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Consulting Engineers Limited

Swadlincote Energy Recovery Facility

R&P Clean Power

BAT Assessment

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Document approval

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1 Introduction

R&P Clean Power Limited is applying to the Environment Agency (EA) under the Environmental Permitting Regulations (EPRs) for an Environmental Permit (application no.: EPR/LP3327SK/A001) to operate the Swadlincote Energy Recovery Facility (the Facility). The Facility will comprise a single stream waste incineration plant to incinerate incoming non-hazardous waste. The Facility will be located in South Derbyshire at Cadley Hill, approximately 2 km west of Swadlincote, Derbyshire.

In response to item 15 of the EA's 'Notice of Request for More Information' issued on 14th April 2025, this report presents a quantitative assessment of the Best Available Techniques (BAT) for the proposed nitrogen oxides abatement technologies at the Facility.

1.1 Assumptions

The Facility will use a moving grate as the combustion technology. The installation will be a single stream energy from waste (EfW) plant, with a nominal design capacity of approximately 23.2 tonnes/hour of municipal solid waste (MSW) and commercial and industrial (C&I) waste, with an average net calorific value (NCV) of 10.5 MJ/kg. This equates to a nominal design capacity of approximately 186,000 tonnes per annum (tpa), assuming 8,000 hours operation per annum. The maximum capacity of the Facility being applied for in the permit is 230,000 tonnes of waste.

For the purposes of this BAT assessment, the design case is considered to be most reflective of 'normal' operations. It is not expected that the conclusions of the BAT assessment would change with the maximum case.

The Facility will generate approximately 20.5 MW_e with a parasitic load of ca. 2.0 MW_e.

It is assumed that urea (40% solution) will be used for the Selective Non-Catalytic Reduction (SNCR) nitrous oxides (NO_X) abatement system.

In order to calculate the global warming potential of electricity consumption – assumed to be imported from the grid – the assumption of 357 gCO_2/kWh has been used, as applied in the greenhouse gas assessment presented Section V, Appendix 21, of the Supporting Information.

For the purposes of this report we have undertaken a quantitative assessment of the available technologies, i.e. SNCR and Selective Catalytic Reduction (SCR), for the proposed capacity using data obtained by Fichtner from a range of different projects.

The following unit costs have been assumed within the relevant operating costs sections of this assessment:

- Water .... £1.00 per tonne
- Urea (40% solution) .... £210.00 per tonne
- Imported power .... £85.00 per MWh
- Electricity revenue .... £165.00 per MWh

2 Nitrogen Oxides (NOx) abatement

2.1 Options considered

Three options have been considered for NOx abatement and are listed below.

1. Selective Catalytic Reduction (SCR), which involves the injection of ammonia solution or urea into the flue gases immediately upstream of a reactor vessel containing layers of catalyst.
2. Selective Non-Catalytic Reduction (SNCR), which involves the injection of ammonia solution or urea into the combustion chamber.

For the purposes of this assessment, it is assumed that urea 40% solution will be the reagent used in the NOx abatement system.

2.2 Environmental Performance

2.2.1 Emissions to Air

The emission rates for nitrogen oxides, nitrous oxide and ammonia are shown in the table below together with the tonnages of nitrogen oxides abated.

Table 2-1: Air Emissions

Parameter	Units	SNCR	SCR
Nitrous oxide	mg/m^3	15	15
Ammonia	mg/m^3	10	10
NO_x, unabated concentration	mg/m^3	350	350
NO_x, unabated rate	tpa	480	480
NO_x, abated concentration	mg/m^3	120	80
NO_x released after abatement	tpa	170	110
NO_x removed	tpa	310	370

For the purposes of this assessment, a long term abated emission concentration of 80 mg/Nm^3 (11% reference oxygen content) is used for SCR, since this is the level that the technology can achieve on a long-term basis. The SNCR system would be required to achieve an emission limit of 120 mg/Nm^3, in accordance with the proposed emission limits for the Facility.

The tonnages of nitrogen oxides removed by the abatement options are also shown.

The impact of emissions to air is considered in detail within the air quality assessment, refer to Section V, Appendix 6, of the Supporting Information. The table below shows the predicted ground level concentrations for the two options considered.

Table 2-2: Air Emissions

Abatement System:		SNCR	SCR
Long Term			
Process Contribution (PC)	µg/m^3	1.30	0.87
Background	µg/m^3	18.9	18.9
Predicted Environmental Contribution (PEC)	µg/m^3	20.20	19.77
Air Quality Objective	µg/m^3	40.00	40.00
PC as % of AQO		3.25%	2.17%
PEC as % of AQO		50.50%	49.42%
Short Term			
Process Contribution (PC)	µg/m^3	40.40	26.93
Background	µg/m^3	37.80	37.80
Predicted Environmental Contribution (PEC)	µg/m^3	78.20	64.73
Air Quality Objective	µg/m^3	200	200
PC as % of AQO		20.20%	13.47%
PEC as % of AQO		39.10%	32.37%

There are no predicted exceedances of air quality objectives for any of the options. Using SCR reduces the long-term PEC by 1.1% of the air quality objective and the short-term PEC by 6.7% of the air quality objective when compared to SNCR.

