



Municipal Waste Incinerators in England – NOx Trial Evaluation

Evaluation of NOx Improvement Condition Trial Reports and BAT Issues

Environment Agency

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Basis of Report

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Executive Summary

This report presents an assessment of Improvement Condition (IC) responses which were supplied to the Environment Agency (EA) by Operators of municipal solid waste incineration (MSWI) plants in England.

The background regulatory context is described in more detail in Section 1.0.

The basic requirement of the IC was for each plant to *“perform a study to determine the extent to which the operation of the current systems in place at the plant to minimise NO_x emissions can be further optimised such that emissions are reduced as far as possible below [180] mg/Nm³ as a daily average, without significantly increasing emissions of other pollutants or having a significant negative effect on plant operation, reliability or bottom ash quality.....”*. The full standard IC text is given in Section 1.0.

The project approach and report structure are described in Section 1.3 below.

Section 2.0 provides “fleet level” comparison graphs to examine potential associations between certain technical and other factors and derived optimal NO_x emission levels.

Sections 3.0 and 4.0 set out the overall conclusions and recommendations that can be drawn from the assessment of the supplied Operator IC returns.

Appendix A of this report provides a review of each of the sixty plants for which IC returns were supplied for evaluation. Key information for each site is summarised, and the key observations and recommendations for the EA are provided, based on the IC return information supplied.

Overall, the work has revealed:

- the regulatory approach adopted by the EA in this case and the responses and collaboration from the sector have been successful in further lowering NO_x and related operational emissions from a sector that has already been subject to significant regulatory controls which have been developed over recent decades;
- nearly all currently operating plants have demonstrated they can now meet or exceed the minimum emission standards for existing plants that are set in the 2019 BREF, and which provides the benchmark for UK installations;
- some installations are seen to already achieve still lower NO_x emission levels, and many have demonstrated the potential to do so, although in doing so many of these encounter compromises, including operational risks & costs, and potential for rises in other emissions e.g. NH₃;
- in some cases, the further NO_x reduction potential is considerable. Such additional emissions reductions may provide overall environmental benefits which outweigh the risks & costs encountered – this consideration of external damage costs has been explored in a separate paper on the subject provided to the EA by SLR as part of this work;
- the collaborative approach between the EA and industry on this matter has already delivered successes but has also laid the foundations for further optimisation and NO_x reduction, both at some existing installations, and for a further significant reduction in combined overall mass emissions from the sector. The context, extent and constraints on these potential additional reductions are discussed in this work;
- the knowledge gained from this body of work (regulator approach and sector response) can contribute to the development of future regulatory “new plant” BAT standards, that will provide the basis of regulation and design of the new installations that will be required as the fleet and related waste and emissions policy evolves.



Table of Contents

Basis of Report	i
Executive Summary	ii
1.0 Introduction	1
1.1 Project Background	1
1.2 The EA NO _x Improvement Condition.....	1
1.3 Project Approach & Report Structure.....	2
1.3.1 Project Approach.....	2
1.3.2 Report Structure	3
2.0 Fleet Data Comparisons	4
2.1 Introduction	4
2.2 Notes on Data Quality & Approach.....	5
2.3 Optimised NO _x TEV vs SNCR Reagent Consumption	6
2.3.1 Urea SNCR Systems.....	6
2.3.2 Ammonia SNCR Systems	6
2.3.3 Data Observations.....	7
2.4 Optimised NO _x TEV vs Ammonia Slip to Air.....	8
2.4.1 Urea SNCR Systems.....	8
2.4.2 Ammonia SNCR Systems	9
2.4.3 Data Observations.....	9
2.5 Optimised NO _x TEV vs Total Plant Capacity	10
2.5.1 Urea SNCR Systems.....	10
2.5.2 Ammonia SNCR Systems	10
2.5.3 Data Observations.....	11
2.6 Optimised NO _x TEV vs Average Line Capacity	12
2.6.1 Urea SNCR Systems.....	12
2.6.2 Ammonia SNCR Systems	12
2.6.3 Data Observations.....	13
2.7 Optimised NO _x TEV vs Number of Injection Points (total at plant).....	14
2.7.1 Urea SNCR Systems.....	14
2.7.2 Ammonia SNCR Systems	14
2.7.3 Data Observations.....	15
3.0 Conclusions.....	16
3.1 Introduction	16
3.2 Site Observations and Discussion Points	17
3.3 Fleet NO _x Performance Level	21



3.4	Main Influences on Optimised NOx Performance	23
3.5	NOx IC Methodology/Compliance Issues	24
4.0	Recommendations	26
4.1	Follow-up Items	26
4.2	Regulatory BAT Position	27

Appendices

Appendix A Plant-by-plant Assessment

A.1	Kirklees	A-1
A.2	Marchwood.....	A-5
A.3	Portsmouth ERF.....	A-9
A.4	Chineham ERF.....	A-13
A.5	Sheffield ERF	A-17
A.6	Chilton Biomass Plant	A-21
A.7	Allington	A-25
A.8	Newhaven ERF	A-28
A.9	Eastcroft EFW	A-32
A.10	Lincolnshire Recycling and Energy Recovery Facility	A-36
A.11	Leeds Recycling and Energy Recovery Facility	A-40
A.12	Staffordshire Energy Recovery Facility	A-44
A.13	Exeter Energy from Waste	A-48
A.14	SELCHP.....	A-51
A.15	Ferrybridge 1.....	A-54
A.16	Beddington ERF.....	A-58
A.17	Rookery South Energy Recovery Facility	A-62
A.18	MVV Environment Devonport Ltd Energy Recovery Facility	A-66
A.19	Ferrybridge 2.....	A-69
A.20	Lakeside Energy from Waste Ltd.....	A-73
A.21	Newlincs EfW Facility	A-77
A.22	Kemsley Energy Recovery Facility	A-81
A.23	Peterborough ERF	A-85
A.24	Greatmoor EfW	A-88
A.25	Riverside	A-92
A.26	Suez – Tees Valley	A-96
A.27	Cornwall	A-100
A.28	Blackburn Meadows	A-103



A.29	Templeborough Biomass.....	A-107
A.30	Newhurst.....	A-110
A.31	Bolton.....	A-113
A.32	Suffolk.....	A-117
A.33	Ridham.....	A-121
A.34	Ardley.....	A-125
A.35	Tyseley.....	A-129
A.36	Runcorn	A-132
A.37	Avonmouth (Viridor)	A-136
A.38	Battlefield	A-140
A.39	Suez - Wilton.....	A-144
A.40	Eye Power Station.....	A-148
A.41	Javelin Park.....	A-152
A.42	Welland	A-156
A.43	Birmingham Biopower	A-160
A.44	Milton Keynes.....	A-164
A.45	North Midlands Stoke	A-167
A.46	Mersey BE Widnes.....	A-171
A.47	Tilbury Green Power	A-175
A.48	Evero Ince	A-179
A.49	Gren – Widmerpool	A-183
A.50	EPR Glanford	A-187
A.51	Holbrook.....	A-191
A.52	EnviroPower Lancing.....	A-195
A.53	London Energy Edmonton.....	A-199
A.54	Thames W Beckton	A-203
A.55	Suez Severnside	A-207
A.56	Thetford Power Station.....	A-211
A.57	Mercia EnviRecover	A-215
A.58	Tradebe Redditch.....	A-219
A.59	Baddesley	A-222
A.60	Allerton.....	A-226



1.0 Introduction

1.1 Project Background

In completing a statutory review of Environmental Permits for Waste Incineration and Co-Incineration plant the Environment Agency (EA) has set lower Emission Limit Values (ELV) for Oxides of Nitrogen emitted to air. ELVs have been set at the upper value of the BAT-AEL range (180 mg/m³) in line with current Defra guidance, unless a tighter ELV was already in place to protect local sensitive receptors.

Whilst this will lead to some reductions in NO_x emissions from existing plants, the EA was also keen to understand whether further reductions might be possible below 180 and what the impacts of this would be on reagent consumption, ammonia emissions (and therefore air quality and habitats impacts), plant operation and residue quality. Information on this would then help inform future regulatory strategy for these plants.

The EA therefore included an improvement condition (IC) as part of the permit review requiring each plant to do a site-specific assessment of the opportunities to further reduce NO_x below 180, including operational trials on the installed selective non-catalytic reduction (SNCR) systems to reduce NO_x, and observation of the impact on plant operation and cross media effects.

This work provides an assessment of operator submissions for the ICs supplied by the Environment Agency, covering 60 installations.

Based upon these IC returns, conclusions and follow up recommendations are provided for each site, and overall observations presented for the entire fleet where possible. These observations aim to inform the Environment Agencies regulatory position, in a general sense. While the focus is upon existing operational plants, but some inference is made regarding new facilities, although a specific assessment of new plant BAT standards is recommended so that technological and policy advancements can be more fully considered.

1.2 The EA NO_x Improvement Condition

The EA NO_x Reduction IC was as follows:

The operator shall perform a study to determine the extent to which the operation of the current systems in place at the plant to minimise NO_x emissions can be further optimised such that emissions are reduced as far as possible below [180] mg/Nm³ as a daily average, without significantly increasing emissions of other pollutants or having a significant negative effect on plant operation, reliability or bottom ash quality. The study shall be based on the results of trials carried out at the installation and shall have regard to the recommendations for test conditions set out in Section 5.4.3 of report titled 'Establishing factors that influence NO_x reduction at waste incineration plant to levels below the upper end of the BAT-AELs' (dated 14/01/2022), or other methodology agreed in writing with the Environment Agency. A written report of the study shall be submitted to the Environment Agency which shall include but not necessarily be limited to the following:

- A brief description of the currently installed measures at the installation to minimise NO_x emissions, including details of how the reagent dosing system responds to emissions monitoring data and historic data which illustrates the current achievable level of daily NO_x emissions.*
- The results of trials conducted to further reduce daily average NO_x emissions using currently installed measures, including:*



- *a description of the parameters that were varied during the trial e.g. ammonia or urea feed rates, physical form of urea injected, air flows, and the range over which they were varied*
- *the levels of NO_x achieved and associated levels of ammonia and nitrous oxide emissions and reagent consumption*
- *observed effects and predicted long-term impacts on plant operation, reliability and maintenance regime*
- *any changes to the composition of the bottom ash and boiler ash and the implications of those changes for the ability to process and use the ash, as well as for the pollution potential of the ash both during processing and its subsequent use as a secondary aggregate*
- *any other relevant cross-media effects*

The report shall also include a description of the extent to which current systems in place at the plant to minimise NO_x emissions can be optimised on a permanent basis, including justification and an implementation plan where relevant.

1.3 Project Approach & Report Structure

1.3.1 Project Approach

This work included a systematic evaluation of the supplied IC responses to assess individual compliance with the IC, as well as consideration of what the overall fleet level data set is suggesting regarding BAT.

The stages of the assessment were:

- Development of a structure to allow extraction of key information from the IC returns.
- Population of tables with extracted information.
- Individual site assessments to identify key observations & recommendations (follow up) for the EA, including expected emission levels.
- Construction of data sets as a basis for graphical comparisons of fleet performance and interpretation of these to extract fleet level observations.
- Development of conclusion and recommendations – including both compiled main site and fleet level observations. The fleet level observations aim to inform the EA view on BAT for the sector.
- The evaluation undertaken is based on the IC return information supplied¹ and to varying degrees of depth covers:
 - Trial approach & reporting
 - Installation type and scale
 - Achieved emission levels
 - Techniques deployed – by comparison with BAT / BREF document
 - Cross media issues

¹ In a project of this type that covers so many installations a deep consideration of plant engineering and performance is not possible, but such assessments and considerations may already be expected to have been undertaken by the Operators in compiling their reports. When combined it may therefore be assumed that the overall observations made are well founded.



- Operational matters
- Economic factors
- Use of the extracted data to compile this report.

1.3.2 Report Structure

This report is structured as follows:

- Section 1.0: Introduction – including project background, approach, structure.
- Section 2.0: Fleet data – a fleet level assessment to examine whether there are correlations between derived optimised NO_x target emission value (TEV) and certain design and other factors.
- Section 3.0: Conclusions (from this work):
 - General matters
 - Site observations and main discussion points
 - Fleet NO_x performance observations
 - Key influences on NO_x performance
 - IC methodology & compliance matters
- Section 4.0: Recommendations:
 - General & follow up items
 - Regulatory / BAT matters
- Appendix A: Plant assessments – for each plant the following information (extracted from the IC report evaluations) is presented:
 - Basic data – information about the plant size, operator, location etc.
 - NO_x system data:
 - techniques deployed
 - SNCR performance data
 - achieved emissions data
 - Key observations – what does the trial data suggest for each plant?
 - EA recommended actions – possible regulatory next steps for each plant.



2.0 Fleet Data Comparisons

2.1 Introduction

This section considers the NO_x IC return data on a fleet level to assess whether there are correlations between the optimised NO_x target emission value (TEV) and certain design and other factors.

To extract meaning from the data, observations are provided where possible². See comments on data quality in section 2.2 below.

The graphs presented in Sections 2.3 to 2.7 explore associations between the Optimised NO_x TEV and the following factors:

- 2.3 SNCR Reagent Consumption
- 2.4 Ammonia Slip to Air
- 2.5 Total Plant Capacity
- 2.6 Average Line Capacity
- 2.7 Number of SNCR injection ports (total plant)

The table below provide a key associating data points and plant names for the graphs that follow. There are 62 data points because the SUEZ Tees Valley plant is reported as three separate installations for the purposes of these graphs (but only one entry in the individual site evaluation section of this report).

Table 1: Site key for Graph Reference

No	Site	No	Site
1	Kirklees EFW	32	Newhurst
2	Marchwood ERF	33	Bolton
3	Portsmouth	34	Suffolk
4	Chineham	35	Ridham
5	Sheffield	36	Ardley
6	Chilton	37	Tyseley
7	Allington	38	Runcorn
8	Newhaven	39	Avonmouth (Viridor)
9	Eastcroft	40	Battlefield
10	Lincoln	41	Suez - Wilton
11	Leeds	42	Eye Power Station
12	Staffordshire	43	Javelin Park
13	Exeter	44	Welland

² While cost data was presented in some of the IC reports, inconsistencies in the presentation of that provided meant it was considered inappropriate to attempt correlation of this information using the graphical approach used in this section. A specific and targeted survey of costing, which specifies data gathering is required to allow such comparison. Tentative conclusions that can be drawn from the cost data set in the IC returns are however discussed in the conclusions and recommendations to this report.



