ | 80 | 1,000 | - | - |
| | 8 Hour TWA | | 40 | 700 | - | - |
| Derived No Effect Levels (DNEL) REACH | - | mg/m³ | 14.4 | 69.79 | 15 | 10.3 |

Based on the data provided above, the outcomes of this assessment are as follows:

- There are short and long-term NMP EALs contained within a previous iteration (2003) of the EA's H1. The other VOC species are not included;

- There are UK health and safety occupational exposure limits for NMP. No other VOC species are included; and
- There are international (non-UK) health and safety occupational exposure limits for NMP and DEC. However, the NMP exposure limits are lower.

This suggests that NMP has the highest risk potential; it is the only VOC for which EALs have previously been established, and UK workplace exposure thresholds are operable.

Furthermore, NMP is a CMR 1 substance. No other species have a CMR rating. NMP is the only VOC listed within the EA's Categorisation of VOCs research document[2]. NMP is categorised as low risk (i.e. Class B). This means it is considered as having a lower degree of harmfulness.

The 2003 EA H1 published EALs for NMP have been used in this assessment. This obviates the need to derive EALs which could introduce uncertainty. All VOC emission releases have therefore been assumed to be NMP. In reality, NMP is only expected to be released at four release vents.

It is acknowledged that the DNEL for EMC is lower than NMP. However, the DNEL is a benchmark and not an exposure limit. Due to the absence of additional supporting data regarding workplace exposure limits or EALs for EMC, NMP has been chosen as the exemplar substance for the AERA. Despite this, as the DNEL for EMC is 10.3mg/m³ vs. 14.4mg/m³ for NMP i.e. approximately 30% lower, a sensitivity review of the modelling output data has been undertaken to determine whether a 30% reduction in the EAL would have any implications.

Table 3-3 sets out the AQALs applied in the assessment.

**Table 3-3: Applied Human AQALs**

| Pollutant | | AQAL | | Averaging Period |
|---|---|---|---|---|
| | | Value | Unit | |
| N-Methyl-2-pyrrolidone | NMP | 1,030 | µg/m³ | Annual Mean |
| | | 30,900 | µg/m³ | 1-Hour Mean |

### 3.1.1 Relevant Exposure

In accordance with Defra's technical guidance on Local Air Quality Management (LAQM.TG(22))[3], the AQALs presented in Table 3-3 should only be assessed at locations of relevant exposure i.e. where members of the public are regularly present and might reasonably be expected to be exposed to pollutant concentrations over the relevant averaging period. These AQALs do not apply to exposure at the workplace.

A summary of the typical relevant locations associated with each applicable AQAL assessed is detailed below in Table 3-4.

[2] Environment Agency. The Categorisation of Volatile Organic Compounds. 1995.

[3] Local Air Quality Management Technical Guidance 22, Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland. August 2022.

**Table 3-4: Relevant Public Exposure**

| AQAL Averaging Period | Locations AQALs Should Apply At | Locations AQALs Should Not Apply At |
|---|---|---|
| Annual mean | Building facades of residential properties, schools, hospitals etc. | Facades of offices, hotels, gardens of residences and kerbside sites |
| 1-hour mean | As above together with kerbside sites of regular access, car parks, bus stations etc. | Kerbside sites where public would not be expected to have regular access |

# 4.0 Dispersion Modelling Methodology

## 4.1 Dispersion Model

ADMS v6 modelling software has been used to quantify potential impacts. ADMS v6 is an advanced atmospheric dispersion model that has been developed and validated by Cambridge Environmental Research Consultants (CERC).

CERC's ADMS suite of software has been used extensively throughout the UK for regulatory compliance purposes.

