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## Northacre Renewable Energy Limited

Abnormal emissions assessment

## Document approval

|              | Name           | Signature   | Position                | Date       |
|--------------|----------------|---|-------------------------|------------|
| Prepared by: | Hannah Lederer |  | Environmental Scientist | 06/07/2020 |
| Checked by:  | James Sturman  |  | Lead Consultant         | 14/07/2020 |

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# 1 Introduction

Northacre Renewable Energy Limited (NRE) is proposing to build the Northacre Renewable Energy facility (the Facility) on land off Stephenson Road, Westbury, Wiltshire. A detailed description of the activities to be undertaken at the Facility is included within the Supporting Information document.

Northacre Renewable Energy Ltd is applying to the Environment Agency (EA) under the Environmental Permitting Regulations (EPR) for an Environmental Permit (EP) to operate the Facility.

The Environmental Permitting Regulations require that abnormal event scenarios are considered.

Article 46(6) of the Industrial Emissions Directive (IED) states that:

*“... the waste incineration plant ... shall under no circumstances continue to incinerate waste for a period of more than 4 hours uninterrupted where emission limit values are exceeded.*

*The cumulative duration or operation in such conditions over 1 year shall not exceed 60 hours.”*

Article 47 continues with:

*“In the case of a breakdown, the operator shall reduce or close down operations as soon as practicable until normal operations can be restored.”*

The conditions detailed in Article 46(6) are considered to be “abnormal operating conditions” for the purpose of this assessment apply to the Facility.

## 2 Identification of Abnormal Operating Conditions

The following are considered to be examples of abnormal operating conditions which may lead to 'abnormal emission levels' of pollutants:

1. Reduced efficiency of lime injection system such as through blockages or failure of fans leading to elevated acid gas emissions (with the exception of hydrogen chloride);
2. Complete failure of the lime injection system leading to unabated emissions of hydrogen chloride. (Note: this would require the plant to have complete failure of the bag filter system. As a plant of modern design, it would have shut down before reaching these operating conditions);
3. Reduced efficiency of particulate filtration system due to bag failure and inadequate isolation, leading to elevated particulate emissions and metals in the particulate phase;
4. Reduced efficiency of the Selective Non-Catalytic Reduction (SNCR) system as a result of blockages or failure of ammonia injection system, leading to elevated oxides of nitrogen emissions; and
5. Complete failure of the activated carbon injection system and loss of temperature control leading to high levels of dioxin reformation and their unabated release.

As a modern design, it is anticipated that the Facility will be operated to a high degree of compliance. Therefore, the identification of plausible abnormal emission levels has been based primarily on the data obtained from modern plants. Where actual data is not available, worst case conservative assumptions have been made.

### 2.1 Plant start-up and shutdown

Start-up of the Facility from cold will be conducted with an auxiliary fuel (low sulphur fuel oil). Waste will not be introduced into the furnace unless the temperature is above the minimum requirement (850°C) and other operating parameters (for example, air flow and oxygen levels) are within the range stipulated in the permit. During the warming up period the flue gas treatment plant will be operational as will be the control systems and monitoring equipment.

The same is true during plant shutdown. The waste remaining in the furnace will be allowed to burn out, the temperature not being permitted to drop below 850°C by the simultaneous introduction of the auxiliary fuel. After complete burnout of the waste, the auxiliary fuel burners are turned off and the system will be allowed to cool. During this period, the combustion control systems, flue gas cleaning equipment, and the monitoring equipment will be fully operational.

It should also be noted that start-up and shutdown are infrequent events; the Facility is designed to operate continuously, and ideally only close down for its annual maintenance programme.

In relation to the magnitude of dioxin emissions during plant start-up and shutdown, research has been undertaken by AEA Technology on behalf of the EA. Whilst elevated emissions of dioxins (within one order of magnitude) were found during shutdown and start-up phases where the waste was not fully established on the grate, the report concluded that:

*"The mass of dioxin emitted during start-up and shutdown for a 4-5 day planned outage was similar to the emission which would have occurred during normal operation in the same period. The emission during the shutdown and restart is equivalent to less than 1% of the estimated annual emission (if operating normally all year)."*

Therefore, there is no reason why start-up and shutdown operations will affect the long-term impact of the Facility.