No	Site	No	Site
14	SELCHP	45	Birmingham Biopower
15	Ferrybridge 1	46	Milton Keynes
16	Beddington	47	North Midlands Stoke
17	Rookery pit	48	Mersey BE Widnes
18	Devonport	49	Tilbury Green Power
19	Ferrybridge 2	50	Evero Ince
20	Newlincs	51	Gren – Widmerpool
21	Lakeside	52	EPR Glanford
22	Kemsley	53	Holbrook
23	Peterborough	54	Enviropower Lancing
24	Greatmoor	55	London Energy Edmonton
25	Riverside	56	Thames W Beckton
26	Suez - TV 1&2	57	Suez Severnside
27	Suez - TV 3	58	Thetford Power Station
28	Suez - TV 4&5	59	Mercia EnviRecover
29	Cornwall	60	Tradebe Redditch
30	Blackburn Meadows	61	Baddesley
31	Templeborough Biomass	62	Allerton

2.2 Notes on Data Quality & Approach

It is important to note that the plotted data points were derived from the IC reports and their assessment. This was necessary because the IC data was presented in the reports in a variety of formats, and often there was a lack of clarity regarding conclusions.

Due to these derived data quality limitations, professional judgement rather than precise statistical analysis, was used to extract the data points plotted in this section. It is acknowledged that this approach introduces some interpretation, which is also why the observations made are expressed, and should be interpreted, with due caution.

For example, to compare NO_x emission levels against reagent consumption it was necessary to identify both a NO_x value and a reagent dose rate value. The data points selected were those which appeared representative of the optimised (new) longer-term emissions performance that the Operator IC return report data indicated is reasonably achievable. This data point selection involved consideration of the IC trials performance data to estimate an “optimum” NO_x performance i.e. that which appeared possible to maintain, with limited compromises (such as NH₃ slip or reagent dose rate acceleration).

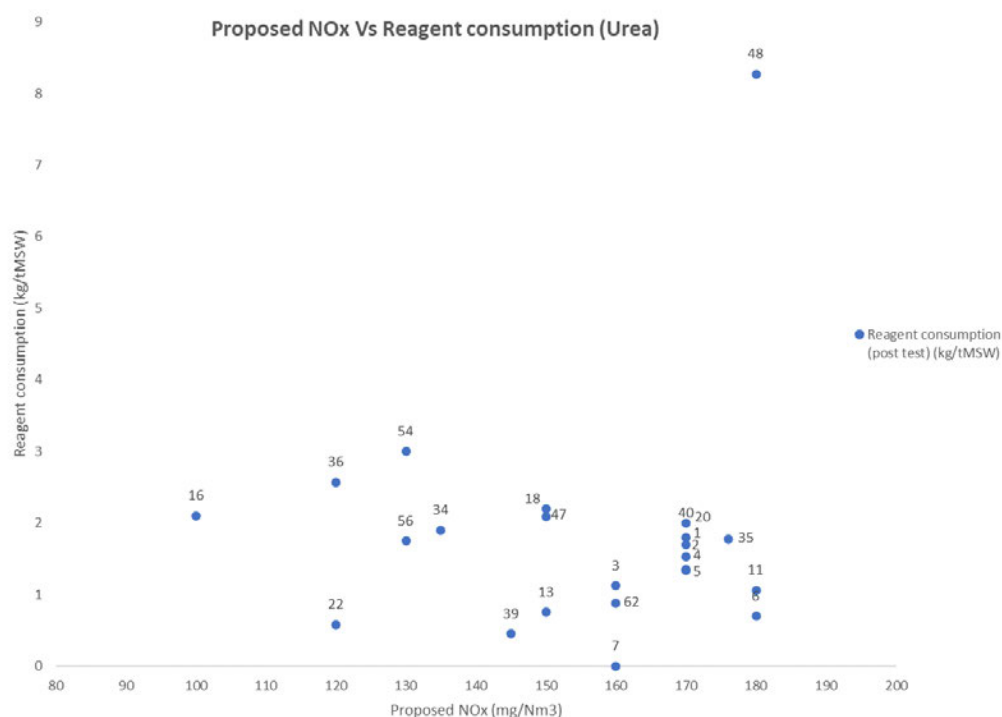
In some case this selected data point then differs from the “compliance” or “target” level suggested in the IC report conclusions by the Operator, which may have focussed upon a set point that delivers compliance with the new BATAEL (usually 180 mg/Nm³ for NO_x) rather than such long-term “optimum operational” emission value.



2.3 Optimised NO_x TEV vs SNCR Reagent Consumption

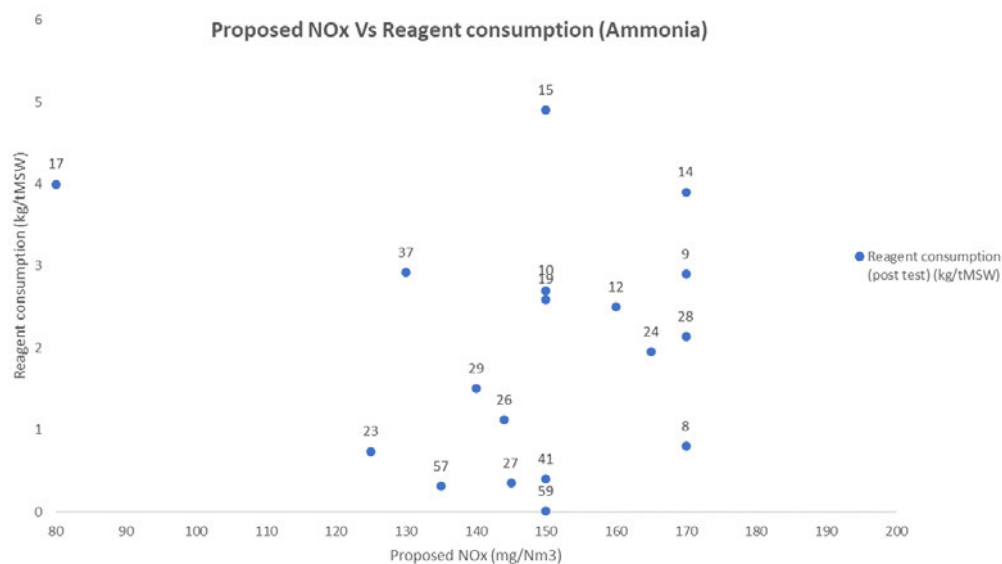
2.3.1 Urea SNCR Systems

The graph below compares the derived TEV NO_x levels and reagent consumption rates (in kg/tMSW) for urea based SNCR systems, with the results discussed in section 2.3.3 below.



2.3.2 Ammonia SNCR Systems

The graph below compares the derived TEV NO_x levels and reagent consumption rates (in kg/tMSW) for ammonia based SNCR systems, with the results discussed in section 2.3.3 below.



2.3.3 Data Observations

Overall:

- All plants can comply with the NO_x BATAEL of 180 mg/Nm³, and NH₃ level of 15mg/Nm³ regardless of technical approach and waste type.
- Reagent consumption level range is wider for Ammonia (typical 0.5 to 5 kg/tMSW) than Urea SNCR systems (typical 0.5 to 3 kg/tMSW), although an overall a similar range of NO_x emission levels result i.e. mostly 120 to 180 mg/Nm³ ignoring outliers).

At installations using urea based SNCR (ref graph in 2.3.1):

- The derived optimised NO_x levels fall within a range of 100 (see outlier note below) and 180 mg/Nm³, with the majority between 140 and 170 mg/Nm³.
- Reagent consumption at the optimised NO_x levels falls within a range of close to zero (at Allington due to low primary NO_x from the untypical fluidised bed design) and 2.3 kg/tMSW, and most often in the range of 1 to 2 kg/tMSW.
- Across the fleet, with urea as the SNCR reagent, the theoretical expectation that higher dose rates would result in lower optimised NO_x outcomes is not seen. In fact, the data (see graph section 2.3.1) shows a lack of sensitivity when comparing plant to plant across the fleet, although at an individual plants such correlations were noted. This suggests that the ability of an installation to deliver a low optimal NO_x performance is mostly determined by site specific design, operational, cost and emissions compliance factors. The degree of reagent reaction temperature optimisation at an installation is likely to be a key factor in delivering consumption efficient lower NO_x performance.
- The Beddington (point 16) low NO_x result is considered an outlier as the trial report did not report data for mid-range trial NO_x set points where the NO_x optimum may exist i.e. 100 mg/Nm³ is an extreme low trial value which demonstrated compromises.
- The Allington (point 7) dose rate is low (zero) because of its (non-typical) fluidised bed design. Fluidised bed combustion typically generates lower NO_x than the more common (for MSW) grate combustion approach and hence lower reagent does rates can be deployed to achieve an assigned compliance target.

At installations using Ammonia based SNCR (re graph in section 2.3.2):

- The derived optimised NO_x levels with Ammonia as the SNCR reagent generally fall within a range of 120 (see note re data point 17) and 170 mg/Nm³
- Most of the derived optimum NO_x levels are in the range from 150-170 mg/Nm³.
- Reagent consumption at these optimised NO_x levels is within a range of 0 and 5 kg/tMSW, and is usually within the range of 2 to 4 kg/tMSW.
- Whilst the individual plant trials support the theoretical expectation that higher dose rates result in lower NO_x emissions, when considering the fleet data (graph in section 2.3.2) the data is very scattered, and at best only a weak dose increment – NO_x reduction correlation can be seen. Similarly to the findings for urea systems, this suggests that the final outturn “optimal” performance of each plant for Ammonia systems is similarly dependent site-specific optimisation, design, cost and operational factors. Again, evidence from the site trials suggest that effective reaction temperature zone targeting is a key factor in delivering reagent efficient lower NO_x levels.



- The Peterborough plant (point 23) site delivers very low NO_x with very low reagent consumption. It is noted that this site was already complying with a low permit ELV of 165mg/Nm³, which was assigned at the design / permitting phase. The adoption of a lower emission target at the design stage is likely the explanation for the observed potential for the reagent efficient lower NO_x level seen here.
- The Rookery pit (point 17) data point is considered an anomaly – the plant only trailed NO_x extreme set points of 100 and 80 mg/Nm³ so a low value has been assigned here. However, the actual plant optimum performance for this plant is expected to be in the untested NO_x emission range of 190 to 100mg/Nm³.

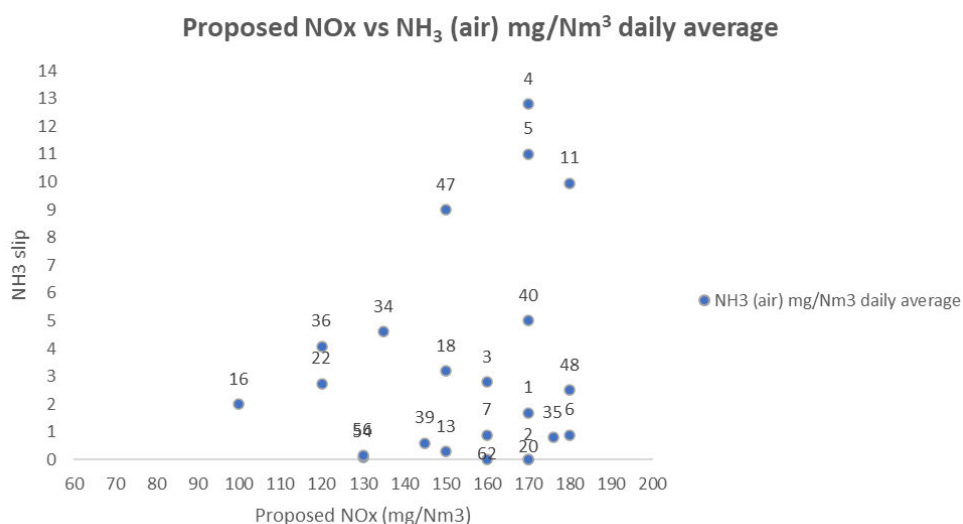
Other notes:

- Only data clearly expressed as kg/tMSW were used to compile these comparisons. Data expressed in other units was excluded to avoid false comparisons. For example, litres per tonne of waste were often used.
- The Baddesley plant (plant 61) was not plotted as reagent consumption was not quoted in kg/tMSW. Currently unique in UK EfW sector, this plant uses SCR (not SNCR). It routinely reports emissions in the range of 60-85 mg/Nm³. Assessment of the trial concluded that a NO_x target value of 80-100 mg/Nm³ may be achievable. SCR is very commonly applied outside the UK, where emission limits of below 100 mg/Nm³ have been set, although cost, operational and energy efficiency compromises are noted.
- Full and accurate comparison would have required an IC condition data gathering instruction to provide data in units that align units & chemical terms, noting that molecular masses differ between different reagents. Liquid reagents are supplied at different concentrations and used at differing dilution ratios, so only data reported as kg/TMSW was considered comparable.

