Riverside Energy Park

Environmental Permit Appendices

APPENDIX:

D

AIR QUALITY ASSESSMENT

ABNORMAL EMISSIONS ASSESSMENT

December 2018 | Revision 0

CORY RIVERSIDE ENERGY

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1 Introduction

1.1.1 Cory Environmental Holdings Limited (trading as Cory Riverside Energy) (Cory or the Applicant) is applying to the Environment Agency (EA) under The Environmental Permitting (England and Wales) Regulations 2016 (Environmental Permitting Regulations) for an Environmental Permit (EP) to operate an integrated Energy Park, to be known as Riverside Energy Park (REP or the Proposed Development). REP would comprise waste treatment facilities together with an associated Electrical Connection.

1.2 Project Description

1.2.1 A detailed description of REP is presented in Sections 1.4 to 1.6 of the Supporting Information. REP would be constructed on land immediately adjacent to Cory's existing Riverside Resource Recovery Facility (RRRF), within the London Borough of Bexley and would complement the operation of the existing facility.

1.2.2 The main elements of REP would be as follows:

- Energy Recovery Facility (ERF): to provide thermal treatment of Commercial and Industrial (C&I) residual (non-recyclable) waste with the potential for treatment of (non-recyclable) Municipal Solid Waste (MSW);
- Anaerobic Digestion facility: to process food and green waste. Outputs from the Anaerobic Digestion facility would be transferred off-site for use in the agricultural sector as fertiliser or as an alternative, where appropriate, used as a fuel in the ERF to generate electricity;
- Solar Photovoltaic Installation: to generate electricity. Installed across a wide extent of the roof of the Main REP Building;
- Battery Storage: to store and supply additional power to the local distribution network at times of peak electrical demand. This facility would be integrated into the Main REP building; and
- On Site Combined Heat and Power (CHP) Infrastructure: to provide an opportunity for local district heating for nearby residential developments and businesses. REP would be CHP Enabled with necessary on site infrastructure included within the REP site.

1.3 The Objective

1.3.1 The Environmental Permitting Regulations require that scenarios of 'abnormal events', as described in paragraph 1.3.2, are considered. The objective of this report is to assess the impact of emissions resulting from such abnormal event scenarios from the ERF.

1.3.2 Article 46(6) of the Industrial Emissions Directive (IED), which has been implemented in England through the Environmental Permitting Regulations, 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."

1.3.3 Article 47 of the IED 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."

1.3.4 The conditions detailed in Article 46(6) are considered to be "abnormal operating conditions".

2 Identification of Abnormal Operating Conditions

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

- 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);
- 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, the ERF would have shut down before reaching these operating conditions);
- Reduced efficiency of particulate filtration system due to bag failure and inadequate isolation, leading to elevated particulate emissions and metals in the particulate phase;
- Reduced efficiency of the Selective Catalytic Reduction (SCR) system as a result of blockages or failure of ammonia injection system, leading to elevated oxides of nitrogen emissions; and
- Complete failure of the activated carbon injection system and loss of temperature control leading to high levels of dioxin reformation and their unabated release.

2.1.2 As a modern design, it is anticipated that REP would 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.

2.2 Plant start-up and shutdown

2.2.1 Start-up of the ERF from cold will be conducted with clean support fuel (low sulphur light fuel oil). Waste is not introduced onto the grate unless the temperature is above the minimum requirement (850ºC) 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 gas cleaning plant will be operational as will be the control systems and monitoring equipment.

2.2.2 The same is true during plant shutdown. The waste remaining on the grate is allowed to burn out, the temperature not being permitted to drop below 850ºC by the simultaneous introduction of clean support auxiliary fuel. After complete burnout of the waste, the burners are turned off and the plant is allowed to cool. During this period the gas cleaning equipment is fully operational, as will be the control systems and monitoring equipment.

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

2.2.4 In relation to the magnitude of dioxin emissions during plant start-up and shutdown, AEA Energy & Environment (AEA) have published a report on behalf of the EA, dated November 2008, which is titled 'Investigation of Waste Incinerator Dioxins During start-up and shutdown'. This report focused on a study on the Tyseley EfW facility. Whilst AEA found that 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)."

2.2.5 There is therefore no reason why such start-up and shutdown operations will affect the long-term air quality impacts associated with the operation of the ERF.

3 Plausible Abnormal Emissions Levels

3.1.1 The following plausible abnormal emission levels for the ERF have been identified based on the performance of similar plants in the UK; which are therefore considered to be representative of REP. The plausible abnormal emissions concentrations are presented in Table 3-1, where available. These have been based on measured data from a comparable ERF or taken from the design data for the ERF.