### 3 Plausible Abnormal Emission Levels

The following plausible abnormal emission levels for the Facility have been identified based on the performance of similar plants in the UK. The plausible abnormal emissions concentrations are presented in Table 1, where available, these have been based on measured data from a comparable Facility.

Table 1: Plausible Abnormal Emissions from an EfW

| Pollutant                              | Permitted Emission Limit, (mg/Nm <sup>3</sup> ) <sup>(1)</sup> |              | Plausible Abnormal Emission, (mg/Nm <sup>3</sup> ) | % Above Max Permitted Emission |
|--|--|--------------|--|--------------------------------|
|  | Daily Average  | ½ hourly max |  |                                |
| Oxides of nitrogen                     | 120  | 400          | 500 <sup>(2)</sup>                                 | 25                             |
| Particulate matter (PM <sub>10</sub> ) | 5  | 30           | 150 <sup>(3)</sup>                                 | 400                            |
| Sulphur dioxide                        | 30   | 200          | 450 <sup>(4)</sup>                                 | 163                            |
| Hydrogen chloride                      | 6  | 60           | 900 <sup>(4)</sup>                                 | 2,817                          |
| Hydrogen fluoride                      | 1  | 4            | 20 <sup>(1)</sup>                                  | 400                            |
| Dioxins and dioxin-like PCBs           | 0.06 ng/Nm <sup>3</sup>  |              | 6 ng/Nm <sup>3</sup>                               | 9900 <sup>(5)</sup>            |
| PCBs                                   | 0.005 mg/Nm <sup>3</sup> <sup>(6)</sup>                        |              | 0.5 mg/Nm <sup>3</sup>                             | 9900 <sup>(7)</sup>            |

NOTES:

- All emissions expressed as Nm<sup>3</sup> based (dry, 0°C, 11% reference oxygen content).
- Taken as the upper end of the range of monitored raw flue gas after the boiler from the Waste Incineration BREF (Table 3.6)
- Taken from the IED maximum permitted level.
- Based on information presented in the Devonport Decision Document (Reference: EPR/WP3833FT).
- Assumes a 99% removal efficiency in lieu of any other information as set out in the Devonport Decision Document (Reference: EPR/WP3833FT).
- The Draft Waste Incineration BREF provides a range of values for PCB emissions to air from European municipal waste incineration plants. This states that the annual average total PCBs is less than 0.005 mg/Nm<sup>3</sup> (dry, 11% oxygen, 273K). In lieu of other available data, this has been assumed to be the emission concentration for the Facility.
- In lieu of any publicly available information, the plausible emissions multiplier for PCBs is assumed to be the same as for dioxins.

A number of assumptions have been made with regard to the emissions of individual metals.

- Emission concentration of mercury has been assumed to be 100% of the draft Best Available Techniques Associated Emission Level (BAT-AEL) concentration of 0.02mg/m<sup>3</sup>.
- Emission concentration of cadmium has been taken as half the draft BAT-AEL concentration for cadmium and thallium and compounds of 0.02mg/m<sup>3</sup>.
- Emission concentration of heavy metals that have a short or long term AQAL have been considered (antimony, arsenic, chromium, copper, lead, manganese, nickel, vanadium) and have been taken from the EA guidance document "Guidance on assessing group 3 metal stack emissions from incinerators" (version 4). This guidance summarises the existing emissions from

18 Municipal Waste Incinerators (MWIs) and Waste Wood Co-incinerators in the UK over a period between 2007 and 2015. This has been used in lieu of any guidance from the EA.

4. The Predicted Abnormal Emissions are calculated based on 30 times the emission concentration, as it is assumed that metals are in the particulate phase with the exception of mercury where it has been assumed there is a 99% removal efficiency.