2.4 Optimised NO_x TEV vs Ammonia Slip to Air

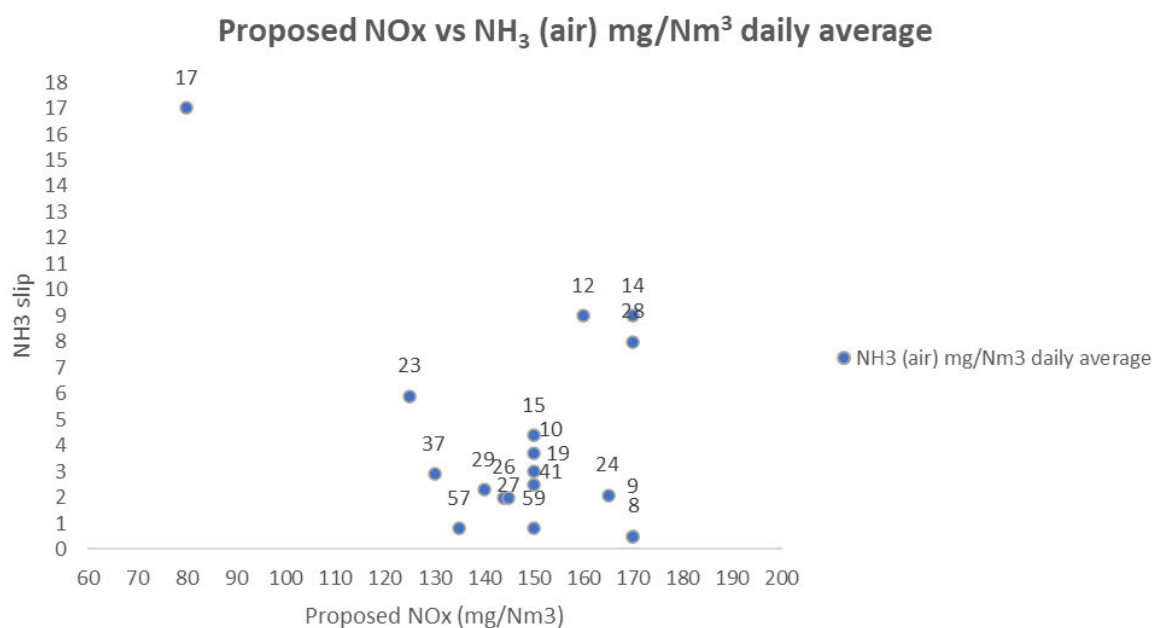
2.4.1 Urea SNCR Systems

The graph below compares the derived TEV NO_x levels and ammonia slip rates for urea based SNCR systems, with the results discussed in section 2.4.3 below.



2.4.2 Ammonia SNCR Systems

The graph below compares the derived TEV NO_x levels and ammonia slip rates for ammonia based SNCR systems, with the results discussed in section 2.4.3 below.



2.4.3 Data Observations

The following observations are made:

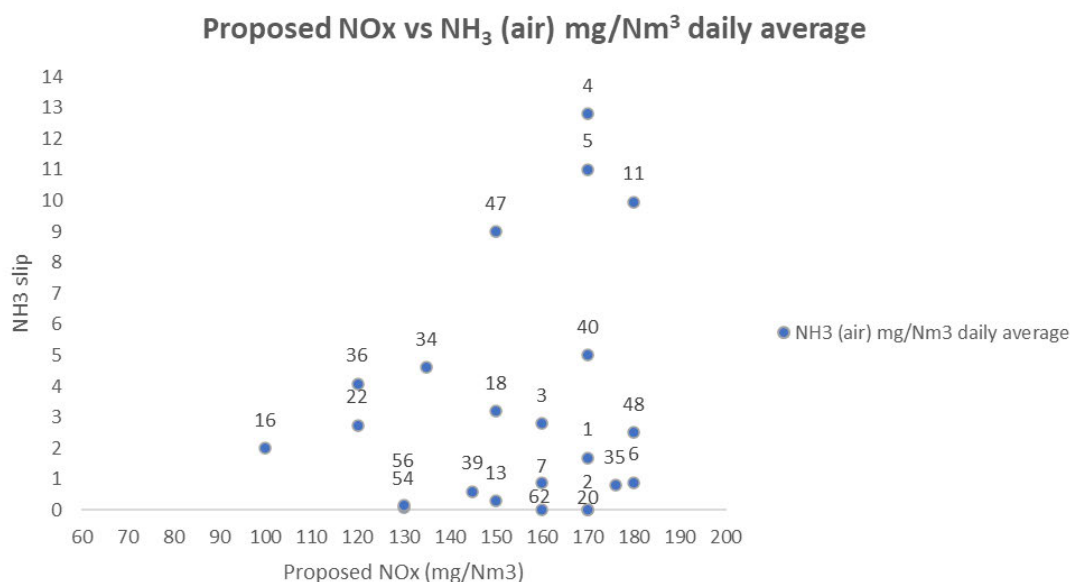
- Although some installations exhibit emission levels above 10 mg/Nm³, in general there is not a difficulty in compliance with the BREF AEL of 15 mg/Nm³.
- At the optimised NO_x level, the NH₃ slip level is commonly below 5 mg/Nm³, suggesting some potential to adopt a lower overall standard fleet BAT AEL.
- Disregarding outliers, in general Urea and Ammonia systems result in similar outcomes i.e. similar ammonia slip emission concentration levels at similar NO_x emission levels.
- For urea (in particular, but also for Ammonia) the data is very scattered. Whilst the theory (and individual plant experience) suggests that higher dose rates used to target lower NO_x levels will result in increased NH₃ slip, the comparison of “optimised NO_x” slip level presented here does not show such a correlation. Overall, the data grouping may be explained by individual operators taking broadly similar operational decisions regarding the acceptability of NH₃ slip and NO_x target levels, informed by regulatory emissions requirements and design capability.
- The data spread may imply that the identified slip level is dominated by site-specific matters related to plant design and operational details.
- Refer to section 2.3.3 above for discussion of outliers.



2.5 Optimised NO_x TEV vs Total Plant Capacity

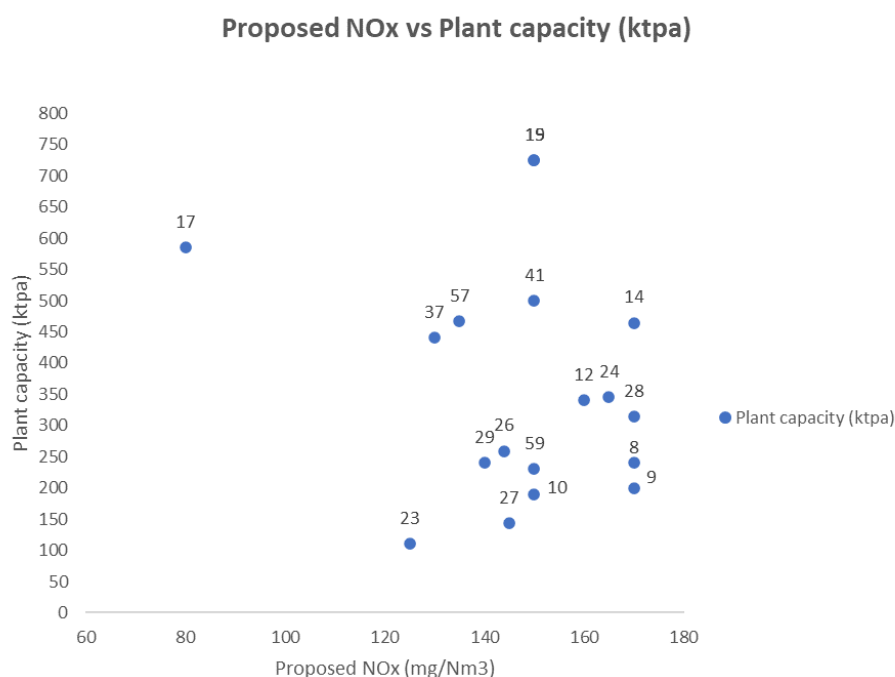
2.5.1 Urea SNCR Systems

The graph below compares the derived TEV NO_x levels and total plant capacity for urea based SNCR systems, with the results discussed in section 2.5.3 below.



2.5.2 Ammonia SNCR Systems

The graph below compares the derived TEV NO_x levels and total plant capacity for ammonia based SNCR systems, with the results discussed in section 2.5.3 below.



2.5.3 Data Observations

The following observations are made:

- For both urea and ammonia SNCR systems the data suggests only a very weak correlation between larger plant capacity and lower optimised NOx values, which is the theoretical expectation i.e. larger plants may have an economy of scale that permits the cost-effective deployment of more advanced approaches to NOx reduction.
- The strength of this correlation is undermined by the very high degree of data scatter. The lack correlation is likely to be due to plant designs being focussed on achieving a required regulatory concentration emission level rather than on applying the potential benefits of economies of scale saving to further NOx reduction.
- The regulatory implication of a correlation between lower NOx and larger installations is that larger installations (particularly at newer installations without prior design constraints) may be expected to achieve lower NOx concentration targets than smaller installations without excessive or significant cost. Noting mass emissions and ground level impacts from larger installations may be greater (at a given emission concentration value), the application of economies of scale to reduce larger plant concentration emission values may align with environmental impact reduction objectives.
- Data points 17 (Rookery pit) and (16) Beddington data points are considered outliers and may be disregarded for the reasons given above.

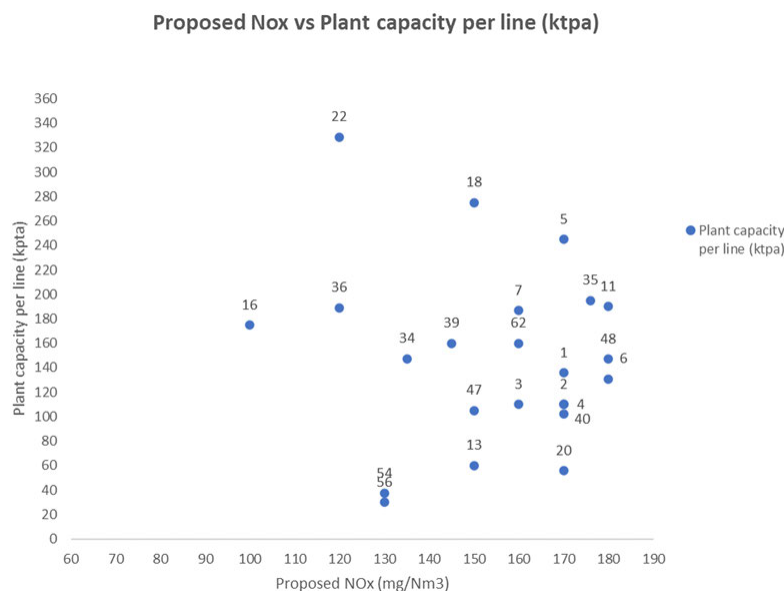


2.6 Optimised NO_x TEV vs Average Line Capacity

The graphs below were created to assess whether any correlations existed between NO_x levels and line capacity, noting that this capacity varies from tens of thousands to over 300 thousand tonnes of waste per year treated in each line.

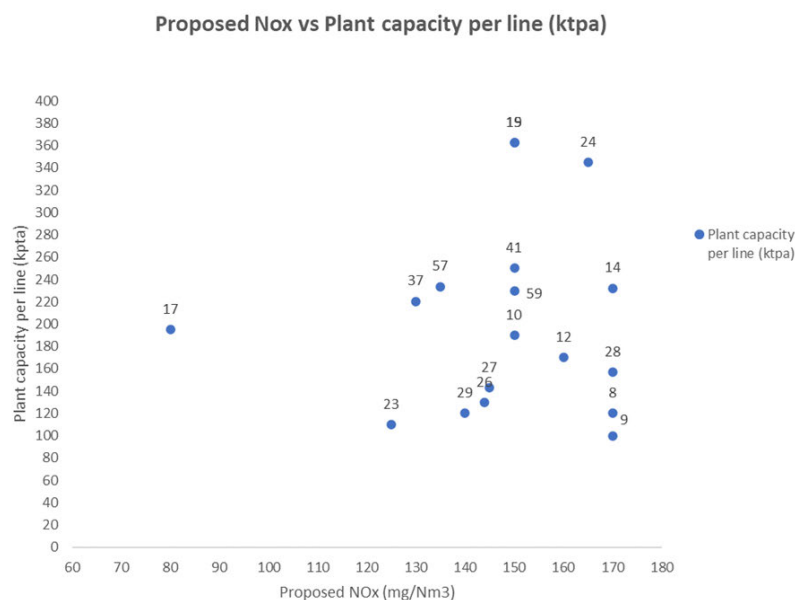
2.6.1 Urea SNCR Systems

The graph below compares the derived TEV NO_x levels and average line capacity for urea based SNCR systems, with the results discussed in section 2.6.3 below.



2.6.2 Ammonia SNCR Systems

The graph below compares the derived TEV NO_x levels and average line capacity for ammonia based SNCR systems, with the results discussed in section 2.6.3 below.



2.6.3 Data Observations

The following observations are made:

- Similarly to the consideration of plant total capacity, when looking across the fleet and selecting “optimum” NO_x performance levels, the data plots for both urea and ammonia systems show a high degree of scatter and only a weak correlation with increasing line capacity i.e. larger lines may result in lower NO_x, but the correlation in this data is weak.
- As already noted in the plant capacity discussion (in section 2.5.3 above) the theoretical expectation is that larger lines³ might permit economies of scale, or exhibit improved combustion stability, that then allow closer control of reagent reaction conditions and permit the cost-effective deployment of enhanced controls leading to lower NO_x emissions.
- Similarly to the plant capacity discussions (see 2.5.3), the weakness of the correlation between line size and lower NO_x emissions is expected to be significantly due to original plant designs being focussed on reaching and complying with a required regulatory concentration emission level rather than then applying the potential benefits of economies of scale saving to further NO_x reduction.
- Also similarly to the discussion in section 2.5.3 above, economies of scale available to larger capacity lines, combined with their potential for larger environmental impacts (for a given emission level⁴) may provide a basis more favourable cost-effective opportunity for emission concentration and hence impact reductions at larger installations.
- Data points 17 (Rookery pit) and (16) Beddington data points are considered outliers and may be disregarded for the reasons given above.