## 4.2 Receptors

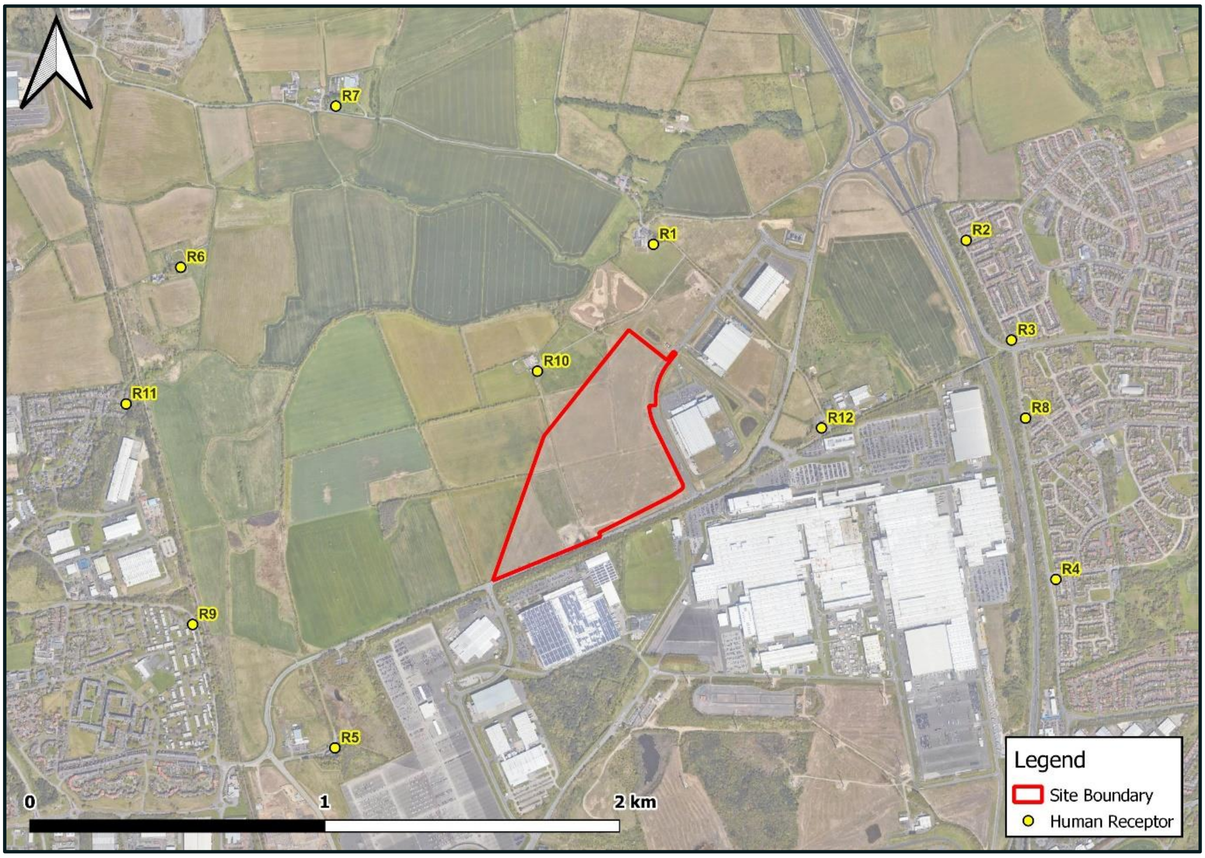
Human receptors considered in the modelling assessment are detailed in Table 4-1 and their locations are illustrated in Figure 4-1 (titled discrete human receptors).

These receptor locations are considered to capture worst-case relevant exposure relative to the Site, in accordance with LAQM.TG(22) presented in Table 3-4.

**Table 4-1: Modelled Discrete Human Receptor Locations**

| Receptor | Details | Exposure Period | NGR | | Height (m) |
|---|---|---|---|---|---|
| | | | X | Y | |
| R1 | Residential | All | 433414 | 559496 | 1.5 |
| R2 | Residential | All | 434475 | 559509 | 1.5 |
| R3 | Residential | All | 434628 | 559171 | 1.5 |
| R4 | Residential | All | 434779 | 558359 | 1.5 |
| R5 | Residential | All | 432334 | 557787 | 1.5 |
| R6 | Residential | All | 431811 | 559418 | 1.5 |
| R7 | Residential | All | 432337 | 559965 | 1.5 |
| R8 | Residential | All | 434676 | 558906 | 1.5 |
| R9 | Residential | All | 431851 | 558206 | 1.5 |
| R10 | Residential | All | 433020 | 559065 | 1.5 |
| R11 | Residential | All | 431626 | 558954 | 1.5 |
| R12 | Hotel | Short Term | 433984 | 558873 | 1.5 |

**Figure 4-1: Modelled Human Receptors**




**Aerial Imagery Source: Google Maps**

## 4.3 Terrain

The ADMS modelling guidance indicates it is generally unnecessary to include terrain where gradient in slopes is less than 10%.

An evaluation of the terrain covering the extent of the model domain suggests that the area is generally flat with little to no significant terrain features. Therefore, terrain has not been included within the dispersion model.

## 4.4 Building Downwash

The Buildings Module within the ADMS model has been used to incorporate buildings within the model, in line with EA guidance, where:

- the maximum height of the building is equivalent to at least 40% of the emission height; and
- are within a distance defined as five times the lesser of the height or maximum projected width of the building (referred to as 5L)).