The plausible abnormal emissions concentrations for metals are presented in Table 2.

Table 2: Predicted Abnormal Metal Emissions from an EfW

| Pollutant     | Emission Concentrations ( $\mu\text{g}/\text{Nm}^3$ ) | Predicted Abnormal Emission ( $\mu\text{g}/\text{Nm}^3$ ) | % Above Max Permitted Emission |
|---------------|---|---|--------------------------------|
| Antimony      | 11.5  | 345   | 2,900                          |
| Arsenic       | 25  | 750   | 2,900                          |
| Cadmium       | 10  | 300   | 2,900                          |
| Chromium      | 92  | 2,760   | 2,900                          |
| Chromium (VI) | 0.13  | 3.9   | 2,900                          |
| Copper        | 29  | 870   | 2,900                          |
| Lead          | 50.3  | 1,509   | 2,900                          |
| Manganese     | 60  | 1,800   | 2,900                          |
| Mercury       | 20  | 2,000   | 9,900                          |
| Nickel        | 220   | 6,600   | 2,900                          |
| Vanadium      | 6   | 180   | 2,900                          |

The definition of ‘abnormal operating conditions’ also encompasses periods where the continuous emission monitoring equipment is not operating correctly and data relating to the actual emission concentrations are not available. This assessment has only used data where the concentration of continuously monitored pollutants has been quantified. Furthermore, no data on flow characteristics (flow rate, temperature etc.) during these abnormal operating conditions is available, so for the purposes of this assessment the design flow characteristics have been applied to the plausible emission levels to derive an emission rate and assess impact.

In defining abnormal operating conditions Annex VI, Part 3 (2) notes that under no circumstances shall the total dust concentration exceed  $150 \text{ mg}/\text{Nm}^3$  expressed as a half hourly average. As such total dust has been included in this analysis. However, Annex VI, Part 3 (2) goes on to state that the limits prescribed for TOC set must not be exceeded. As such there is no potential for the impact of emissions of TOC to be greater than that outlined in the Air Quality Assessment; therefore, TOC has not been considered within this abnormal emissions assessment.



## 4 Impact Resulting from Plausible Abnormal Emissions

### 4.1 Impact from normal operations

The Air Quality Assessment has considered the impact of the Facility in isolation and has not identified any local developments that have the potential to cause point source cumulative impacts with the Facility. Therefore, the process contribution used in this assessment is that of the Facility operating in isolation. This data is presented in Appendix B.

### 4.2 Predicted abnormal short-term impacts

In order to assess the effect on short term ground level concentrations associated with the Facility operating at the identified abnormal emission concentration, the calculated ground level concentration has been increased pro-rata as presented in Table 3.