³ Within the scale seen at the EFW facilities in this work i.e. from a few tens to over 300 ktpa

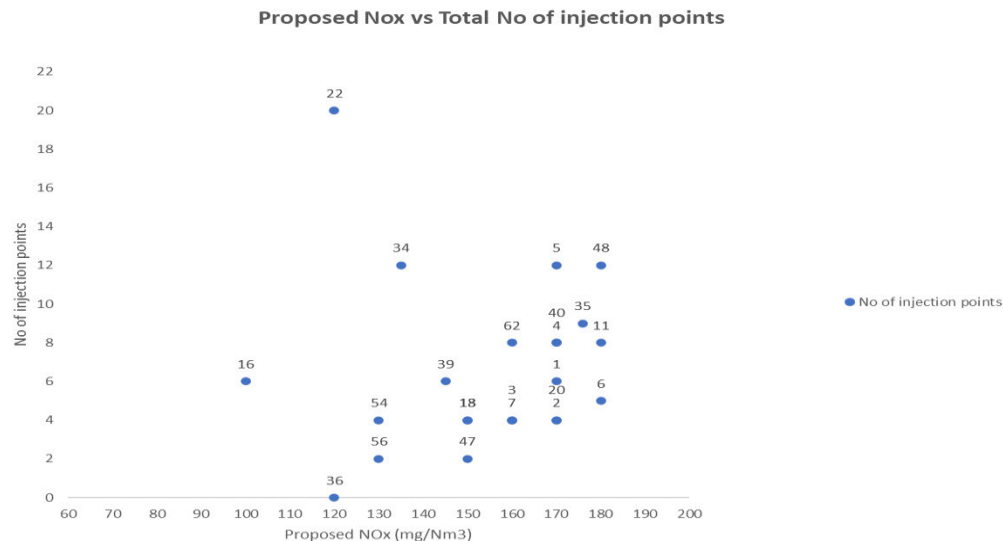
⁴ Other impact assessment criteria also need consideration, particularly dispersion factors including stack height and local background emissions & sensitivities – such factors are discussed in a separate paper provided to the EA as part of this work.



2.7 Optimised NO_x TEV vs Number of Injection Points (total at plant)

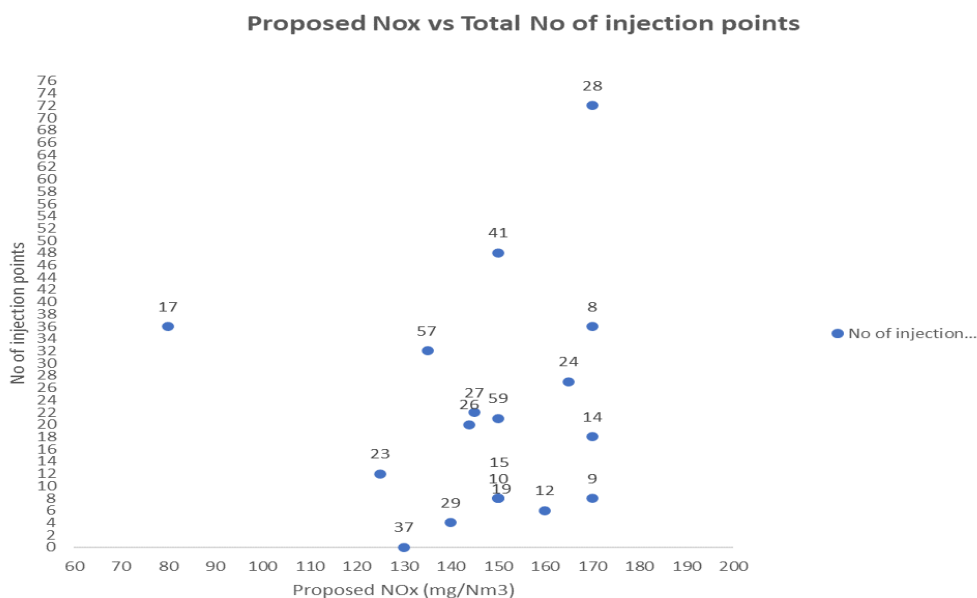
2.7.1 Urea SNCR Systems

The graph below compares the derived TEV NO_x levels and the total number of injection points per plant for urea based SNCR systems, with the results discussed in section 2.7.3 below.



2.7.2 Ammonia SNCR Systems

The graph below compares the derived TEV NO_x levels and the total number of injection points per plant for ammonia based SNCR systems, with the results discussed in section 2.7.3 below.



2.7.3 Data Observations

The following observations are made:

- Urea SNCR systems tend to have less than 10 injection locations, whereas this is often a minimum for facilities using Ammonia systems.
- The data plots for both urea and ammonia systems show a similarly high degree of scatter, but there is a weak suggestion in both cases that more injection points permits a somewhat lower NO_x level. This aligns with combustion system control theory.
- Data points 17 (Rookery pit) and (16) Beddington data points are considered outliers and may be disregarded for the reasons given above.
- SUEZ TV (data point 30 is Lines 4&5) and Wilton (data point 43) both have very large number of de-NO_x access ports. Line 4 at TV is noted as already capable of NO_x levels iro 140 to 150 mg/Nm³, but line 5 is more constrained at present, albeit with some expectation that similar level may eventually be achievable.



3.0 Conclusions

3.1 Introduction

Work by plant operators to undertake NO_x trials was mostly carried out in 2023 and 2024. Their IC reports were then submitted to the Environment Agency during 2023 & 2024.

This report provides an evaluation of the IC reports supplied by a total of sixty sites in England that are regulated by the Environment Agency.

The report provides a structured expert assessment and presentation of:

- the key IC return site data & trial conclusions;
- observations and recommendations for each site;
- fleet level data comparisons; and
- overall conclusions and recommendations.

The timing of the supply of the IC submissions meant that an initial set of twenty-four were evaluated during 2023 & 2024, with an interim report provided. The interim report was then updated to eventually consider the entire fleet of sixty sites, which are now considered in this work. The earlier report, and all its plant assessments, conclusions and recommendations are superseded by this report.

The Environment Agency issued a template for IC returns which was well used by the sector and helped to provide a degree of consistency in what was reported and assessed. However, there remained some deviation, including both how the trials were conducted and how the IC reports were prepared.

Notable variations included:

- the use of different trial NO_x set point emission levels – these were a site-specific selection;
- trial approaches – most trials sought to explore lower NO_x emission levels as was indicated in the issued IC, but some adopted an approach that focussed on new BATAEL compliance or focussed on reagent use / cost optimisation. Some operators used the process to explore optimisation and then identified further works to be undertaken to seek further knowledge and improvement possibilities;
- reporting – some Operator reports provided very comprehensive NO_x trial assessments and explanations, but others much briefer reports and limited evidence to support the conclusions presented;
- scope – most operators focussed upon NO_x emissions (and other) variations arising from changes to their existing abatement systems (usually SNCR), but fewer incorporated a full and integrated consideration / explanation of the range of NO_x reduction approaches, even where such approaches were likely to already be used on the site, such as primary combustion control approaches;
- emissions – not all operators reported all relevant emissions. For example, some did not provide information about residue contamination, and many did not consider nitrous oxide emission levels. These information gaps are considered to have undermined the ability to draw precise conclusions.

Expert judgement has been used to develop the conclusions and recommendations in this report. However, it must be noted that the noted trial and reporting variations lead to additional complications when seeking to make comparisons across the fleet. Therefore, the



individual site observations may be considered to have a higher degree of precision than the fleet level observations.

3.2 Site Observations and Discussion Points

The sections in Appendix A provide a plant-by-plant summary and evaluation of the supplied operator IC returns, including:

- Basic data – information about the plant size, operator, location etc.
- NO_x system data:
 - techniques deployed
 - SNCR performance data
 - achieved emissions data
- Key observations – what does the trial data suggest for each plant?
- EA recommended actions – possible regulatory next steps for each plant.

The reader should refer to the Appendix A observations and recommendations to understand how they relate to each plant. The bullet point list below provides a summary of some key themes that emerge:

- All sites assessed have confirmed they can comply with the standard BATAEL values 180 mg/Nm³ NO_x and 15mg/Nm³ EAL. This reduction has already delivered a degree of sector emission reductions.
- Many sites also suggest a lower “target” or “operational” NO_x emission level that they believe they can achieve. Usually this is a daily or longer-term average and is often proposed by the Operator as an objective that will allow operational margin to ensure compliance with a higher EAL compliance value.
- Typically, these “target values” (also referred to as “set points”) are 10 to 20 mg/Nm³ below the set AEL (daily average) and deliver measured emission levels that are compliant with the AEL, but may also be aligned with the target set. Operators generally do not set such compliance set points more than 20mg/Nm³ below the daily average AEL.
- Whilst this evaluation work and the IC returns have focussed upon daily averages, Operators do also have to comply with shorter term averaging periods, and deal with process and waste composition variations (which are often beyond their control). The need to deal with such variations and comply with shorter term AELs, means that lowering such AELs and the consequent need to target lower operational levels further below these to provide a “compliance margin” can lead to a destabilisation of plant operations, and increased risk of non-compliance. These considerations, and the difficulties in seeking performance levels beyond those originally intended (proscribed in permits and/or specified during design) provide a valid constraint and rationale for the limitations on performance that the NO_x IC returns evaluation reveals.
- In line with business standard quality system requirements and BAT permit requirements for continuous improvement, the suite of IC returns reveal that many Operators have proposed compliance with the new standard BATEAL levels along with a commitment to undertake additional optimisation / continuous improvement investigations. In some of these cases, the Operator has indicated that this may (subject to further trial findings) lead to further NO_x target or even actual EAL compliance reduction.



- In many cases, Operators indicates that such further investigations need to be carried out over a longer term to properly consider O&M issues and full life-cycle costs, noting that the trials themselves were under specific conditions and over a relatively short timescale. This is a genuine and important point, noting that plant lifetimes are usually some decades, and that they need to accommodate a very wide variety of waste compositions and other issues that can lead to both short-term and longer-term operating, performance and cost risks & issues.
- Mostly the new EAL / optimised NO_x emission targets proposed by the Operators in their IC report conclusions are suitably supported by the trial data presented. However, in some cases, Operators appear to draw “minimum change” conclusions when the actual trial data suggests that a somewhat lower NO_x target is achievable i.e. while trial data may show the plant is capable of delivering lower NO_x performance than that committed to, the Operator has not then provided evidence of the compromises or constraints to achieving such improved NO_x performance.
- Generally speaking, newer plants are more likely to fall into this category. This is because such plants have been developed during the past decade, when the lower BATAELs may have been anticipated, meaning supplier and designers have already provided systems which already incorporate the approaches which give lower NO_x adaptation potential. Such facilities may then deliver these lower NO_x enhancements simply by deploying this potential, although this is very much a plant specific consideration, as can be seen from the variations noted across the full set of IC returns – refer to plant specific assessments in Appendix A for details.
- Increases in NH₃ slip to air and in reagent consumption are the most common justifications for concluding that NO_x reduction has reached its optimum.
- Very few Operators report issues with solid residues contamination. Where noted, contamination of APCr is more common than of IBA, and mostly only where very high reagent dose levels were deployed during trials to examine extremes. Some Operators note elevations of some parameters and/or odours, but there are not reports of any such changes creating difficulties with downstream treatment and disposal routes. In general, in these trials residue contamination is not therefore a key constraint on NO_x reduction, but some limitations may be expected if extreme reductions are sought.
- Usually, the reagent consumption dose rate constraints presented in the IC trial reports are also linked to increased Operator costs. However, the significance of these incremental reagent cost appear low in relation to overall plant O&M costs and may also be low when compared with the potential for reduction of NO_x emissions (and associated external damage costs). Other wider costs (e.g. corrosion / fouling) are sometimes noted and are valid considerations (and need to be considered with the comments above regarding trial length and the need to consider long term operational risks).
- It is common for original plant design constraints to be noted in the IC reports as reasons for not further reducing NO_x targets below the standard BATAELs. This includes general statements regarding earlier NO_x emission compliance designs, as well as specific items such as pump speed limitations on SNCR reagent dosing rates. Where pump speed or dosing screw feeder limitations are noted, these constraints were not then accompanied by any cost-benefit assessment for replacement, which would appear to be appropriate to fully explore the constraint presented.
- Original and fundamental plant design basis issues emerge from this assessment as perhaps the most relevant constraint on NO_x reduction opportunity. This reflects the normal plant design development process whereby plant designers and developers’



size and design / select equipment for an EFW plant by balancing a wide variety of constraints, and emissions compliance levels form an important part of this. Whilst a degree of subsequent performance optimisation and flexibility, above and beyond the original design, is usually possible (and may be designed in), there are limits to post operational performance optimisation, with these limits being set by the earlier design decisions. More significant performance (emissions reduction) alterations will usually require more drastic upgrades, and hence lead on to more significant complexity and cost. This evaluation of IC returns confirms the significance of these original design limitations, and suggests that older facilities are the most constrained. Some of the older facilities were designed when higher, or indeed no⁵, ELVs were stated for NO_x. Significant sums may have been invested in upgrades to meet more recent ELVs, but then new limitation points are met.

- Some newer facilities appear to have already been designed with “future standards”⁶ in mind i.e. the ability to be adapted to comply with lower EALs for NO_x through operational adjustments and without the need for substantial technical or capital investments. Such plants have typically already incorporated certain design features⁷ to provide this “spare emission reduction capacity”. They then find it easier to “trim” their operations and have the potential to reliably meet emission values that are beyond the reach of older plants. This discussion reveals the importance of emission standards for new facilities being set with the future in mind, rather than being purely based upon the constrained performance of existing facilities, which will have been designed to meet older standards. The need to look forward when setting new plant standards is all the more important during times of significant or rapid change⁸.
- Solid reagent injection systems (usually urea) are noted to sometimes experience dosing blockages requiring targeted preventative maintenance and other specific measures to reduce blockage risks and the consequent risk of short-term emissions compliance issues. Concerns over such blockages have been noted as constraints on achieving lower NO_x levels, and plant operational practices (including preventative maintenance and monitoring) then become more critical.
- No such blockage issues were reported with liquid reagent injection, which is most commonly used for Ammonia systems, but also for urea solution injection. Variant dilution of reagents using reagent and diluent mixing rates provides a commonly used concentration flexibility which has the additional benefit of affording an additional control option. In some cases, the additional cooling effect of liquid reagent injection is also noted as providing further NO_x control options (via temperature control).
- Despite such apparent advantages from liquid reagent systems, switching to liquid reagent injection is only rarely noted as an option. The reasons for this lack of consideration is mostly related to the IC focus on the optimisation of “current systems

⁵ Directive 89/369/EEC set ELVs for various pollutants, but not for NO_x <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31989L0369>

⁶ Whilst the most recent EU BREF was published in December 2019, it was developed over several years prior to that, and so plant designers / suppliers / customers are likely to have had awareness of emerging NO_x requirements, especially noting that the earlier EU BREF from 2006 already identified a 24 hour average non-SCR emission range of 120-180 mg/Nm³ as BAT, and 40-100 mg/Nm³ for SCR installations.