Table 3-1 - Plausible abnormal emissions from a comparable ERF

Pollutant	Permitted Emission Limit, (mg/Nm³)(5)		Plausible Abnormal Emission, (mg/Nm³)	% Above Max Permitted Emission
	Daily Average	½ hourly max		
Oxides of nitrogen	75	400	550	38
Particulate matter (PM10s)	5	30	150(1)	400
Sulphur dioxide(4)	30	200	450	125
Carbon monoxide (CO)	50	100	100(1)	0
Hydrogen chloride(4)	6	60	900(2)	1,400
Hydrogen fluoride(4)	1	4	90	2,150
Total Organic Carbon (TOC)	10	20	20	0
Dioxins	0.06 ng/m³		10 ng/m³(3)	16,567

1. Taken from the Best Available Techniques (BAT) Reference Document on Waste Incineration (here in referred to as the Waste Incineration BREF).
2. Based on information presented in the Devonport Decision Document (Reference: EPR/WP3833FT)
3. As previously requested by the EA.
4. All emissions expressed as Nm³ based (dry, 0°C, 11% reference oxygen content).

3.1.2 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 IED emission concentration of 0.05mg/m³, as stated in Annex VI, Part 3, paragraph 1.3.
- Emission concentration of cadmium has been taken as half the IED emission concentration for cadmium and thallium and their compounds of 0.05mg/m³, as stated in Annex VI, Part 3, paragraph 1.3.
- Emission concentration of heavy metals that have a short or long-term Environmental Assessment level (EAL) have been considered (antimony, arsenic, chromium, copper, lead, manganese, nickel, vanadium) and have been taken from the EA guidance document titled '*Guidance on assessing group 3 metal stack emissions from incinerators*' (version 4). This guidance summarises the recorded emissions from 18 existing Municipal

Waste Incinerators (MWIs) and Waste Wood Co-incinerators in the UK over a period between 2007 and 2015.

- The Predicted Abnormal Emissions are calculated based on 30 times the emission concentration, as it is assumed that metals are in the particulate phase.
- The Plausible Abnormal Emissions Concentrations for metals are presented in Table 3-2.

Table 3-2 - Plausible Abnormal Metal Emissions from an ERF

Pollutant	Emissions Concentrations (µg/Nm³)	Predicted Abnormal Emission, (µg/Nm³)	% Above Max Permitted Emission
Antimony	11.5	172.5	2,900
Arsenic	25	375	2,900
Cadmium	25	375	2,900
Chromium	92	1380	2,900
Chromium (VI)	0.130	1.95	2,900
Copper	29	435	2,900
Lead	50.3	754.5	2,900
Manganese	60	900	2,900
Mercury	50	750	2,900
Nickel	220	3300	2,900
Vanadium	6	90	2,900

3.1.3 The definition of ‘abnormal operating conditions’, refer to paragraph 1.3.3, 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.

3.1.4 In defining abnormal operating conditions Annex VI, Part 3 paragraph 2 of the IED notes that under no circumstances shall the total dust concentration exceed 150 mg/Nm³ expressed as a half hourly average. As such total dust has been included in this analysis. However, this paragraph continues to state that the limits prescribed for CO and TOC set must not be exceeded. As such there is no potential for the impact of emissions of CO or TOC to be greater than that outlined in the Dispersion Modelling Assessment, refer to Appendix D of which this report is a part, and these pollutants have not been considered further in this assessment.

4 Impact Resulting from Plausible Abnormal Emissions

4.1.1 REP will consist of two lines which operate individually. For the purpose of this analysis it has been assumed that both lines operate under abnormal operating conditions concurrently. This is a very worst case assumption.

4.2 Predicted short term impacts

4.2.1 In order to assess the effect on short-term ground level concentrations associated with REP operating at the identified abnormal emission concentration, the calculated ground level concentration has been increased pro-rata as presented in Table 4-1. These have been compared with the relevant Air Quality Assessment Level (AQAL), as explained in paragraph 3.13.1 of the Dispersion Model Report submitted with this EP application, refer to Appendix D of this application.