Table 3: Short-term Impacts Resulting from Plausible Abnormal Emissions

| Pollutant                              | AQAL ( $\mu\text{g}/\text{m}^3$ ) | Predicted Impact – BAT-AELs    |           | Predicted Impact – Abnormal Emission |           |
|--|-----------------------------------|--------------------------------|-----------|--------------------------------------|-----------|
|  |                                   | Conc. $\mu\text{g}/\text{m}^3$ | % of AQAL | Conc. $\mu\text{g}/\text{m}^3$       | % of AQAL |
| Nitrogen dioxide                       | 200                               | 16.80                          | 8.40%     | 21.01                                | 10.50%    |
| Particulate matter (PM <sub>10</sub> ) | 50                                | 0.15                           | 0.30%     | 4.45                                 | 8.91%     |
| Sulphur dioxide (24-hour)              | 125                               | 1.89                           | 1.51%     | 28.33                                | 22.66%    |
| Sulphur dioxide (1-hour)               | 350                               | 23.81                          | 6.80%     | 53.6                                 | 15.31%    |
| Sulphur dioxide (15-min)               | 266                               | 27.07                          | 10.18%    | 60.9                                 | 22.90%    |
| Hydrogen chloride                      | 750                               | 12.74                          | 1.70%     | 191.1                                | 25.49%    |
| Hydrogen fluoride                      | 160                               | 0.85                           | 0.53%     | 4.2                                  | 2.65%     |
| Pollutant                              | AQAL ( $\text{ng}/\text{m}^3$ )   | Predicted Impact – BAT-AELs    |           | Predicted Impact – Abnormal Emission |           |
|  |                                   | Conc. $\text{ng}/\text{m}^3$   | % of AQAL | Conc. $\text{ng}/\text{m}^3$         | % of AQAL |
| Antimony                               | 150,000                           | 2.45                           | <0.01%    | 73.37                                | 0.05%     |
| Chromium                               | 150,000                           | 19.56                          | 0.01%     | 586.94                               | 0.39%     |
| Copper                                 | 200,000                           | 6.17                           | <0.01%    | 185.01                               | 0.09%     |
| Manganese                              | 1,500,000                         | 12.76                          | <0.01%    | 382.79                               | 0.03%     |
| Mercury                                | 7,500                             | 4.25                           | 0.06%     | 425.32                               | 5.67%     |
| Vanadium                               | 1,000                             | 1.28                           | 0.13%     | 38.28                                | 3.83%     |
| PCBs                                   | 6,000                             | 1.06                           | 0.02%     | 106.33                               | 1.77%     |

This is considered to be a highly conservative assessment as it assumes that the plausible abnormal emissions coincide with worst case meteorological conditions. Even with this highly conservative

factor, the process contribution is not predicted to exceed any of the short term AQALs. The maximum predicted process contribution (as a % of the applied AQAL) 25.49% for hydrogen chloride, with all other pollutants lower.

### 4.3 Predicted abnormal long-term impacts

In order to assess the effect on long term ground level concentrations associated with the Facility operating at the identified abnormal emission levels, the calculated long term ground level concentrations have been increased pro-rata as presented in Table 4.

There is no AQAL for dioxins and dioxin-like PCBs against which the impact can be assessed. Therefore, to assess the impact of dioxins and dioxin-like PCBs, the increase in concentration at the point of maximum impact has been assessed. As can be seen from the results presented in Table 5, the impact of abnormal emissions is to increase in the maximum ground level concentration by 67.81%.

This assessment assumes that the Facility is operating at the daily average BAT-AELs for 8,700 hours per year and at the plausible abnormal emission levels for 60 hours per year.

Table 4: Long-term Impacts Resulting from Plausible Abnormal Emissions

| Pollutant                              | AQAL<br>( $\mu\text{g}/\text{m}^3$ ) | Predicted Impact –<br>BAT-AELs        |           | Predicted Impact –<br>Abnormal Emission |           |
|--|--------------------------------------|---------------------------------------|-----------|---|-----------|
|  |                                      | Conc.<br>( $\mu\text{g}/\text{m}^3$ ) | % of AQAL | Conc.<br>( $\mu\text{g}/\text{m}^3$ )   | % of AQAL |
| Nitrogen dioxide                       | 40                                   | 0.76                                  | 1.89%     | 0.77                                    | 1.93%     |
| Particulate matter (PM <sub>10</sub> ) | 40                                   | 0.05                                  | 0.11%     | 0.05                                    | 0.14%     |
| Hydrogen fluoride                      | 16                                   | 0.01                                  | 0.06%     | 0.01                                    | 0.06%     |
| Pollutant                              | AQAL<br>( $\text{ng}/\text{m}^3$ )   | Predicted Impact –<br>BAT-AELs        |           | Predicted Impact –<br>Abnormal Emission |           |
|  |                                      | Conc.<br>( $\text{ng}/\text{m}^3$ )   | % of AQAL | Conc.<br>( $\text{ng}/\text{m}^3$ )     | % of AQAL |
| Antimony                               | 5,000                                | 0.10                                  | <0.01%    | 0.12                                    | <0.01%    |
| Arsenic                                | 3                                    | 0.23                                  | 7.52%     | 0.27                                    | 9.01%     |
| Cadmium                                | 5                                    | 0.09                                  | 1.80%     | 0.11                                    | 2.16%     |
| Chromium                               | 5,000                                | 0.83                                  | 0.02%     | 0.99                                    | 0.02%     |
| Chromium (VI)                          | 0.2                                  | <0.01                                 | 0.59%     | 0.00141                                 | 0.70%     |
| Copper                                 | 10,000                               | 0.26                                  | <0.01%    | 0.31                                    | <0.01%    |
| Lead                                   | 250                                  | 0.45                                  | 0.18%     | 0.54                                    | 0.22%     |
| Manganese                              | 150                                  | 0.54                                  | 0.36%     | 0.65                                    | 0.43%     |
| Mercury                                | 250                                  | 0.18                                  | 0.07%     | 0.30                                    | 0.12%     |
| Nickel                                 | 20                                   | 1.99                                  | 9.93%     | 2.38                                    | 11.90%    |
| Vanadium                               | 5,000                                | 0.05                                  | <0.01%    | 0.06                                    | <0.01%    |
| PCBs                                   | 200                                  | 0.05                                  | 0.02%     | 0.08                                    | 0.04%     |