⁷ Such as multiple SNCR nozzle locations, directional nozzles, temperature and emission monitoring and controls.

⁸ In Dec 2024 DEFRA indicated policy requirements for new EFW plants including a closer focus on carbon capture, which have potential to influence future EFW designs including NO_x considerations <https://www.gov.uk/government/news/government-to-crack-down-on-waste-incinerators-with-stricter-standards-for-new-builds>



in place”, but also may be for reasons of existing plant compatibility⁹ / cost, or liquid storage hazards and regulation. It is advisable that all plants experiencing solid reagent blockage issues should carry out a plant specific assessment of alternatives, including switching to liquid reagent injection.

- Overall, in line with the IC wording (see Section 1.2) Operator trials and conclusions focus upon the optimisation of existing plant and operations i.e. OPEX approaches. As such, limited consideration was given in the IC reports and trials to capital investments and equipment change / upgrade options, although the constraints imposed by such existing equipment are commonly noted as part of the rationale for not achieving further NO_x reductions.
- The IC returns often omit consideration of primary (combustion control etc) measures (although a few do this well and identify certain benefits¹⁰) and the focus is mostly¹¹ on SNCR system optimisation. The focus of the trials was therefore mostly on SNCR optimisation, and few of the Operators have considered other NO_x reduction methods, or enhancements to the SNCR system.
- With regard to overall NO_x control optimisation and efficient emissions reduction this low level of consideration of primary measures is a significant gap. Where operators have integrated consideration of primary and secondary systems gains are apparent, including lowering final NO_x emissions without excessive reagent consumption – see further comments below on “primary measures” and “temperature zone targeting”.
- The IC focus on existing systems (and mostly on SNCR) means that other NO_x reduction systems, or SNCR upgrades, that are already widely deployed in the sector internationally (& within the UK fleet) have not been fully considered. For example, the deployment of additional (targeted) SNCR injection locations, use of alternative reagents, SCR systems, or the use of wet / polishing scrubbers¹² to capture and recycle NH₃ slip when higher dose SNCR is deployed – all of which are known to be used to deliver lower NO_x emission levels at EfW plants.
- Temperature reaction zone targeting of reagent injection is possibly the most significant technical approach for efficient SNCR operation and then overall NO_x reduction with cost optimisation. The set of IC trial reports highlight a sector trend to including multiple and better targeted SNCR reagent injection locations. This assessment shows that newer plants have been more commonly adopting this approach. The approach is likely to be most beneficial with larger boiler dimensions to assist with good reagent mixing and closer and more targeted temperature zone control, although this assessment did not find a strong correlation between line size and number of injection locations – possibly because such an association is clouded by other data noise. Overall, more injection locations do appear to help temperature zone targeting and therefore NO_x reduction efficiency via SNCR approaches, although it is also noted that some plants, following commissioning and optimisations, do not deploy all injection locations – some appear to end up being

⁹ Locating injection equipment to access optimal reagent reaction temperature zones and liquid reagent storage may be relevant issues, along with other logistics matters.

¹⁰ Good combustion not only reduces NO_x production, but also improves stability, which allows better targeting of SNCR reagent injection, and may also enhance reagent reaction chemistry (stoichiometry) by avoiding the production of pre-cursors which “scavenge” reagent.

¹¹ The IC required trial to focus the optimisation of existing measures, but did not specify only the SNCR system.

¹² This technique is noted in the 2019 BREF and has been deployed in recent decades as a means to provide lower NO_x emissions with SNCR & without NH₃ slip emission issues. It is not however, without its complexity so should not be regarded as a “silver bullet” and specific plant feasibility assessment is required, including consideration of plume visibility issues associated with tail end wet scrubbing.



redundant as they have not been located in areas where empirical operational data reveal inappropriate temperatures.

- NO_x and SNCR monitoring and control systems emerge as having a key role in ensuring optimal NO_x emissions. This is not surprising, given the sensitivity of SNCR systems to temperature and mixing/contact time, and reactor conditions. However, some plants appear to still adopt a simple set point approach, with manual intervention. The wider adoption of more modern monitoring and control systems that automatically respond to live measurements has potential to deliver lower NO_x outcomes.
- Primary measures – as already noted, with the trials focus generally upon existing secondary SNCR abatement system dosing trials, only a few operator reports provide a full consideration of the contribution from combustion optimisation approaches in a “holistic” assessment. Combustion optimisation assessments have been carried out in some cases, and these are shown to have benefits for NO_x performance and SNCR efficiency. However, these combustion optimisations were sometimes separate from NO_x assessments, targeting other combustion and plant performance issues rather than NO_x emissions. As an example, in some cases the % oxygen excess was reduced, and noted to help reduce NO_x formation¹³. Noting that wider considerations regarding CO, VOC and other important combustion and operating parameters do need to be considered, an overall a holistic consideration is required to also consider combustion emission risks and plant operational risks alongside the potential benefits from NO_x reduction.
- Reagent storage, tanker delivery & UK market supply logistics constraints are sometimes noted as reasons why higher doses of reagent cannot be adopted. The validity of these reasons could not be fully verified in this work, but it is noted that recent years have seen some press reports indicating UK based production capacity constraints, and it is known that storage of substances (including Ammonia) above certain capacity thresholds can trigger certain regulatory and planning requirements, adding regulatory burden.
- Across the suite of IC reports there is an inconsistent approach to the adoption and consideration of FGR. In some cases, FGR is mentioned as having a key role in the NO_x reduction strategy, and in others it is not fitted or not mentioned. In at least one case FGR is fitted but not used, and in another it was fitted but then removed. In several cases this report recommends that Operators consider FGR and (at least) provide a justification for their approach. It may be noted that different suppliers take a different view of FGR, and design their facilities accordingly, so this may be a matter to consider further in relation to future BAT policy, but informed by current approaches.

3.3 Fleet NO_x Performance Level

This section provides a summary collection of the main “fleet level” BAT observations that emerge from the graphical assessments in Section 2.0 above.

¹³ For example, in one case the plant conclusion on limitations with the NO_x reduction potential appear undermined by the conclusions of the combustion optimisation report, which suggests approaches that will actually reduce the need for the high reagent dosing which is noted as a main constraint.



All references to emission & consumption levels noted here are the derived¹⁴ longer-term average operational optimum performance emission levels, which were derived and compared in the graphs in Section 2.0, rather than suggested permit compliance AELs:

- All plants can comply with the NO_x BATAEL of 180 mg/Nm³, and NH₃ level of 15mg/Nm³ regardless of technical approach and waste type.
- Plants with urea or ammonia based SNCR de-NO_x generally result in derived optimal NO_x emission performance (actual emission not AEL) levels from 140-170 mg/Nm³. Outliers arise for site specific reasons – see discussions in section 2.
- Around half of the current operational fleet already show potential to deliver target NO_x emission levels (daily average target) close to 150 mg/Nm³, with more also showing potential to approach this level subject to further long-term assessment. Older plants, which were designed for higher emission levels are generally unlikely to approach such performance but may deliver iro 170 mg/Nm³ as a longer-term average in seeking to maintain compliance with the new EAL of 180 mg/Nm³.
- Overall, this possibility to move towards lower NO_x targets means there is potential to achieve fleet wide mass emissions reductions of NO_x, which may be in the region of 20%, and more (estimated 30-40% overall across the fleet) may be possible noting that larger newer facilities not only emit the largest mass emissions, but also often have the most modern and capable NO_x reduction systems already available, or available to them at the lowest cost per tonne of waste impact.
- Nearly all plants have no difficulty in compliance with the Ammonia slip BREF AEL of 15 mg/Nm³. At the derived optimised NO_x levels, the NH₃ slip level is commonly below 5 mg/Nm³, and nearly always below 10mg/Nm³. Peaks are generally short-term, suggesting there is potential to adopt a lower overall standard fleet BAT AEL (daily average) even when derived NO_x optimum levels are targeted.
- While NH₃ slip levels do usually increase at a plant when an SNCR approach is “pushed”, at the fleet level when comparing the achieved optimised NO_x level, there is not a fleet level correlation indicating that those plants with the lowest NO_x are doing this at the expense of higher NH₃ emissions – each plant appears to optimise within its own set of design, operational and regulatory constraints.
- Whilst increasing reagent dose rates generally reduces NO_x emissions at individual installations, there are limitations that arise from original plant design and other factors. At the fleet level a weak correlation between increased dose rates and NO_x reduction is seen with Ammonia SNCR systems, but not with urea SNCR systems.
- The IC fleet data suggests a weak correlation between plant & line size and the derived optimal NO_x performance. The weakness of the correlation between plant size and lower NO_x emissions is likely to be due to plant designs being focussed on reaching and complying with a required regulatory concentration emission level rather than then applying the potential cost benefits of economies of scale to further NO_x reduction.
- The IC fleet data suggests an association between the number of reagent injection points and derived optimal NO_x performance, which follows the process engineering theory expectation i.e. more injection points facilitate better system control and can deliver lower NO_x outcomes, although there are also limitations to this.

¹⁴ Refer to data notes given in the Introduction to Chapter 3 which explain how the data was derived using a professional judgement assessment of the supplied trials data to identify optimisation points.



3.4 Main Influences on Optimised NO_x Performance

This work suggests the largest influences on NO_x performance are:

- **The original design (and permit) specification** – see notes in Section 3.2. Plants that have adopted a lower NO_x emission design basis from conception demonstrate they are able to optimise at lower emission levels.
- **The age of the installation** – older plants generally have higher emission levels, which is mainly due to the different design / regulatory specification that informed the original design basis, coupled with the techno/economic constraints on the plant performance that then arise.
- **Operator commitment** to reducing NO_x emissions (mass emissions) through continuous improvement, rather than a “compliance is enough” approach, delivers lower NO_x levels. Such approaches allow exploration of emission reduction opportunities whilst considering installation specific constraint, design, cost, waste variation and operational factors in an operating & commercial context. Percentile compliance permit emission standards and targets that recognise the difference between short term and longer-term emissions impacts are important as targeting lower emission can increase the risk of short-term challenges. A holistic assessment approach is required.
- **The deployment of available modern (BAT) systems for NO_x control**, including combining both primary (e.g. combustion control) and secondary approaches, including enhanced SNCR control & optimisation approaches that improve reagent reaction conditions and thus efficiency. Amongst these, it is evident from the IC return information that the following are of particular relevance:
 - **Combustion optimisation** – this provides a stable combustion gas chemistry that then allows efficient SNCR application.
 - **Targeted SNCR reagent delivery** – various factors combine so that reagent reaction chemistry is optimised. **Temperature zones** are critical, as well as dose rates. Effective system monitoring and (automated and dynamic) dose control and distribution are also important.
 - **A greater number of better controlled SNCR injection locations** facilitates SNCR system control and optimisation.

These approaches, whilst increasingly deployed with success, especially at newer facilities or those with a continuous improvement focus, are not deployed consistently across the current fleet.

- **Targeted preventative maintenance** approaches help to optimise system performance as well as reducing the risk of malfunction and drift from optimal performance. Notably this includes actions to avoid solid reagent blockages, which emerge to an extent that suggest that liquid reagent injection may be preferred as BAT.
- **Reagent dose rate** increases do generally reduce NO_x emissions, but there is a **diminishing return and compromise points are reached** (e.g. ammonia slip / reagent consumption). The actual point at which an existing plant reaches its optimum is process and site specific, but the IC trials suggest that emission targets below the BAT AEL of 180 mg/Nm³ can be achieved at the majority of plants, and many may target some way below this. See comments in Section 3.3 for the emission levels discussed.
- **Ammonia slip does increase as SNCR systems are “pushed”**. However, the significance of the increases reported requires further consideration. For example, in



a hypothetical (but representative) case, a NO_x daily average reduction from 170 to 140 mg/Nm³ may be possible, with an increase NH₃ slip value from iro 1 to 2 or 3 mg/Nm³. This NH₃ emission is still well within the BATAEL compliance level of 15 mg/Nm³. Further (spite-specific) assessment of actual incremental emission of NH₃ compared to the NO_x reduction benefit, is required¹⁵.

3.5 NO_x IC Methodology/Compliance Issues

In general, Operators adopted a consistent approach to undertaking trials and reporting the results. Many of the reports covered a wide range of relevant subjects and demonstrated a thorough approach that fully explored NO_x reduction and optimisation potential.

However, some trials and reports were much less comprehensive, which led to difficulties in their evaluation. These are noted where relevant in the plant specific evaluation sections of this work. In some cases, the trials did not appear to be compliant with the IC requirements, and further trials are then recommended.