2.2.2 Deposition to Land

The impact of nitrogen deposition on sensitive habitats has been assessed in the Air Quality Assessment, refer to Section V, Appendix 6, of the Supporting Information.

As can be seen from the results presented in the report, the impact of nitrogen deposition can be screened as insignificant at all European and nationally designated ecological receptors; and will not result in any exceedances at local wildlife sites. On this basis, it is concluded that there will be 'no likely significant effects' of nitrogen deposition.

2.2.3 Emissions to Water

There are no emissions to water from any of the NO_x abatement systems.

2.2.4 Photochemical Ozone Creation Potential

Nitrogen dioxide (NO_2) has a photochemical ozone creation potential (POCP) of 2.8 and nitrogen oxide (NO) has a POCP of -42.7. Assuming that 10% of NOx is released as NO_2 and the rest as NO, the POCP is -6,500 for the SNCR option and -4,200 for the SCR option, meaning that SCR is less favourable. This is because nitrogen oxide converts to nitrogen dioxide in the atmosphere by reacting with ozone, this removing ozone from the atmosphere. Hence, the abatement of NO actually has a negative impact on POCP.

2.2.5 Global Warming Potential

The direct emissions of greenhouse gases are the same for each option, since the carbon dioxide and nitrous oxide emission concentrations are unchanged. However, the energy consumption is different in each option, which would change the power exported from the plant in each case. In particular, SCR imposes an additional pressure drop on the flue gases, leading to an increase in power consumption on the induced draft (ID) fan. In addition, SCR requires the flue gases to be reheated which reduces the power generated by the turbine.

This means that the reduction in greenhouse gas emissions due to the displacement of power generated by other power stations would be different in each case.

In order to calculate the global warming potential of electricity consumption, the figure of 357 kg CO_2 equivalent per MWh has been used, as applied in the greenhouse gas assessment, refer to Section V, Appendix 21, of the Supporting Information.

Table 2-3: Global Warming Potential

Parameter	Units	SNCR	SCR
Power consumed	kWe	210	430
Power not generated	kWe	-	300
Change in exported power	MWh pa	1,700	5,800
GWP	t CO_2 eq pa	600	2,200

2.2.6 Raw Materials

The estimated consumption of raw materials for each option is shown below.

Table 2-4: Raw Materials

	Units	SNCR	SCR
Water	tpa	1,400	770
Urea	tpa	970	550

2.2.7 Waste Streams

There will be no additional residues generated from any of the NO_x abatement options.

2.3 Costs

The estimated costs associated with each option are presented below. In order for direct comparisons to be made, the costs are presented as annualised costs, with the capital investment and financing costs spread over a 30-year lifetime with a rate of return of 9%, using the method recommended in Technical Guidance Note EPR-H1.

Table 2-5: Costs

Cost item	Units	SNCR	SCR
Capital cost	£	£500,000	£7,200,000
Annualised Capital Cost	£ pa	£49,000	£701,000
Maintenance	£ pa	£10,000	£144,000
Water and reagents	£ pa	£205,000	£116,000
Loss of exported power	£ pa	£145,000	£493,000
Total Annualised Cost	**£ pa**	**£409,000**	**£1,454,000**

2.4 Conclusions

The table below provides a summary comparison of the two options.

Table 2-6: Comparison table

	Units	SNCR	SCR
NO_x released after abatement	tpa	170	110
NO_x removed	tpa	310	370
POCP	t ethylene-eq pa	-6,500	-4,200
Global Warming Potential	t CO_2 eq pa	600	2,200
Urea used	tpa	970	550
Total Annualised Cost	£ pa	£409,000	£1,454,000
Average cost per tonne NO_x abated	£ p.t NO_x.	£1,319	£3,930

As can be seen from the table above, applying SCR to the Facility:

1. increases the annualised costs by approximately £1 million;
2. abates an additional 80 tonnes of NOx per annum;
3. reduces the benefit of the Facility in terms of the global warming potential by approximately 1,600 tonnes of CO_2;
4. reduces reagent consumption by approximately 420 tonnes per annum; and
5. costs approximately £2,600 (ca. +200%) more per tonne of NOx abated, compared to an SNCR system.

The additional costs associated with SCR are not considered to represent BAT for the Facility. On this basis, SNCR is considered to represent BAT.

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