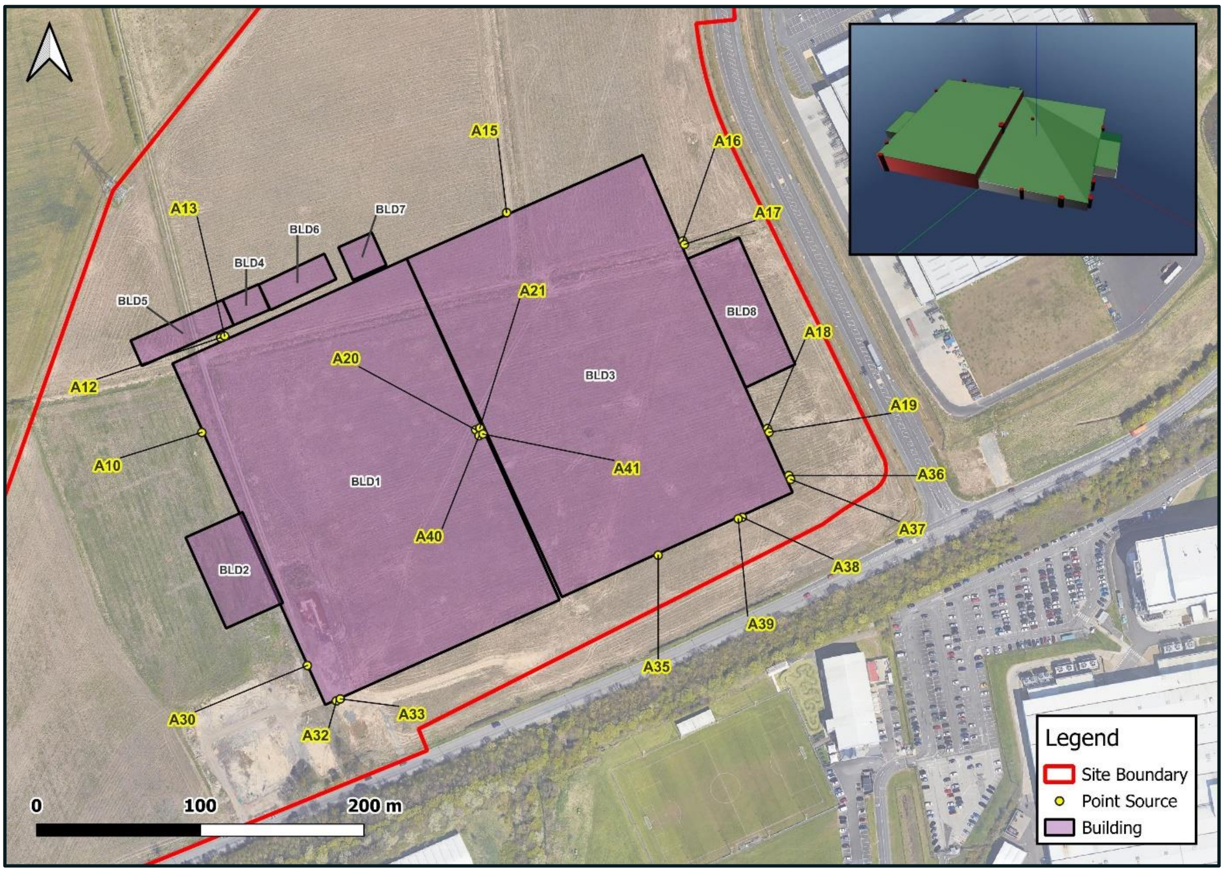
Details of the buildings are provided in Table 4-2, whilst their locations are illustrated in Figure 4-2.

**Table 4-2: Modelled Buildings**

| Name | Centre Easting (m) | Centre Northing (m) | Height (m) | Length / Diameter (m) | Width (m) | Angle (°) |
|---|---|---|---|---|---|---|
| BLD1 | 433197.2 | 558667.9 | 30.0 | 156.7 | 228.2 | 65.9 |

| Name | Centre Easting (m) | Centre Northing (m) | Height (m) | Length / Diameter (m) | Width (m) | Angle (°) |
|---|---|---|---|---|---|---|
| BLD2 | 433116.8 | 558613.9 | 15.0 | 38.0 | 60.7 | 66.0 |
| BLD3 | 433339.4 | 558732.6 | 16.0 | 157.4 | 225.3 | 66.3 |
| BLD4 | 433124.1 | 558775.9 | 17.0 | 23.8 | 16.9 | 246.6 |
| BLD5 | 433085.1 | 558758.7 | 11.0 | 61.3 | 16.9 | 246.1 |
| BLD6 | 433155.4 | 558789.9 | 14.0 | 44.3 | 17.1 | 64.8 |
| BLD7 | 433195.0 | 558805.5 | 20.0 | 22.3 | 21.9 | 66.0 |
| BLD8 | 433425.2 | 558771.3 | 17.0 | 33.9 | 84.8 | 67.8 |