The process contribution is not predicted to exceed any of the long term AQALs. The maximum predicted process contribution (as a % of the applied AQAL) is less than 11.90% for nickel, with all other pollutants lower.

There is no AQAL for dioxins and dioxin-like PCBs against which the impact can be assessed. Therefore, to assess the impact of dioxins and dioxin-like PCBs, the increase in concentration at the point of maximum impact has been assessed. As can be seen from the results presented in Table 5, the impact of abnormal emissions is to increase in the maximum ground level concentration by 67.81%.

Table 5: Long Term Impacts from Predicted Dioxin Emissions

| Pollutant                    | Predicted Impact – BAT-AELs | Predicted Impact –Abnormal Emission |            |
|------------------------------|-----------------------------|-------------------------------------|------------|
|                              | fg/m <sup>3</sup>           | fg/m <sup>3</sup>                   | % increase |
| Dioxins and dioxin like PCBs | 0.54                        | 0.90                                | 67.81%     |

#### 4.4 Impact of plausible abnormal emissions – Human Health Risk Assessment

Based on the results of the Human Health Risk Assessment (HHRA), the highest dose of dioxins and dioxin-like PCBs is predicted to be 4.06% of the TDI. This is based on the ingestion and inhalation of dioxins and dioxin-like PCBs by a child agricultural receptor at the point of maximum impact. Assuming the impact of abnormal operations, it is calculated that the process contribution at this receptor will be  $(4.06\% \times 1.6781) = 6.81\%$  of the UK TDI for dioxins and dioxin-like PCBs. Existing sources contribute 90.65% of the TDI, and therefore the total exposure will be 97.46% of the TDI.

In addition, the HHRA considers the impact of the ingestion of dioxins by an infant being breast fed by an adult agricultural receptor at the point of maximum impact. The impact is predicted to be 12.75% of the UK TDI for dioxins. There are no other significant pathways for infant receptors. Assuming the impact of abnormal operations, it is calculated that this receptor will be exposed to  $(12.86\% \times 1.6781) = 21.58\%$  of the UK TDI for dioxins.

Based on the conservative assumptions used within the modelling, there will be no exceedances of the TDI for dioxins and dioxin-like PCBs.

## 5 Predicted Environmental Concentration – Abnormal Operations

The EA's Air Emissions Guidance includes the following method for identifying which emissions require further assessment by applying the following criteria:

- the long-term process contribution is <1% of the long term environmental standard; and
- the short-term process contribution is <10% of the short term environmental standard.

Where the impact of abnormal emissions is greater than the above criteria consideration of the background concentration has been made to ensure that the AQAL is not exceeded as a result of abnormal operations.