Examples of main areas where IC methodology / compliance issues arose were:

- Limited emission set points or only emission level extremes were tested, rather than a stepwise set point reduction approach that targeted the identification of an optimum point:
 - In some cases, limitations were placed on the emission set points assessed by existing process limitations (e.g. reagent pump delivery capacity) – these process limitations then prevented testing lower emission set points.
 - In other cases, the trials assessed compliance with 180 mg/Nm³ and then very low emission points. Conclusions were then presented confirming certain constraints were apparent (e.g. high dose rates or NH₃ slip levels), although set points in between (where the optimal emissions operation may be located) were not investigated.
- One installation did not appear to have carried out or reported emission trials. In that case the plant has provided information from an SNCR study that targets compliance with the standard BATAELs. Although of interest and some relevance, this approach does not appear to be aligned with the IC return approach of *undertaking trials to determine the possibility of achieving emission levels below the standard levels*. In that case the plant scale (mass emissions) and sensitive (AQMA) location provided additional context to suggest that an approach closer to the IC requirements was merited.
- Lack of N₂O data – in many cases plants did not report or consider N₂O emissions, or they reported results that were not measured during the trials but obtained from routine operations. Given the potential impacts of N₂O emissions, this data gap undermines the conclusions of the IC report & the assessment of the optimised NO_x level. It is understood that this may have occurred in some cases because the trials were conducted before EA guidance on the matter was available.
- In some cases, the Operator IC conclusions did not fully align with the data and findings reported in their trials. The main example being where trials data suggested a lower NO_x emission set point / target may be readily achievable, but the Operator then concluded that compliance with the upper BATAEL of 180 mg/Nm³ was sufficient. In the fleet comparisons in Section 2.0 an attempt to overcome this has

¹⁵ In general, there would appear to be opportunity to reduce overall fleet permitted NH₃ emissions as performance is already well below that permitted.



been made by deriving “optimal” NO_x values for the graphical comparisons then made.

- Some cost data was presented for increasing reagent dosing. However, many sites presented no or very limited cost information. In some cases, arguments were presented that cost increments were excessive, although the scale of such increments appeared low in relation to overall plant operating costs. Some Operators suggested cost increments were a constraint without presenting any quantitative evidence.
- Incremental costs of reagent consumption were the most often noted cost constraint. However, where calculations showed the actual cost increment, it usually appeared very low in relation to typical overall plant operating costs. For example, figures in the region of £100 per day were sometimes noted as excessive. While there may be other operational and risk cost items that have not been presented, given the potential for substantial avoided NO_x impacts and damage costs a more robust justification approach appears appropriate. In a separate discussion note that was part of this work, SLR have provided comment to the EA on approaches for the consideration of NO_x damages.
- Some of the IC return reports presented a case for not further lowering NO_x emissions based upon UK supply market challenges. Some of these also provided estimations of reagent supply chain (CO₂) impacts. A methodology for consideration of such “external” (supply chain) factors in EA permitting would help with consistency and avoid situations where relatively small increments in supply chain impact (when compared to plant stack emissions) are used to justify not implementing further NO_x reduction. This matter is also briefly discussed in the SLR NO_x damages paper.



4.0 Recommendations

4.1 Follow-up Items

This assessment identifies a wide range of items that the EA may consider following up on. Broadly speaking they fall into the following categories:

- Site specific aspects – the site assessments in Appendix A each include recommended actions for each plant.
- Fleet level BAT policy aspects – see Section 3.0 Conclusions & Section 4.3 below.

Some highlight items to follow up on are:

- Pursuing the emerging “continuous improvement” opportunity to encourage incremental NO_x optimisation and reduction over time under operational conditions, including the use of “target” emission approaches.
- Encourage greater consideration of the full range of potential BAT NO_x reduction approaches i.e. beyond SNCR reagent dosing changes to include consideration of the integration of other BAT options in a site-specific context. Specifically, more efficient NO_x reduction appears possible at many plants through combining and improving the use of SNCR with the application of the combustion optimisation, reagent injection temperature & location targeting approaches noted in section 3.4 above. A plant specific BAT assessment / position justification may be appropriate, with a review cycle e.g. every 4-5 years.
- Evidence from several plants trials reports suggest that, where used, solid reagent blockage management is a significant risk for operators, requiring close attention and pro-active preventative maintenance. Blockage risk emerges from this assessment as an issue that constrains many operators’ ability and confidence levels when seeking lower NO_x emissions. Higher actual compliance levels may then be suggested in order to allow additional “compliance head room” for blockage periods. There were no reports of such issues with liquid reagent injection systems. Consequently, consideration is required whether liquid reagent is preferred as BAT, with a strong case for new installations, but various prior design and other site-specific constraints¹⁶ potentially constraining existing facilities abilities to adopt.
- Noting the significant global warming potential of N₂O emissions, more consistent Operator consideration of N₂O emissions, and impact assessment work is needed to establish an EAL that will then allow significance of N₂O releases to be balanced against other emissions being reduced. Whilst the data in this report did not permit conclusions on this matter, it is noted that the EU BREF suggest that the risk of N₂O emissions at plants using urea may be higher than those with ammonia SNCR
- Consider lowering the standard EAL for NH₃ slip – see other notes in this report.
- Those (few) Operators who have not carried out trials, not reported with appropriate quality, or in their trials have not covered emission areas where the optimum is likely to be, should be required to address these gaps to comply with the spirit of the issued IC. This may include the need for new NO_x trials.

¹⁶ E.g. storage of larger quantities of liquid Ammonia is separately regulated under hazardous substances storage legislation, and



- Explore incremental abatement cost vs avoided NO_x damage cost as a means to assess whether costs are excessive or reasonable – see also SLR discussion paper on this matter.
- Encouraging proactive preventive maintenance and automated monitoring & control systems, both to prevent short-term exceedances, and to control routine and overall mass emission more optimally.

4.2 Regulatory BAT Position

The operating fleet can comply with the new BATAELs of 180mg/Nm³ and NH₃ 15mg/Nm³ (daily averages). The NO_x level appears appropriate as a general fleet wide emission EAL for operational plants and can be achieved using a combination of BAT approaches, with SNCR usually required.

There is also an immediate opportunity to set a new lower EAL for NH₃. A level of 10mg/Nm³ daily average appears generally achievable across the fleet (very few limited exceptions), and a lower may be considered over time following a period of compliance assessment with 10 mg/Nm³ and fleet assessment.

While 180 mg/Nm³ provides the general operational fleet AEL, a significant number of Operators and IC trial reports suggest that EALs and target emission values below the 180 mg/Nm³ can be already adopted in these cases or may be adopted following further assessment. See discussion on this, including in Section 3.3 above.

The EA clearly has an opportunity to consider applying (some) lower EALs for specific plants with such lower NO_x capability. The EA may also consider the positive regulatory & environmental impact reduction role that “target emission values” may play by delivering substantially lower overall fleet NO_x emissions.

In many cases, where targeting lower emissions have been identified, Operators often also suggest the need for longer term trials. Such longer-term operational assessment is appropriate to allow consideration of the longer-term issues that could not be assessed in trials e.g. performance and maintenance risks.

Encouraging such further lower emission target investigations and “continuous improvement” approach on a site-by-site basis may be expected to lead to overall fleet emission reductions. It may also then lead to the more widespread adoption and testing of approaches that will inform future BAT technical knowledge and innovation.

The important influence of initial design / regulatory specifications emerges as a key finding of this work. Such specifications set the framework and future constraints on optimisation potential, for plants that will operate for some decades. The distinction between existing and new plant standards is therefore important.

While future “new plant standard” BAT needs to be *informed by* the existing fleet performance, it is also important that it is not unduly constrained by it i.e. older fleet performance might be excluded when developing the standards for the future, but their operations still permitted as “existing plant” that then optimises within the constraints they have (subject to an acceptable minimum “no harm” type performance level), perhaps only for a defined remaining life time, until they are decommissioned / replaced.

With the growth of the EFW fleet in the UK, and changes in the energy and other sectors, the sector has become more prominent with regard to the significance of its air emissions. This work highlights that the sector has already proved it can deliver lower emission in line with the new BATEAL 180 mg/Nm³ level but also points to the potential for many plants and the sector as a whole to contribute to further overall NO_x reductions, and to the potential of many plants to implement known BAT approaches that may be expected to deliver such reductions through “optimisation” & without the need for major capital investments.



A long-term debate has existed in the sector regarding the need for SCR, rather than SNCR, with the UK regulatory policy approach favouring SNCR, and consequently SCR only deployed at one installation in England (Baddesley). It is noted that this facility does deliver NO_x emissions that are well below the majority of the fleet and beyond that which this assessment suggests is possible for SNCR plants.

Whilst there may be a case for SCR to be preferred for new installations where local air quality and impact issues dictate, evidence in this assessment does suggest that new installations, when fitted with modern high -specification SNCR systems can achieve longer term target emissions in the region of 100 – 120 mg/Nm³, provided such performance is specified during the design phase. Indeed, some existing plants have already shown such capability, although this may be because such lower NO_x emission performance was already included in designs in anticipation of tighter future emission levels.

Noting the evolution in design standards and regulation in recent years, and the differences between older plants designed some decades ago, newer operating facilities and the new plants that may eventually replace older facilities, the following general plant age and compliance categories may be considered:

Current plant age	NO _x compliance comment
New plant	- Compliance with 120 mg/Nm³ from day one for all installations – this aligns with the top end of the EU BREF (2019) range for new plant - SCR is likely to be appropriate where local environmental conditions dictate e.g. where there is an AQMA's, other sensitive receptors, or other need to assure a NO_x emission level below 100 mg/Nm³¹⁷.
< 5 years	- Compliance with a TEV in the range of 120 – 150 mg/Nm³ may generally be expected - Some installations may be able to achieve a TEV below 120 mg/Nm³
5 – 10 years	- All capable of compliance with an AEL of 180 mg/Nm³ - The majority may be expected to investigate and implement BAT approaches to deliver target emission levels iro 120 – 160 mg/Nm³ - Some installations may be able to achieve a TEV below 120 mg/Nm³
10 -20 years	- All capable of compliance with an AEL of 180 mg/Nm³ - All may be expected to investigate and implement BAT approaches to deliver target emission levels iro 150 – 180 mg/Nm³ - Some installations may be able to achieve a TEV below 150 mg/Nm³ (prior design constraints may restrict options and performance at this level for the majority)
Over 20 years	All capable of compliance with an AEL of 180 mg/Nm³

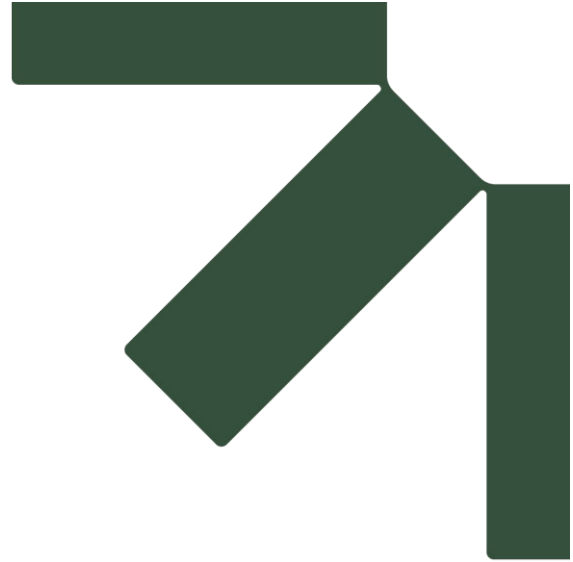
¹⁷ Whilst levels below 100mg/Nm³ are achievable in some cases with SNCR, this is unusual and often results in other compromises. For example, higher NH₃ slip production, while manageable with additional wet scrubbing, will then need further effluent management and may increase stack plume visibility.



Current plant age	NO _x compliance comment
	• All may be expected to investigate BAT approaches targeting emission levels iro 150 – 180 mg/Nm³ • Some installations may be able to achieve a TEV below 180 mg/Nm³ (prior design constraints may restrict options and performance at this level for the majority)
Notes: • In all cases mg/NM³ at 11% oxygen and STP • All plant to implement preventative maintenance & continuous improvement approaches and regularly examine cost effective emission reduction approaches. • Operational risks (and costs) may be assessed over several months and years, and need due consideration on a site specific basis i.e. certain techniques and performance levels may not be available at some installations for basic design constraint reasons. • Operational evidence of higher emissions levels, emission instability or exceedance permitted emission levels suggest that the implementation of further BAT measures is a priority. • In all cases the implementation of an NH₃ AEL of 10 mg/Nm³ appears possible. Plant trial and emissions data also suggest that a further reduction toward 5mg/Nm³ may already be possible at many installations, and in time possibly across the entire fleet. • More detailed and consistent consideration of N₂O emissions is required and may influence the conclusions presented here.	

Beyond the NO_x focus in this report, the sector is noted to be already exploring means to reduce other emissions, including more recently carbon dioxide. In the UK the Government has announced its intention to include EFW plants in the UK Emission Trading Scheme, and projects are being developed that consider the addition of carbon capture plants. These are very significant changes for the sector, that may be expected to prompt new approaches for both existing and new facilities. Noting that carbon capture facilities will receive the flue gases and be impacted by the flue gas composition and volumes, it may be expected that this then has implications for future NO_x (and other) emissions control. Ensuring that regulatory standards are set in a way that facilitates this change and allows innovation will be important.





Appendix A Plant-by-plant Assessment

This appendix provides a plant-by-plant summary and assessment of the information supplied in the IC returns, categorised as:

- Basic data – information about the plant size, operator, location etc.
- NO_x system data:
 - techniques deployed
 - SNCR performance data
 - achieved emissions data
- Key observations – what does the trial data suggest for each plant?
- EA recommended actions – possible regulatory next steps for each plant.

This appendix presents more detail, compared to Section 2.0, which presented the fleet level data correlations and noted more general observations on fleet level BAT conclusions arising.

The use of *italics* in this section denotes a direct quotation taken from the operator IC report.

A.1 Kirklees

A.1.1 Basic Data

The table below summarises basic installation data.

Table A-1: Basic installation data

Subject Area	Data
Name	• Kirklees Energy from waste
Operator	• Suez
Location / Address	• Huddersfield HD1 6BY
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial • AQMA
Capacity tonnes / annum total	• 136 ktpa
Number of lines	• 1
First operation date	• 2000
Main supplier / OEM (grate/boiler/furnace lead)	• HZI
Main supplier SNCR/ FGT	• No information

A.1.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided);
- Achieved emission levels.



- Other information & comments e.g. supplied operational or cost comments and data.