**Figure 4-2: Model Setup**




**Aerial Imagery Source: Google Maps**

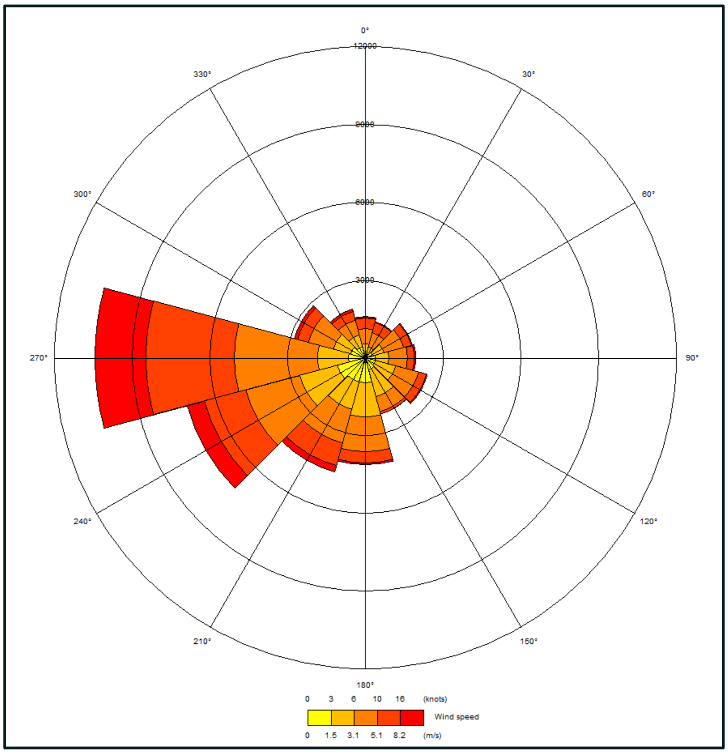
## 4.5 Meteorological Data

The nearest and most representative meteorological station in comparison to the Site is Newcastle Airport (approximately 19km northwest of the Site).

Five consecutive years of hourly sequential meteorological data (2015-2019) recorded at Newcastle Airport meteorological station has been used in the dispersion modelling assessment

A wind rose for the period is presented in Figure 4-3.

**Figure 4-3: Newcastle Airport (2015-2019) Wind Rose**




## 4.6 Advanced Dispersion Parameters

### 4.6.1 Surface Roughness

The Site is situated amidst diverse land uses, nestled predominantly on the periphery of industrial and residential areas. In order to accurately depict the surrounding environment, a surface roughness of 0.5m has been applied to the dispersion site.

A surface roughness of 0.3m has been applied to the meteorological station (Newcastle Airport).

### 4.6.1 Minimum Monin-Obukhov Length

A minimum Monin-Obukhov length of 30m has been used in relation to the study area, which relates to 'mixed urban/industrial'.

A minimum Monin-Obukhov length of 10m has been applied to the meteorological station (Newcastle Airport).

## 4.7 Background Datasets

NMP is not routinely monitored measured in the UK. Background concentrations are assumed to be negligible..

## 4.8 Model Outputs

Predicted pollutant concentrations are summarised in the following formats:

- Process contribution (PC) – the predicted contributions from the proposed new sources alone, as output from ADMS v6; and
- Predicted environmental concentration (PEC) – the resultant predicted concentration (i.e. PC + ambient background concentration value).

Table 4-3 presents the treatment of averaging periods of relevance to this assessment.

**Table 4-3: Model Outputs**

| Averaging Period | PC | PEC (If Calculated) |
|---|---|---|
| 1-Hour maximum | Maximum 1-hour mean | PC + 2 x Annual mean background |
| Annual mean | Annual mean | PC + Annual mean background |

### 4.8.1 Operational Envelope

The assessment has assumed that all proposed plant equipment will be operational for 8,760 hours per year (i.e. continuously), whereby no adjustment has been made to the model output.

This ensures all meteorological conditions are assessed. This is considered conservative. In reality operational hours are likely to be less to account for maintenance and downtime.

## 4.9 Assessment of Impact and Significance

Emissions can be considered to be insignificant and not require further assessment if:

- the PC <1% the long term AQAL; and
- the PC <10% the short-term AQAL.

For PCs that cannot be considered insignificant, further assessment has been undertaken and the PEC has been determined for comparison as a percentage of the relevant AQAL.

## 4.10 Uncertainty

It is recognised that dispersion modelling is inherently uncertain, particularly in circumstances where verification of modelled predictions relative to real-world condition is not possible. The accuracy of modelled predictions is intrinsically reliant on assessment inputs (i.e. emission rates, exhaust temperatures etc.), and the ability of the dispersion model to replicate real-world conditions.