### 5.1 Baseline concentrations

The values for the annual average background concentrations that have been used to evaluate the impact of the Facility are presented in Appendix A. These are the baseline concentrations, presented in the Air Quality Assessment.

### 5.2 Predicted short term impacts

Table 6 presents the predicted impacts of plausible abnormal operations in the short term at the point of maximum impact and the Predicted Environmental Concentration (PEC) (process contribution plus baseline) for those pollutants for which the impact cannot be screened as insignificant.

Table 6: Short Term PEC Resulting from Plausible Abnormal Emissions

| Pollutant                 | AQAL<br>( $\mu\text{g}/\text{m}^3$ ) | Baseline<br>Conc.        | PC –<br>Abnormal<br>Emissions | PEC – Abnormal<br>Emissions |           |
|---------------------------|--------------------------------------|--------------------------|-------------------------------|-----------------------------|-----------|
|                           |                                      | $\mu\text{g}/\text{m}^3$ | $\mu\text{g}/\text{m}^3$      | $\mu\text{g}/\text{m}^3$    | % of AQAL |
| Nitrogen dioxide          | 200                                  | 26.38                    | 21.01                         | 47.39                       | 23.7%     |
| Sulphur dioxide (24-hour) | 125                                  | 4.42                     | 28.33                         | 32.75                       | 26.2%     |
| Sulphur dioxide (1-hour)  | 350                                  | 4.42                     | 53.57                         | 57.99                       | 16.6%     |
| Sulphur dioxide (15-min)  | 266                                  | 4.42                     | 60.92                         | 65.34                       | 24.6%     |
| Hydrogen chloride         | 750                                  | 1.42                     | 191.15                        | 192.57                      | 25.7%     |

As shown, the PEC is not predicted to exceed the AQAL at the point of maximum impact for any pollutant during abnormal operations.

### 5.3 Predicted long term impacts

Table 7 presents the predicted impacts of plausible abnormal operations in the long term at the point of maximum impact, and the PEC. This assessment assumes that the Facility is operating at the BAT-AELs for 8,700 hours per year and at the plausible abnormal emission levels for 60 hours per year.

Table 7: Long Term PEC Resulting from Plausible Abnormal Emissions

| Pollutant        | AQAL<br>( $\mu\text{g}/\text{m}^3$ ) | Baseline<br>Conc.        | PC –<br>Abnormal<br>Emissions        | PEC – Abnormal<br>Emission |           |
|------------------|--------------------------------------|--------------------------|--------------------------------------|----------------------------|-----------|
|                  |                                      | $\mu\text{g}/\text{m}^3$ | $\mu\text{g}/\text{m}^3$             | $\mu\text{g}/\text{m}^3$   | % of AQAL |
| Nitrogen dioxide | 40                                   | 13.19                    | 0.77                                 | 13.96                      | 34.9%     |
| Pollutant        | AQAL<br>( $\text{ng}/\text{m}^3$ )   | Baseline<br>Conc.        | PC –<br>Abnormal<br>Emissions<br>(1) | PEC – Abnormal<br>Emission |           |
|                  |                                      | $\text{ng}/\text{m}^3$   | $\text{ng}/\text{m}^3$               | $\text{ng}/\text{m}^3$     | % of AQAL |
| Arsenic          | 3                                    | 1.1                      | 0.27                                 | 1.37                       | 45.7%     |
| Cadmium          | 5                                    | 0.57                     | 0.11                                 | 0.68                       | 13.6%     |
| Nickel           | 20                                   | 14                       | 2.38                                 | 16.38                      | 81.9%     |

As shown, the PEC is not predicted to exceed the AQAL at the point of maximum impact for any pollutant during abnormal operations.

## 6 Summary

An assessment of the impact on air quality associated with abnormal operating conditions from the Facility has identified plausible abnormal emissions based on a review of monitoring data from operational facilities of a similar type in the UK. Notwithstanding the low frequency of occurrence of such abnormal operating conditions identified by the review, the potential impact on air quality has been assessed.