A.1.2.1 Techniques Deployed

Table A-2: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	Yes	Yes	The operator focuses on maintaining stable steam production, adjusting air flowrates as necessary, which impacts NO_x and CO emissions. Although the system is not optimized for minimizing NO_x emissions.
	Oxygen set point (% excess)	Yes	Yes	
	Waste feed control	?	?	
	FGR	Yes	Yes	At Kirklees EfW, there is no flue gas recirculation system.
Secondary	SNCR	Yes	Yes	The SNCR system is designed to meet daily ELVs of 200 mg/Nm³ for NO_x and 20 mg/Nm³ for NH₃. NO_x and NH₃ emission limits and indicates enhancements beyond these limits could necessitate redesigns. They highlight the system's optimization within its design parameters, with adjustments like the 2018 urea injection optimization enhancing efficiency.
	SCR	No	No	
	Catalytic filter bags	No	No	
	Wet scrubber (NH ₃ polish)	No	No	

A.1.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-3: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Carbamin 5723 (Urea solution)	Carbamin 5723 (Urea solution)	
Concentration etc	40% volume urea solution	40% volume urea solution	
Dose rate kg/tMSW	?	1.15-4.91 1.15 @ 170	NO_x targets of 140 mg/Nm³ required the highest urea usage at 4.91 kg per tonne of waste, whereas for a target of 180 mg/Nm³, urea consumption was just 1.15 kg/tMSW.
Number of injection levels	1	1	
Number of injection points (total)	6	6	
SNCR control system	Y	Y	
Injection location optimisation applied. Y/N (e.g. for temperature zones)	Y	Y	In 2019, raising the urea injection points by ~5m was reported for optimal reaction temperatures, resulting in urea usage dropping from ~5 kg to ~3 kg per tonne of waste burnt.



A.1.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-4: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180	?	170	The operator found it challenging to meet NO_x emission targets below 170 mg/Nm³ with their urea system. While consistent averages were achieved in the mid-150s mg/Nm³, targets of 150 and 140 mg/Nm³ proved difficult due to erratic combustion affected by variable waste input and moisture.
NH ₃ (air) mg/Nm ³ daily average	15	1.69	?	?	During the trial, the operator observed a slight increase in ammonia slip, linked to higher urea usage rates. However, the peak daily average of ammonia slip was only 1.69 mg/Nm³.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	2.9-6	Trend only.
Residue quality	N	Y	N	Y	Despite variations in IBA moisture content, no significant operational issues arise that could affect residue quality.

A.1.3 Key Observations

- The operator reported difficulty meeting NO_x emission targets below 170 mg/Nm³ with their current urea system, due to the variability in waste input and moisture, especially during heavy rainfall.
- They achieved compliance with an EAL of 180 with NH₃ of 15mg/Nm³ and consider a target range of 160-170 mg/Nm³ achievable. However, a target below 170 mg/Nm³ is not advised without further investigation, and constraints were noted relating to incoming waste variations and other factors.
- There was a slight increase in ammonia slip during the trial, but it remained significantly below the regulatory limit.
- N₂O trend data was provided (not absolute emissions). The trend suggested more significant emissions at set points below 150 mg/Nm³.
- Stable steam production is prioritized over reducing NO_x emissions due to a trade-off between maintaining desired steam output and controlling NO_x and CO levels.
- The system was initially designed for daily ELVs of 200 mg/Nm³ for NO_x and 20 mg/Nm³ for NH₃.
- Emission targets of 180 mg/Nm³ and 170 mg/Nm³ showed only minor differences in average emissions and urea usage. However, reducing targets to 160 mg/Nm³ significantly increased urea consumption.
- NO_x targets of 140 mg/Nm³ required increased urea usage at 4.91 kg per tonne of waste. For a target of 180 mg/Nm³, the urea consumption was 1.15 kg/tMSW.
- While ammoniacal nitrogen in APCR residue increases at lower NO_x targets, it was noted that this does not then affect the subsequent treatment process (no impact).



A.1.4 EA Recommended Actions

Evaluation of the IC return information suggests:

- Compliance with an EAL at 180 mg/Nm³ can be achieved, while aiming for operational target daily averages between 160-170 mg/Nm³, combined with conducting further optimisation investigations.
- Low trial ammonia slip levels suggest consideration may be given to setting an NH₃ ELV lower than the standard 15mg/Nm³.
- N₂O emissions data is required to allow for a more in-depth assessment of their significance and the optimal NO_x emission level.
- Further assessment of combustion controls contribution to reducing NO_x emissions is recommended.
- There remains a need to justify the absence of FGR.
- The Operator suggestion is that the current SNCR system is constrained by the earlier design basis (200 mg/Nm³ target).
- Information on costs is required to allow consideration of cost benefit issues.



A.2 Marchwood

A.2.1 Basic Data

The table below summarises basic installation data.

Table A-5: Basic installation data

Subject Area	Data
Name	• Marchwood Energy Recovery Facility
Operator	• Veolia
Location / Address	• Marchwood, Southampton SO40 4BD
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial • AQMA
Capacity tonnes / annum total	• 220 ktpa
Number of lines	• 2
First operation date	• December 2004
Main supplier / OEM (grate/boiler/furnace lead)	• CNIM/MARTIN
Main supplier SNCR/ FGT	• No information

A.2.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.2.2.1 Techniques Deployed

Table A-6: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	No	Yes	• The operator asserts maintaining good combustion conditions, primarily focusing on SNCR control, yet lacks detailed explanations or evidence on primary controls.
	Oxygen set point (% excess)	No	Yes	
	Waste feed control	No	Yes	
	FGR	Yes	Yes	• Extent of FGR use is not described.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Secondary	SNCR	Yes	Yes	Urea prills are injected at two levels in the furnace's post-combustion area, with the rate and nozzle activation based on furnace temperature and NO_x levels. Monthly nozzle blockages are managed by weekly inspections. Recent refractory changes impacting the temperature profile, are noted concerns.
	SCR	No	No	
	Catalytic filter bags	No	No	
	Wet scrubber (NH ₃ polish)	No	No	

A.2.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-7: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea prills	Urea prills	
Concentration etc			
Dose rate kg/tMSW	0.74	Line 1: 1.2-1.4 (170) Line 2: 0.45-0.65 (150)	- The operator conclusion reports reagent consumption increase from 0.74 to 1.93 kg/tMSW when operating at levels below 180mg/Nm³. - Figures reported left are for what appears to be the point at which an "optimal" NO_x level was achieved in the trials, noting any concerns over longer terms operations and other factors.
Number of injection levels	2	2	
Number of injection points (total)	4	4	
SNCR control system	Y	Y	
Injection location optimisation applied. Y/N (e.g. for temperature zones)	N	N	

A.2.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-8: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180	?	170	- The operator suggests a NO_x emission target of 170 mg/Nm³ to stay under the 180 mg/Nm³ ELV. - On line 1, targeting NO_x below 170 mg/Nm³ led to increased ammonia slip and reagent use, with instability at levels nearer 140 mg/Nm³. - On line 2, targeting below 160 and 150 mg/Nm³ maintained lower NO_x with minimal change in ammonia slip, consistently below the 15 mg/Nm³ regulatory limit.
NH ₃ (air) mg/Nm ³ daily average	15	?	?	Not given	The operator noted that further lowering NO_x emission targets may result in undesirable environmental impacts, including increased ammonia slip (up to 18 mg/Nm³), but a post-trial average emission target was not given, other than compliance with 15mg/Nm³
N ₂ O (air) mg/Nm ³ daily average	?	?	?	8-14	The operator noted the absence of nitrous oxide records for 2020 and 2021 trials but provides June 2023 data showing N₂O levels of 8-14 mg/Nm³ for normal operations at a NO_x set point of 170mg/Nm³.
Residue quality	N	Y	N	Y	Throughout 2021, operator monitored nitrogen compounds in IBA and APCr, using regular odour checks instead of sampling during trial periods. In 2023, with the new 180mg/m³ emission level, they increased sampling and maintained operational stability, although an odour issue was noted during trials. Recipients of residues reported no issues.

A.2.3 Key Observations

The key observations on NO_x control arising from assessment of the IC return for this installation are:

- The operator suggests a NO_x emission target of 170 mg/Nm³, to comply with a new Emission Limit Value (ELV) of 180 mg/Nm³.
- Ammonia slip differed between Line 1 and Line 2, with Line 2 showing lower levels, which may suggest the potential for a lower target than 170 mg/Nm³ on this line.
 - For Line 1, ammonia slip remained 6-7mg/Nm³ at emission levels below 170 mg/Nm³ but increased to 9-16mg/Nm³ when targeting below 160 mg/Nm³ NO_x. Further reduction toward 140 mg/Nm³ saw worsened slip and higher reagent use.
 - Line 2 showed more stable performance with lower NO_x targets, maintaining ammonia slip within 3-4 mg/Nm³, well below the regulatory limit of 15 mg/Nm³.
- The operator's rationale for not decreasing NO_x emission levels further is primarily technical and environmental, citing increased ammonia slip and residue odour as constraints. Concerns are raised about the increased reagent costs due to higher rates of urea usage, from 0.74 kg/tMSW up to 1.93 kg/tMSW.
- There is a lack of discussion and data on N₂O emissions.
- Despite technical limitations and the absence of N₂O data, the operator's arguments against further NO_x EAL reductions are reasonable in terms of system limitations.



- The operator has engaged in optimization trials and presents reasonable conclusions regarding SNCR optimization, though some areas are noted for ongoing investigation and improvement.

A.2.4 EA Recommended Actions

Evaluation of the IC return information suggests:

- The installation can comply with a new Emission Limit Value (ELV) of 180 mg/Nm³. The operator suggests a NO_x emission target of 170 mg/Nm³.
- The trial data suggests that line 2 may be able to comply with a slightly lower EAL and emissions target. The EA should investigate the reasons for the better performance at Line 2 and consider any appropriate measures for adoption in Line 1.
- The EA may request additional description and justification from the operator to demonstrate that combustion conditions and controls are optimized for NO_x level control through primary measures, as well as the role of the SNCR system.
- During routine inspections, the EA might consider checking the extent of FGR use - some plants have FGR systems, but do not use them extensively e.g. due to duct corrosion issues.
- The EA may investigate with the Operator the further prevention of injection port blockages, including the exploration of potential alternative reagent types, such as liquid options, and ensure continued regular blockage checks and preventative maintenance.
- The EA and Operator should follow up on the further optimization opportunities, including those specifically noted in the assessment.
- more information and consideration of N₂O emissions is required, noting that the data reported was not measured during the trial.
- The EA should follow up on the residue contamination results at the new target emission level and assess whether odour at lower trial levels indicates that a limit point has been reached.
- Cost issues related to further optimization approaches were noted by the operator, such as potential reagent change and primary NO_x reduction. These require further detail to allow consideration of these costs are reasonable / excessive.



A.3 Portsmouth ERF

A.3.1 Basic Data

The table below summarises basic installation data.

Table A-9: Basic installation data

Subject Area	Data
Name	• Integra Southeast (Portsmouth) ERF
Operator	• Veolia UK
Location / Address	• Quartremaine Rd. Portsmouth. PO3 5QH
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial • AQMA
Capacity tonnes / annum total	• 220 ktpa
Number of lines	• 2
First operation date	• March 2005
Main supplier / OEM (grate/boiler/furnace lead)	• CNIM
Main supplier SNCR/ FGT	• No information

A.3.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.3.2.1 Techniques Deployed

Table A-10: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	N	N	• The operator reported 2019 combustion optimization study by CCS OEM, which suggested no need for improvements.
	Oxygen set point (% excess)	N	N	
	Waste feed control	N	N	
	FGR	Yes	Yes	• FGR system is used which recirculates cleaned flue gas at around 150°C.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Secondary	SNCR	Yes	Yes	SNCR is used with dual nozzle injection levels, switching between them based on roof temperature—primarily the top level, and the bottom for reduced loads or emergencies. Urea injection effectiveness into the furnace requires pressurized air, with its rate regulated by the NO_x signal from the stack.
	SCR	No	No	
	Catalytic filter bags	No	No	
	Wet scrubber (NH ₃ polish)	No	No	

A.3.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-11: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea prills	Urea prills	
Concentration etc			
Dose rate kg/tMSW	0.74	Line 1: 1.08-2.04 (180-140) Line 2: 1.11-2.05 (170)	Operator conclusion reports reagent consumption increases from 89.28% kg/tMSW when operating at levels below 180mg/Nm³.
Number of injection levels	2	2	
Number of injection points (total)	4	4	
SNCR control system	Y	Y	
Injection location optimisation applied. Y/N (e.g. for temperature zones)	N	N	

A.3.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-12: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180	?	160	ELV of 180 mg/Nm³ with set point at 160 mg/Nm³ to maintain compliance with 180 mg/Nm³ to allow margin for process disruptions, etc.



Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NH ₃ (air) mg/Nm ³ daily average	15	2-3.2	?	?	- Initially, with a NO_x target of 190 mg/Nm³, ammonia slip remained under 2 mg/Nm³. - Lowering the NO_x target to 140 mg/Nm³ over five weeks led to a slight increase in ammonia slip, maintained below 3.2 mg/Nm³.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	13-21	- Line 1 N₂O levels ranged from 13 to 16 mg/Nm³. - Line 2 N₂O levels from 18 to 20 mg/Nm³.
Residue quality	N	N	N	N	The operator justifies the new emission level by noting the absence of IBA/APCr sampling during trials, relying instead on odour checks. Background nitrogen levels for IBA and APCr were based on 2021 data. In 2023, at the new emission level of 180mg/m³, samples were compared to 2021 data, with no concerns from residue processors about IBA/APCr suitability, indicating it remains fit for reuse.

A.3.3 Key Observations

- Trial data shows plant parameters closely align with design values, and the OEM suggests an ELV of 180 mg/Nm³ is feasible.
- Ammonia slip levels are balanced against NO_x reductions, with the aim to manage slip within a range that remains below 3.2 mg/Nm³.
- N₂O emissions were not assessed during trials. Separate data gave emission levels ranging from 13-20 mg/Nm³.
- A 2019 combustion optimization study indicated no improvements were needed in deNO_x system.
- Flue gas recirculation (FGR) system is used.
- The deNO_x system employs a two-level SNCR method, adjusting based on temperature and operational needs.
- Urea consumption increases more significantly when operating at targets below 180 mg/Nm³.
- No significant deviations in IBA/APCr suitability or operational changes reported during trials
- SNCR system's design constraints imply that achieving lower than the proposed emission levels might necessitate significant modifications.
- The operator has not discussed the associated costs in IC, but indicates that urea consumption increases non-linearly as NO_x targets are lowered.