In respect to this, all operational inputs have been provided or validated by AESC UK Plant 2 Ltd. Furthermore, the suite of ADMS software packages is well validated with observed concentrations for a number of scenarios by the model developers CERC and UK permitting authorities.

To provide certainty with respect to the assessment outcomes, wherever possible, this assessment has incorporated a number of conservative assumptions, which will result in an overestimation of predicted ground level concentrations. As such, the actual predicted ground level concentrations are expected to be lower than this and, in some cases, significantly lower, with the operation of the Site. Examples of these include (but are not limited to):

- 100% of the total VOC emission concentration used in this assessment is assumed to be NMP. Based upon research conducted, NMP has the highest risk potential; it is the only VOC for which EALs have previously been established, and UK workplace exposure thresholds are operable. NMP is only expected to be released at four release vents; and

- The assessment has assumed a continuous operational profile (i.e. 8,760 hours per year), at the applied emission concentration limits (Section 2.2.1.1) to ensure all worst-case dispersion conditions are assessed.

# 5.0 Predicted Air Quality Impacts

PCs have initially been assessed and compared against AERA prescribed insignificance thresholds. For those PCs that cannot be considered insignificant, further assessment has been undertaken to determine the PEC for comparison with the corresponding AQALs.

## 5.1 VOC (NMP)

Modelled annual mean VOC (NMP) impacts are presented in Table 5-1.

**Table 5-1: Annual Mean VOC Modelled Impacts**

| Receptor | PC (µg/m$^3$) | PC as % of AQAL |
|---|---|---|
| R1 | 0.2 | <0.1 |
| R2 | 0.1 | <0.1 |
| R3 | 0.1 | <0.1 |
| R4 | 0.1 | <0.1 |
| R5 | <0.1 | <0.1 |
| R6 | <0.1 | <0.1 |
| R7 | <0.1 | <0.1 |
| R8 | 0.1 | <0.1 |
| R9 | <0.1 | <0.1 |
| R10 | 0.4 | <0.1 |
| R11 | <0.1 | <0.1 |
| R12 | Hotel (short term exposure only) | |

Modelled VOC (NMP) annual mean PCs are below 1% of the AQAL at all receptor locations. Emissions are considered insignificant, and no further consideration is required.

The maximum modelled annual mean PC is 0.4µg/m$^3$ at Receptor R10. This represents an air quality impact equivalent to 0.039% of the annual mean EAL for NMP (1,030µg/m$^3$). This demonstrates that the proposed VOC emissions from the operation of the Site pose no credible risk of leading to an exceedance of the EAL, and that there is significant headroom between the predicted worst case air quality impacts vs. the EAL (a factor of 2,575).

Furthermore, the EAL would need to be 40µg/m$^3$ in order for emissions to be 1% of the AQAL, thus surpassing the EA insignificance threshold.

The above analysis indicates a significant headroom and safety margin, suggesting a low risk potential. Minor changes to the predicted emissions locations or emissions data are unlikely to pose any risk of exceeding the EAL, or exceeding the insignificance screening criteria.

Modelled 1-hour mean VOC (NMP) impacts are presented in Table 5-2.

**Table 5-2: 1-Hour Mean VOC (NMP) Modelled Impacts**

| Receptor | PC (µg/m$^3$) | PC as % of AQAL |
|---|---|---|
| R1 | 4.9 | <0.1 |
| R2 | 2.8 | <0.1 |
| R3 | 2.8 | <0.1 |

| Receptor | PC (µg/m³) | PC as % of AQAL |
|---|---|---|
| R4 | 2.7 | <0.1 |
| R5 | 3.0 | <0.1 |
| R6 | 2.4 | <0.1 |
| R7 | 2.5 | <0.1 |
| R8 | 2.9 | <0.1 |
| R9 | 2.5 | <0.1 |
| R10 | 10.5 | <0.1 |
| R11 | 2.1 | <0.1 |
| R12 | 6.4 | <0.1 |
| **Table Notes:**<br>PEC is not calculated as PCs are less than AERA insignificant thresholds. | | |

Modelled 1-hour mean VOC (NMP) PCs are below 10% of the AQAL at all receptor locations. Emissions are considered to be insignificant, and no further consideration is required.

The maximum modelled 1-hour mean PC is 10.5µg/m³ at Receptor R10. This represents an air quality impact equivalent to 0.034% of the 1-hour mean EAL for NMP (30,900µg/m³). This demonstrates that the proposed VOC emissions from the operation of the Site pose no credible risk of leading to an exceedance of the EAL, and that there is significant headroom between the predicted worst case air quality impacts vs. the EAL (a factor of 2,943).