The predicted impact on air quality associated with the identified plausible abnormal emissions has been calculated by pro-rating the impact associated with normal operations by the ratio between the normal and plausible abnormal emission values. This is considered to be a highly conservative assessment as it assumes that the plausible abnormal emissions coincide with the worst-case meteorological conditions for dispersion.

Even with these conservative factors, there are no predicted exceedances of any of the short term or long term AQALs associated with abnormal operation. The maximum predicted short term process contribution (as % of the applied AQAL) is 25.49%; and the maximum predicted long term process contribution (as % of the applied AQAL) is less than 12%. In addition, the assessment has shown that there will not be any exceedances of the TDI for dioxins.

It is concluded that during periods of abnormal operation as permissible under the IED (Article 46) is not predicted to give rise to an unacceptable impact on air quality or the environment.

# Appendices

## A Baseline Concentrations

Table 8: Summary of Baseline Concentrations

| Pollutant                     | Concentration | Units                | Justification  |
|-------------------------------|---------------|----------------------|--|
| Nitrogen dioxide              | 13.19         | µg/m <sup>3</sup>    | Maximum mapped background concentration from within 5 km of Site- DEFRA 2017 dataset.              |
| Oxides of nitrogen            | 18.25         | µg/m <sup>3</sup>    | Maximum mapped background concentration from within 5 km of Site- DEFRA 2017 dataset.              |
| Sulphur dioxide               | 2.21          | µg/m <sup>3</sup>    | Maximum mapped background concentration from within 5 km of Site- DEFRA 2001 dataset.              |
| Particulate matter (as PM10)  | 14.91         | µg/m <sup>3</sup>    | Maximum mapped background concentration from within 5 km of Site- DEFRA 2017 dataset.              |
| Particulate matter (as PM2.5) | 9.77          | µg/m <sup>3</sup>    | Maximum mapped background concentration from within 5 km of Site- DEFRA 2017 dataset.              |
| Carbon monoxide               | 266           | µg/m <sup>3</sup>    | Maximum mapped background concentration from within 5 km of Site- DEFRA 2001 dataset.              |
| Benzene                       | 0.39          | µg/m <sup>3</sup>    | Maximum mapped background concentration from within 5 km of Site- DEFRA 2001 dataset.              |
| 1,3-butadiene                 | 0.16          | µg/m <sup>3</sup>    | Maximum mapped background concentration from within 5 km of Site- DEFRA 2001 dataset.              |
| Ammonia                       | 2.93          | µg/m <sup>3</sup>    | Maximum mapped background concentration from within 5 km of Site- DEFRA (CEH) 2014 dataset.        |
| Hydrogen chloride             | 0.71          | µg/m <sup>3</sup>    | Maximum monitored concentration across the UK 2012 to 2015   |
| Hydrogen fluoride             | 2.35          | µg/m <sup>3</sup>    | Maximum measured concentration from EPAQS report   |
| Cadmium                       | 0.57          | ng/m <sup>3</sup>    | Maximum annual concentration averaged across all urban industrial sites across the UK 2015 to 2019 |
| Thallium                      | -             | ng/m <sup>3</sup>    |  |
| Mercury                       | 2.80          | ng/m <sup>3</sup>    |  |
| Antimony                      | -             | ng/m <sup>3</sup>    |  |
| Arsenic                       | 1.10          | ng/m <sup>3</sup>    |  |
| Chromium                      | 39.00         | ng/m <sup>3</sup>    |  |
| Cobalt                        | 0.92          | ng/m <sup>3</sup>    |  |
| Copper                        | 33.00         | ng/m <sup>3</sup>    |  |
| Lead                          | 16.00         | ng/m <sup>3</sup>    |  |
| Manganese                     | 36.00         | ng/m <sup>3</sup>    |  |
| Nickel                        | 14.00         | ng/m <sup>3</sup>    |  |
| Vanadium                      | 1.70          | ng/m <sup>3</sup>    |  |
| Dioxins and Furans            | 32.99         | fgTEQ/m <sup>3</sup> | Maximum monitored concentration across all UK sites 2012 to 2016                                   |
| Dioxin-like PCBs              | 128.93        | pg/m <sup>3</sup>    | Maximum monitored concentration across all UK sites 2014 to 2018                                   |