Table 4-1 - Short term Impacts Resulting from Plausible Abnormal Emissions

Pollutant	AQAL (µg/m³)	Predicted Impact, Draft Waste Incineration BREF Limits		Predicted Impact, Abnormal Emissions	
		Conc. µg/m³	% of AQAL	Conc. µg/m³	% of AQAL
Nitrogen dioxide	200	14.8	7.4%	20.3	10.2%
Particulate matter (PM10s)	50	0.2	0.4%	5.7	11.4%
Sulphur dioxide (24-hour)	125	2.0	1.6%	26.2	20.9%
Sulphur dioxide (1-hour)	350	20.8	6.0%	41.7	11.9%
Sulphur dioxide (15-min)	266	24.2	9.1%	48.5	18.2%
Hydrogen chloride	750	11.7	1.6%	155.5	20.7%
Hydrogen fluoride	160	0.8	0.5%	1.9	1.2%
Pollutant	**AQAL (ng/m³)**	**Predicted Impact – Draft Waste Incineration BREF Limits**		**Predicted Impact – Abnormal Emissions**	
		Conc. ng/m³	**% of AQAL**	**Conc. ng/m³**	**% of AQAL**
Antimony	150,000	2.24	0.001%	67.08	0.045%
Chromium	150,000	17.89	0.012%	536.62	0.358%
Copper	200,000	5.64	0.003%	169.15	0.085%
Manganese	1,500,000	11.67	0.001%	349.97	0.023%

Mercury	7,500	3.89	0.052%	116.66	1.555%
Vanadium	1,000	1.17	0.117%	35.00	3.500%

4.2.2 This is considered to be a highly conservative assessment as it assumes that the plausible abnormal emissions occur on both lines and coincide with worst case meteorological conditions. Even with these highly conservative factors, 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) is less than 21% for 24-hour sulphur dioxide and 1-hour hydrogen chloride, with all other pollutants being lower.

4.3 Predicted long-term impacts

4.3.1 In order to assess the effect on long-term ground level concentrations associated with REP operating at the identified abnormal emission levels, the calculated long-term ground level concentrations have been increased pro-rata as presented in Table 4-2 and Table 4-3. This assessment assumes that REP is operating at the daily average IED emission limits for 8,700 hours per year and at the plausible abnormal emission levels for 60 hours per year. These have been compared with the relevant AQAL.

Table 4-2 – Long term Impacts Resulting from Plausible Abnormal Emissions

Pollutant	AQAL (µg/m³)	Predicted Impact, Draft Waste Incineration BREF Limits		Predicted Impact, Abnormal Emissions	
		Conc. µg/m³	% of AQAL	Conc. µg/m³	% of AQAL
Nitrogen dioxide	40	0.67	1.66%	0.69	1.73%
Particulate matter (PM10s)	40	0.06	0.16%	0.08	0.19%
Hydrogen fluoride	16	0.01	0.08%	0.01	0.08%
Pollutant	**AQAL (ng/m³)**	**Predicted Impact – Draft Waste Incineration BREF Limits**		**Predicted Impact – Abnormal Emissions**	
		Conc. ng/m³	**% of AQAL**	**Conc. ng/m³**	**% of AQAL**
Antimony	5,000	0.15	0.003%	0.17	0.003%
Arsenic	3	0.32	10.56%	0.38	12.65%
Cadmium	5	0.13	2.53%	0.15	3.04%
Chromium	5,000	1.17	0.02%	1.40	0.03%
Chromium (VI)	0.2	0.00165	0.82%	0.00197	0.99%
Copper	10,000	0.37	0.004%	0.44	0.004%

Lead	250	0.64	0.25%	0.76	0.31%
Manganese	150	0.76	0.51%	0.91	0.61%
Mercury	250	0.25	0.10%	0.30	0.12%
Nickel	20	2.79	13.93%	3.34	16.70%
Vanadium	5,000	0.08	0.0015%	0.09	0.0018%

4.3.2 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 17% for nickel, with all other pollutants lower.

4.3.3 There is no AQAL for dioxins against which the impact can be assessed. Therefore, to assess the impact of dioxins, the increase for the receptor exposed to the Tolerable Daily Intake (TDI) has been used to assess whether there will be a significant increase in the impact of dioxins by assessing against the receptor exposed to the TDI. As can be seen from the results presented in Table 4-3 this represents an increase in the maximum ground level concentration of approximately 114%.

Table 4-3 - Long term Impacts Resulting from Plausible Abnormal Emissions

Pollutant	Predicted Impact, BREF Limits	Predicted Impact, Abnormal Emissions	
	fg/m³	fg/m³	% increase
Dioxins	0.76	1.62	113.47%

4.3.4 Based on the results of the Human Health Risk Assessment, refer to Appendix D of which this report is a part, the receptor receiving the highest dose of dioxins from REP is predicted to be exposed to 5.4% of the TDI for an agricultural child at receptor ‘Farmer East’, refer to paragraph 3.5.4 of the Human Health Risk Assessment. Assuming the impact of abnormal operations, it is calculated that the receptor receiving the highest maximum dose will be exposed to (5.4% x 2.113) = 11.5 % of the UK TDI for dioxins.