Furthermore, the EAL would need to be 105µg/m³ in order for emissions to be 10% of the AQAL, thus surpassing the EA insignificance threshold.

The above analysis indicates a significant headroom and safety margin, suggesting a low risk potential. Minor changes to the predicted emissions locations or emissions data are unlikely to pose any risk of exceeding the EAL, or exceeding the insignificance screening criteria.

## 5.2 Sensitivity Test

In recognition of the difference in the DNELs for NMP vs. EMC (Section 3.1), a further sensitivity test has been conducted.

The DNEL for EMC is approximately 30% lower than the NMP. The applied NMP EALs have been reduced by 30% to account for this. However, it is worth noting that there are no published workplace exposure limits or EALs for EMC; this forms an indicative risk based sensitivity test.

The outcomes of this exercise are detailed in Table 5-3. The modelled PCs remain the same, however have been compared against the adjusted EALs.

**Table 5-3: VOC Modelled Impacts: Sensitivity Test**

| Receptor | Annual Mean (AQAL = 721µg/m³) | 1-Hour Mean (AQAL = 21,360µg/m³) |
|---|---|---|
| | PC as % of AQAL | |
| R1 | <0.1 | <0.1 |
| R2 | <0.1 | <0.1 |
| R3 | <0.1 | <0.1 |

| Receptor | Annual Mean (AQAL = 721µg/m$^3$) | 1-Hour Mean (AQAL = 21,360µg/m$^3$) |
|---|---|---|
| | PC as % of AQAL | |
| R4 | <0.1 | <0.1 |
| R5 | <0.1 | <0.1 |
| R6 | <0.1 | <0.1 |
| R7 | <0.1 | <0.1 |
| R8 | <0.1 | <0.1 |
| R9 | <0.1 | <0.1 |
| R10 | <0.1 | <0.1 |
| R11 | <0.1 | <0.1 |
| R12 | Hotel (short term exposure only) | <0.1 |

Modelled short and long-term VOC (NMP) PCs are <0.1% of the adjusted EALs at all receptor locations. Emissions are considered to be insignificant, and no further consideration is required.

# 6.0 Conclusions

The ADMS v6 dispersion model has been used to quantify potential impacts on surrounding human receptors.

The conclusions of the detailed atmospheric dispersion modelling assessment demonstrate that the air quality impacts resulting from the emissions associated with the proposed operation of the Site pose no credible risk of leading to an exceedance of the environmental assessment levels applied, and have been shown to be insignificant.

# Appendix A Modelling Checklist

## Air Emissions Risk Assessment

**Environmental Permit**

**AESC UK Plant 2 Ltd**

SLR Project No.: 416.065272.00001

15 March 2024

**Table A-1: Modelling Checklist**

| Item | Yes / No | Details / Reason for Omission |
|---|---|---|
| Location map | Yes | Figure 1-1 |
| Site plan | Yes | Figure 1-1 |
| Pollutants modelled | Yes | Section 2.0 |
| Relevant environmental standards | Yes | Section 3.0 |
| Details of modelled scenarios | Yes | Section 2.0 and 4.0 |
| Details of relevant ambient concentrations | Yes | Section 4.0 |
| Model description and justification | Yes | Section 4.1 |
| Special model treatment used | Yes | None |
| Table of emission parameters used | Yes | Appendix B |
| Details of modelled domain and receptors | Yes | Section 4.2 |
| Details of meteorological data used | Yes | Section 4.5 |
| Details of terrain treatment | Yes | Section 4.3 |
| Details of building treatment | Yes | Section 4.4 |
| Model uncertainty and sensitivity | Yes | Section 4.10 |
| Assessment of impacts | Yes | Section 5.0 |
| Contour plots | No | PCs are insignificant |
| Model input files | No | On request |