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| Pollutant | Concentration | Units | Justification  |
|-----------|---------------|-------|--|
| PaHs      | 0.98          | ng/m3 | Maximum annual concentration averaged across all background sites across the UK 2015 to 2019 |

## B Process Contribution – Normal Operations

Table 9: Dispersion Modelling Results – Point of Maximum Impact

| Pollutant                               | Quantity                      | Units             | AQAL | Max PC |              |
|---|-------------------------------|-------------------|------|--------|--------------|
|   |                               |                   |      | Conc.  | as % of AQAL |
| Nitrogen dioxide                        | Annual mean                   | µg/m <sup>3</sup> | 40   | 0.76   | 1.89%        |
|   | 99.79th %ile of hourly means* | µg/m <sup>3</sup> | 200  | 16.80  | 8.40%        |
| Sulphur dioxide                         | 99.18th %ile of daily means   | µg/m <sup>3</sup> | 125  | 1.89   | 1.51%        |
|   | 99.73rd %ile of hourly means* | µg/m <sup>3</sup> | 350  | 23.81  | 6.80%        |
|   | 99.9th %ile of 15 min. means* | µg/m <sup>3</sup> | 266  | 27.07  | 10.18%       |
| Particulates (PM <sub>10</sub> )        | Annual mean                   | µg/m <sup>3</sup> | 40   | 0.05   | 0.11%        |
|   | 98.4th %ile of daily means    | µg/m <sup>3</sup> | 50   | 0.15   | 0.30%        |
| Hydrogen chloride                       | Annual mean                   | µg/m <sup>3</sup> | 20   | 1.27   | 0.17%        |
|   | Hourly mean*                  | µg/m <sup>3</sup> | 750  | 12.74  | 1.70%        |
| Hydrogen fluoride                       | Annual mean                   | µg/m <sup>3</sup> | 16   | 0.01   | 0.06%        |
|   | Hourly mean*                  | µg/m <sup>3</sup> | 160  | 0.85   | 0.53%        |
| Mercury                                 | Annual mean                   | ng/m <sup>3</sup> | 250  | 0.18   | 0.07%        |
|   | Hourly mean                   | ng/m <sup>3</sup> | 7500 | 4.25   | 0.06%        |
| Cadmium                                 | Annual mean                   | ng/m <sup>3</sup> | 5.00 | 0.18   | 3.61%        |
|   | Hourly mean                   | ng/m <sup>3</sup> | 1500 | 4.25   | -            |
| Dioxins and furans and dioxin-like PCBs | Annual mean                   | fg/m <sup>3</sup> | -    | 0.54   | -            |
| PCBs                                    | Annual mean                   | ng/m <sup>3</sup> | 200  | 0.05   | 0.02%        |
|   | Hourly mean                   | ng/m <sup>3</sup> | 6000 | 1.06   | 0.02%        |
| Group 3 metals                          | Annual mean                   | ng/m <sup>3</sup> | -    | 2.71   | -            |
|   | Hourly mean                   | ng/m <sup>3</sup> | -    | 63.80  | -            |

Notes:  
 \* Assumes operation at the half-hourly ELV.  
 All other results based on operation at the daily or period mean ELV.

ENGINEERING  CONSULTING

**FICHTNER**

Consulting Engineers Limited

Kingsgate (Floor 3), Wellington Road North,  
Stockport, Cheshire, SK4 1LW,  
United Kingdom

t: +44 (0)161 476 0032

f: +44 (0)161 474 0618

[www.fichtner.co.uk](http://www.fichtner.co.uk)