4.3.5 Assuming the conservative factors stated within the modelling, there will be no exceedances of the TDI for dioxins.

5 Predicted Environmental Concentration – Abnormal Operations

5.1.1 The EA's guidance document '*Air Emissions Risk Assessment for your Environmental Permit*' (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.

5.1.2 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.

5.2 Background concentrations

5.2.1 The values for the annual average background concentrations that have been used to evaluate the impact of REP are presented in Appendix A.1. These are as presented in the Dispersion Modelling Report, refer to Appendix D of which this report is a part.

5.3 Predicted short term impacts

5.3.1 Table 5-1 below 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 background) for those pollutants for which the impact presented in Table 4-1 is greater than 10%.

Table 5-1 -Short term Impacts Resulting from Plausible Abnormal Emissions

Pollutant	AQAL (µg/m³)	Background Conc.	PC – Abnormal Emissions	PEC, Abnormal Emissions	
		µg/m³	µg/m³	µg/m³	% of AQAL
Nitrogen dioxide	200	33.2	20.33	53.53	26.8%
Particulate matter (PM10s)	50	29.0	5.70	34.70	69.4%
Sulphur dioxide (24-hour)	125	4.0	26.15	30.15	24.1%
Sulphur dioxide (1-hour)	350	4.0	41.65	45.65	13.0%
Sulphur dioxide (15-min)	266	4.0	48.45	52.45	19.7%
Hydrogen chloride	750	2.0	155.54	157.54	21.0%

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

5.4 Predicted long term impacts

5.4.1 Table 5-2 below presents the predicted impacts of plausible abnormal operations in the long-term at the point of maximum impact and the PEC for those pollutants for which the impact presented in **Table 4-2** is greater than 1%. This assessment assumes that REP is operating at the IED emission limits for 8,700 hours per year and at the plausible abnormal emission levels for 60 hours per year.

Table 5-2 – Long term Impacts Resulting from Plausible Abnormal Emissions

Pollutant	AQAL (µg/m³)	Background Conc.	PC – Abnormal Emissions	PEC, Abnormal Emissions	
		µg/m³	µg/m³	µg/m³	% of AQAL
Nitrogen dioxide	40	16.6	0.69	17.29	43.2%
Pollutant	**AQAL (ng/m³)**	**Background Conc.**	**PC – Abnormal Emissions(1)**	**PEC, Abnormal Emissions**	
		ng/m³	**ng/m³**	**ng/m³**	**% of AQAL**
Arsenic	3	1	0.38	1.38	46.0%
Cadmium	5	0.25	0.15	0.40	8.0%
Nickel	20	1	3.34	4.34	21.7%
1. The ground level impact has been calculated by apportioning the maximum monitored emission concentration for each metal to the total group 3 metal Process Contribution.					

5.4.2 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

6.1.1 An assessment of the impact on air quality associated with abnormal operating conditions from REP has identified plausible abnormal emissions based on a review of monitoring data from operational facilities of a similar type in the UK. Notwithstanding the that it is unlikely for the occurrence of such abnormal operating conditions identified by the review, the potential impact on air quality has been assessed.

6.1.2 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 occur on both lines concurrently and they coincide with the worst case meteorological conditions.

6.1.3 Even with these highly conservative factors, there are no predicted exceedances of any of the short-term or long-term air quality limits associated with abnormal operations. The maximum predicted short-term process contribution (as a % of the applied AQAL) is less than 21%; and the maximum predicted long-term process contribution (as a % of the applied AQAL) is less than 17%.

6.1.4 None of the Predicted Environmental Contributions, will result in any exceedances of the relevant air quality objectives.

6.1.5 Abnormal emissions from REP will not cause any exceedances of any AQAL. In addition, there will not be any exceedances of the TDI for dioxins.

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

Appendix A Background Concentrations

A.1 Summary of Background Concentrations

Pollutant	Annual Mean Concentration	Units	Justification
Nitrogen dioxide	16.6	µg/m³	DEFRA mapped background (2016) for grid square containing REP
Particulate matter (PM10s)	14.5	µg/m³	DEFRA mapped background (2016) for grid square containing REP
Sulphur dioxide	2	µg/m³	Max Location DEFRA background concentration calibrated against locally measured concentration at Rush Green
Hydrogen chloride	1	µg/m³	As used in the ES chapter prepared for the site extension in 2014
Hydrogen fluoride	0.5	µg/m³	As used in the ES chapter prepared for the site extension in 2014
Cadmium	0.25	ng/m³	Chadwell St Mary for 2016
Arsenic	1	ng/m³	
Nickel	1	ng/m³	