# Appendix B Emission Release Information

## Air Emissions Risk Assessment

**Environmental Permit**

**AESC UK Plant 2 Ltd**

SLR Project No.: 416.065272.00001

15 March 2024

**Table B-1: Review of Emission Source Risk**

<table>
<tr><th>Emission Points</th><th>Activity</th><th colspan="2">Substances Present</th><th>Justification</th><th>Emissions to Air Risk</th></tr>
<tr><td>A10, A12, A13, A30, A32 and A33</td><td>Cathode - preparation and application of coating mixture</td><td colspan="2">NMP</td><td>-</td><td>Yes</td></tr>
<tr><td rowspan="3">A20, A21, A40 and A41</td><td rowspan="3">Battery filling with electrolyte</td><td rowspan="3">VOC vapours from electrolytes.</td><td>DEC</td><td rowspan="3">-</td><td rowspan="3">Yes</td></tr>
<tr><td>EC</td></tr>
<tr><td>EMC</td></tr>
<tr><td rowspan="3">A15 and A35</td><td rowspan="3">De-gas roll press</td><td rowspan="3">Possible trace VOC vapours from the presence of electrolytes.</td><td>DEC</td><td rowspan="3">The de-gas roll press does not use these materials and it is suspected that they will not be present in the air emitted. However, have been incorporated for completeness.</td><td rowspan="3">Yes</td></tr>
<tr><td>EC</td></tr>
<tr><td>EMC</td></tr>
<tr><td>A16, A17, A18, A19, A36, A37, A38 and A39</td><td>Cell assembly and cell pouch bonding</td><td colspan="2">Possible trace VOC emissions from glue modules.</td><td>Trace VOC emissions associated with the thermal glue resin which contains 1-5% of petroleum which could be a VOC, but only present at very low concentrations. However, have been incorporated for completeness.</td><td>Yes</td></tr>
<tr><td>A7, A8, A27 and A28</td><td>Anode Coating – Mixing</td><td colspan="2">Negligible dust / particulates associated with mixing powdered material with deionised water to prepare the paste for application</td><td>No direct extraction from the coating mixing and preparation process as these are closed systems.<br>Potential dust / particulates extracted from plant area using LEV extraction which is routed via a HEPA filter for abatement prior to release. These operational areas of the plant are not expected to have significant levels of particulate materials present, but the HEPA filters are installed as a precautionary measure to ensure that no particulate materials are released to atmosphere.</td><td>No</td></tr>
</table>

| Emission Points | Activity | Substances Present | Justification | Emissions to Air Risk |
|---|---|---|---|---|
| | | | The HEPA filters are understood to achieve an abatement efficiency of around 99.99%. No particulate dust is expected to be present. | |
| A10, A12, A30 and A32 | Cathode Coating – Mixing | Negligible dust / particulates and metals (e.g. nickel) associated with mixing powdered metal oxides with NMP to prepare the paste for application. The powdered material present is a mixture of lithium, nickel, cobalt and aluminium oxides. Nickel monoxide or lithium oxide is the primary constituent. | No direct extraction from the coating mixing and preparation process as these are closed systems.<br>Potential dust / particulates extracted from plant area using LEV extraction which is routed via a HEPA filter for abatement prior to release. These operational areas of the plant are not expected to have significant levels of particulate materials present, but the HEPA filters are installed as a precautionary measure to ensure that no particulate materials are released to atmosphere.<br>The HEPA filters are understood to achieve an abatement efficiency of around 99.99%. No particulate dust is expected to be present. | No |
| A9, A11, A14, A29, A31 and A34 | Other | No pollutants present (hot air and traces of water vapour). | - | No |

**Table B-2: Emission Release Characteristics**

| ID | NGR | | Stack Internal Diameter (m) | Stack Height (AGL m) | Volumetric Flow Rate | | Velocity (m/s) | Temperature (ºC) |
|---|---|---|---|---|---|---|---|---|
| | X | Y | | | Actual ($Am^3/s$) | Normalised ($Nm^3/s$) | | |
| A10 | 433097.0 | 558698.0 | 0.315 | 33 | 1.07 | 1.00 | 13.8 | 20 |
| A12 | 433108.5 | 558755.8 | 0.450 | 33 | 1.83 | 1.71 | 11.5 | 20 |
| A13 | 433111.0 | 558756.8 | 0.280 | 33 | 0.97 | 0.90 | 15.7 | 20 |
| A15 | 433283.1 | 558832.2 | 0.350 | 19 | 1.08 | 1.01 | 11.3 | 20 |
| A16 | 433390.6 | 558814.8 | 0.450 | 19 | 1.89 | 1.76 | 11.9 | 20 |
| A17 | 433391.6 | 558812.7 | 0.450 | 19 | 1.89 | 1.76 | 11.9 | 20 |
| A18 | 433442.2 | 558700.3 | 0.450 | 19 | 1.89 | 1.76 | 11.9 | 20 |
| A19 | 433443.2 | 558698.0 | 0.450 | 19 | 1.89 | 1.76 | 11.9 | 20 |
| A20 | 433264.2 | 558699.6 | 0.630 | 33 | 4.35 | 4.05 | 14.0 | 20 |
| A21 | 433266.7 | 558700.6 | 0.500 | 33 | 2.23 | 2.07 | 11.3 | 20 |
| A30 | 433161.4 | 558555.8 | 0.315 | 33 | 1.07 | 1.00 | 13.8 | 20 |
| A32 | 433179.1 | 558534.1 | 0.450 | 33 | 1.83 | 1.71 | 11.5 | 20 |
| A33 | 433181.5 | 558535.4 | 0.280 | 33 | 0.97 | 0.90 | 15.7 | 20 |
| A35 | 433375.6 | 558623.1 | 0.350 | 19 | 1.08 | 1.01 | 11.3 | 20 |
| A36 | 433455.4 | 558671.7 | 0.450 | 19 | 1.89 | 1.76 | 11.9 | 20 |
| A37 | 433456.5 | 558669.3 | 0.450 | 19 | 1.89 | 1.76 | 11.9 | 20 |
| A38 | 433426.9 | 558646.2 | 0.450 | 19 | 1.89 | 1.76 | 11.9 | 20 |
| A39 | 433424.4 | 558645.3 | 0.450 | 19 | 1.89 | 1.76 | 11.9 | 20 |
| A40 | 433266.2 | 558696.0 | 0.630 | 33 | 4.35 | 4.05 | 14.0 | 20 |

| ID | NGR | | Stack Internal Diameter (m) | Stack Height (AGL m) | Volumetric Flow Rate | | Velocity (m/s) | Temperature (ºC) |
|---|---|---|---|---|---|---|---|---|
| | X | Y | | | Actual ($Am^3/s$) | Normalised ($Nm^3/s$) | | |
| A41 | 433268.6 | 558697.0 | 0.500 | 33 | 2.23 | 2.07 | 11.3 | 20 |

### Table B-3: VOC Emission Concentration Inputs

| ID | Emission Concentration | | | Emission Rate (g/s) |
|---|---|---|---|---|
| | Value (mg/Nm$^3$) | VOC Species | Justification | |
| A10 | 2 | NMP (CMR1) | Design guarantee (CMR 1A or 1B VOC WGC BAT-AEL = 1-5mg/Nm$^3$) | 0.001998 |
| A12 | 2 | NMP (CMR1) | Design guarantee (CMR 1A or 1B VOC WGC BAT-AEL = 1-5mg/Nm$^3$) | 0.003417 |
| A13 | 2 | NMP (CMR1) | Design guarantee (CMR 1A or 1B VOC WGC BAT-AEL = 1-5mg/Nm$^3$) | 0.001802 |
| A15 | 20 | DEC, EC and EMC | Maximum Total VOC WGC and STS BAT-AEL (1-20mg/Nm$^3$) | 0.020188 |
| A16 | 2 | Trace VOCs | Worst-case assumption. No BAT AEL applies (VOC emission rate is <100g/h). | 0.003514 |
| A17 | 2 | Trace VOCs | Worst-case assumption. No BAT AEL applies (VOC emission rate is <100g/h). | 0.003515 |
| A18 | 2 | Trace VOCs | Worst-case assumption. No BAT AEL applies (VOC emission rate is <100g/h). | 0.003515 |
| A19 | 2 | Trace VOCs | Worst-case assumption. No BAT AEL applies (VOC emission rate is <100g/h). | 0.003516 |
| A20 | 20 | DEC, EC and EMC | Maximum Total VOC WGC and STS BAT-AEL (1-20mg/Nm$^3$) | 0.081064 |
| A21 | 20 | DEC, EC and EMC | Maximum Total VOC WGC and STS BAT-AEL (1-20mg/Nm$^3$) | 0.041464 |
| A30 | 2 | NMP | Design guarantee (CMR 1A or 1B VOC WGC BAT-AEL = 1-5mg/Nm$^3$) | 0.001998 |
| A32 | 2 | NMP | Design guarantee (CMR 1A or 1B VOC WGC BAT-AEL = 1-5mg/Nm$^3$) | 0.003417 |
| A33 | 2 | NMP | Design guarantee (CMR 1A or 1B VOC WGC BAT-AEL = 1-5mg/Nm$^3$) | 0.001802 |
| A35 | 20 | DEC, EC and EMC | Maximum Total VOC WGC and STS BAT-AEL (1-20mg/Nm$^3$) | 0.020188 |
| A36 | 2 | Trace VOCs | Worst-case assumption. No BAT AEL applies (VOC emission rate is <100g/h). | 0.003514 |
| A37 | 2 | Trace VOCs | Worst-case assumption. No BAT AEL applies (VOC emission rate is <100g/h). | 0.003515 |
| A38 | 2 | Trace VOCs | Worst-case assumption. No BAT AEL applies (VOC emission rate is <100g/h). | 0.003515 |
| A39 | 2 | Trace VOCs | Worst-case assumption. No BAT AEL applies (VOC emission rate is <100g/h). | 0.003516 |
| A40 | 20 | DEC, EC and EMC | Maximum Total VOC WGC and STS BAT-AEL (1-20mg/Nm$^3$) | 0.081064 |
| A41 | 20 | DEC, EC and EMC | Maximum Total VOC WGC and STS BAT-AEL (1-20mg/Nm$^3$) | 0.041464 |

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