A.3.4 EA Recommended Actions

Evaluation of the IC return information suggests:

- A NO_x EAL of 180 mg/Nm³ can be complied with.
- Emission Limit Value (ELV) of 180 mg/Nm³ with set point iro 170 mg/Nm³ appears suitable from trial data.



- A longer term average TEV point at 160 mg/Nm³ may be achievable in the longer term, but needs consideration of a wide range of optimisation and feasibility factors, including N₂O emissions (no data from trials provided).
- There appears to be a possibility of applying a lower NH₃ ELV, subject to the wider assessment of NO_x reduction optimisation investigations suggested below.
- Further optimisation and a thorough evaluation of the overall deNO_x system appears merited since the last assessment was in 2019 assessment. Specifically, this may sensibly include injection levels/locations and the control system, connecting maintenance activities to control of emission events, measures for consistent combustion control, plans addressing urea nozzle blockages.



A.4 Chineham ERF

A.4.1 Basic Data

The table below summarises basic installation data.

Table A-13: Basic installation data

Subject Area	Data
Name	• Integra North (Chineham) ERF
Operator	• Veolia UK
Location / Address	• Whitmarsh Ln. Chineham. Basingstoke. RG24 8LL
Location Character (Industrial/ Urban/Rural/ Mixed)	• Rural
Capacity tonnes / annum total	• 110 ktpa
Number of lines	• 1
First operation date	• 1994
Main supplier / OEM (grate/boiler/furnace lead)	• CNIM
Main supplier SNCR/ FGT	• No information

A.4.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.4.2.1 Techniques Deployed

Table A-14: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	N	Y	• After extended trials, a combustion study led to implementing recommendations like adjusting combustion air flow ratios and raising the oxygen level to 7% from 6.5%, enhancing combustion quality.
	Oxygen set point (% excess)	N	Y	
	Waste feed control	N	N	
	FGR	N	N	• The Facility ERF was originally designed with flue gas recirculation (FGR), but this system was subsequently retrofitted and removed.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Secondary	SNCR	Yes	Yes	The Facility employs a dry SNCR system using urea to lower NO_x emissions, with urea prills injected post-combustion to transform NO_x into nitrogen, water, and minimal CO₂.
	SCR	No	No	
	Catalytic filter bags	No	No	
	Wet scrubber (NH ₃ polish)	No	No	

A.4.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-15: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea prills	Urea prills	
Concentration etc			Solid prills
Dose rate kg/tMSW	1.34	1.34-1.56	- Operating to target emission values below 170 mg/Nm³ (to be compliant with 180 mg/Nm³) increased urea consumption to 1.5 kg/tMSW. - Operating at a setpoint of 160 mg/Nm³ to target emissions below 170 mg/Nm³, would report an increase ca 22% which is 1.56 kg/tMSW.
Number of injection levels	2	2	
Number of injection points (total)	8	8	
SNCR control system	Y	Y	Adjusting urea injection for the SNCR process, and tweaking the control system based on roof temperature and NO_x/NH₃ stack measurements. They also modified airflows to optimize the temperature and gas mixing conditions essential for effective NO_x reduction.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	N	N	

A.4.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-16: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180	?	160	Aiming for emissions below 170 mg/Nm³ led to excessive reagent use and ammonia slip, risking non-compliance. A further NO_x reduction would increase reagent usage by 22% compared to efforts targeting below 180 mg/m³.
NH ₃ (air) mg/Nm ³ daily average	15	7-12.8	15	?	The Operator justifies the proposed ammonia slip level, explaining that reducing NO_x below 170 mg/Nm³ led to excessive ammonia slip and reagent consumption, posing a risk of non-compliance.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	10-14	The document does not provide continuous monitoring data for nitrous oxide (N₂O) emissions during the trials. It mentions that nitrous oxide emissions were not continuously monitored at the time of the trials.
Residue quality	N	N	N	N	During the trials, no cross-media effects on residue quality were detected despite the changes in operational parameters aimed at meeting the new NO_x emission level (ELV) of 180 mg/Nm³. Background data for 2021 indicated stable levels of Total Kjeldahl and Ammoniacal nitrogen in IBA and APCr residues.

A.4.3 Key Observations

- The facility can operate below the 180 mg/m³ BATAEL while maintaining ammonia slip under the required 15 mg/m³ long-term, but further reduction below 170 mg/Nm³ leads to excessive reagent use and potential non-compliance.
- Achieving NO_x emissions below 170 mg/Nm³ results in a 22% increase in reagent usage and a higher ammonia slip.
- Nitrous oxide emissions were not continuously monitored during the trials, but available data confirms stable N₂O levels within the expected range for operating SNCR with dry urea.
- After implementing recommendations from a combustion study (MARTIN), increased oxygen levels needed for better combustion quality make it more challenging to meet ELVs lower than 180 mg/Nm³ over the long term at Chineham.
- The removal of FGR from Chineham ERF's design might affect the facility's NO_x reduction capabilities.
- Chineham's dry SNCR system, which uses urea prills, is controlled based on roof temperature and NO_x/NH₃ measurements, optimizing reagent dosing to prevent excess ammonia slip.
- Operator reports that lowering NO_x targets further than the setpoint increases ammonia slip and increases the risk of operational difficulties including ammonia nozzle blockages, although current levels do not negatively impact residue quality or reuse.



A.4.4 EA Recommended Actions

Based on the operator's justification and the context provided in the IC, the Environmental Agency could recommend the following to the operator:

- A new EAL of 180mg/Nm³, whilst targeting an operational level iro 170 mg/Nm³ to achieve EAL compliance is suitable for this plant.
- As part of routine regulation opportunities to maintain and further reduce NO_x levels may be further investigated as part of ongoing continuous improvement quality approaches, although opportunities appear limited without very significant intervention.
- Such further investigations may reasonably include:
 - investigate the operational impact of the FGR system's removal and the alteration of the O₂ set point.
 - consider N₂O emissions, which have not been detailed in the report.
 - review the MARTIN combustion optimization study to clarify the adoption of recommended practices.
- Overall, given the various constraints / challenges described, and the age (and small scale) of the plant, it is unlikely that significant mass reduction of NO_x can be achieved at this plant without very significant design intervention and costs which may not be feasible overall.



A.5 Sheffield ERF

A.5.1 Basic Data

The table below summarises basic installation data.

Table A-17: Basic installation data

Subject Area	Data
Name	• Sheffield Energy Recovery Facility
Operator	• Veolia UK
Location / Address	• Sheffield S4 7YX
Location Character (Industrial/ Urban/Rural/ Mixed)	• Rural
Capacity tonnes / annum total	• 245 ktpa
Number of lines	• 1
First operation date	• 2006
Main supplier / OEM (grate/boiler/furnace lead)	• CNIM
Main supplier SNCR/ FGT	• No information

A.5.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.5.2.1 Techniques Deployed

Table A-18: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	N	Y	• Combustion controls involved maintaining stable roof temperatures and boiler oxygen levels within normal operating values. • During trials, the procedure involved testing the single operational line and adjusting the primary technique by setting the wet oxygen setpoint at the boiler to 6%. • There is no FGR system.
	Oxygen set point (% excess)	N	Y	
	Waste feed control	N	N	
	FGR	N	N	
Secondary	SNCR	Yes	Yes	• Dry SNCR process that uses urea as a reagent to reduce nitrogen oxides (NO_x) emissions.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
				Urea prills are injected into the post-combustion area, where they react with NO_x to form nitrogen, water, and a small amount of carbon dioxide.
	SCR	No	No	
	Catalytic filter bags	No	No	
	Wet scrubber (NH ₃ polish)	No	No	

A.5.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-19: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Liquid urea	Liquid urea	The deNO_x system utilizes on-site prepared liquid urea, made from solid urea prills and demin water to a 32.5% concentration.
Concentration etc		32.5%	Supplied
Dose rate kg/tMSW	1.35	1.35-1.76	Average urea consumption was increased from 1.35-1.76 kg/tMSW during trials when the emission levels were reduced from 180 - 150 (mg/Nm₃).
Number of injection levels	2	2	
Number of injection points (total)	8	8	
SNCR control system	Y	Y	To optimize NO_x emissions, they fine-tuned oxygen levels for better combustion, adjusted urea injection in the SNCR process, and modified the control system using roof temperature and stack NO_x/NH₃ measurements.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	N	N	Not noted.

A.5.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-20: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	180 (200 original)	180	?	170	- The Operator argues the proposed emission level is sufficiently low, balancing NO_x reduction with ammonia slip management. - Trial data showed increased ammonia slip, especially when the NO_x setpoint was lowered to 150 mg/Nm³, surpassing the 15 mg/Nm³ ammonia slip limit.
NH ₃ (air) mg/Nm ³ daily average	15	7-15.75	15	?	- Over the four-week trial, ammonia slip increased from just over 10 mg/Nm³ during weeks two and three (with NO_x setpoints of 170 mg/Nm³ and 160 mg/Nm³) to a peak of 15.75 mg/Nm³ in the final week (setpoint 150 mg/Nm³). - This rise in ammonia slip, correlating with the gradual lowering of the NO_x setpoint, illustrates the balancing act between reducing NO_x emissions and managing ammonia slip. - The peak ammonia slip on the trial's last day surpassed the regulatory limit of 15 mg/Nm³, underscoring the difficulty of keeping ammonia emissions within acceptable levels at reduced NO_x setpoints.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	7.9-9.2	- Emissions of N₂O were stable within the expected value for the usage of urea reagent. - Emissions of N₂O rose as the urea reagent increased, especially during the last weeks of the trial.
Residue quality	N	N	N	N	- Pushing the emission levels lower to 150 mg/Nm³ resulted in higher contamination in residues like IBA and APCr. - These numbers indicate a threshold which is set point 165 mg/Nm³ beyond which residue quality could be compromised due to increased contaminant levels.

A.5.3 Key Observations

- The plant has already had an EAL of 180mg/Nm³ for several years, having been upgraded from an original EAL of 200 mg/Nm³.
- The NO_x reduction trials ranged from 180 mg/Nm³ to 150 mg/Nm³, with lower levels leading to greater ammonia slip.
- Ammonia slip increased notably when trial NO_x setpoints were lowered to 150 mg/Nm³, peaking at 15.75 mg/Nm³.
- Stable N₂O levels were observed, with minor increases during higher urea dosing.
- The deNO_x system uses liquid urea made on-site, varying urea injection between 131 l/h and 80 l/h to prevent overdosing. No FGR system fitted.
- Average urea consumption rose from 1.35 to 1.76 kg/tMSW during trials.
- Design parameters of the SNCR system were originally set for daily emission limits of 200 mg/Nm³ NO_x and 20 mg/Nm³ NH₃.



- The operator has not discussed the associated costs.

A.5.4 EA Recommended Actions

Evaluation of the IC return information suggests:

- The NOx EAL of 180mg/Nm³ is already complied with.
- Ammonia slip levels are relatively high (compared to other facilities) and appear to constrain NOx reduction opportunity in the current plant configuration.
- Trial suggest challenges with slip are more significant when a set point of 150mg/NOx is used, but there may be some potential for target emission values in the 180-160 mg/Nm³ range, subject to longer term evaluation.
- Such evaluation would need to take full account of existing design constraints as well as costs and the range of applicable and feasible techniques.
- Current trial evidence suggests that significant NOx reductions at this installation would require relatively significant technical changes, rather than lower cost operational optimisation approaches.



A.6 Chilton Biomass Plant

A.6.1 Basic Data

The table below summarises basic installation data.

Table A-21: Basic installation data

Subject Area	Data
Name	• Chilton Biomass plant
Operator	• Veolia UK
Location / Address	• Chilton, Ferryhill DL17 0SF
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial / rural
Capacity tonnes / annum total	• 131 ktpa
Number of lines	• 1
First operation date	• 2011
Main supplier / OEM (grate/boiler/furnace lead)	• ?
Main supplier SNCR/ FGT	• No information

A.6.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.6.2.1 Techniques Deployed

Table A-22: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	N	Y	• Recirculation rates of Flue gas were maintained at normal levels throughout the NO _x trials which is approximately 38,000 Nm ³ with a pressure set point of 9.5 m bar as these were optimised during commissioning.
	Oxygen set point (% excess)	N	Y	
	Waste feed control	N	N	
	FGR	Y	Y	• Increased recirculation rates are noted as a means to cope with higher fuel moisture levels.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Secondary	SNCR	Yes	Yes	The system consists of 5 injection lances with binary fuel nozzles, using urea solution mixed with water and compressed air.
	SCR	No	No	
	Catalytic filter bags	No	No	
	Wet scrubber (NH ₃ polish)	No	No	

A.6.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-23: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea Solution	Urea Solution	
Concentration etc	40%	40%	
Dose rate kg/tMSW	0.5	0.5-0.95	- The reagent consumption was increased by 45% when controlling at the lower set point of 150 mg/Nm³ compared to the normal 190 mg/Nm³ limit. This equates to 0.5 l/tMSW. - Operator mentioned that a lower limit is achievable but due to shorter trial duration and feedstock dynamics a limit no lower than 170 mg/Nm³ is feasible.
Number of injection levels	1	1	
Number of injection points (total)	5	5	
SNCR control system	N	N	- The configuration of the DeNox system was not modified in any way, the existing five nozzles were used for the injection and the only change was to the HMI set point within the PLC. - The operator suggests that further EAL reduction may be achievable by adding additional injection nozzles and pump upgrades.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	N	N	Not noted.

A.6.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-24: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180	?	170	Operator suggested that the plant could meet the forthcoming target of 180 mg/m³ and ammonia slip of 15mg/Nm³, and that a further reduction to comply with an EAL of 170 mg/Nm³ might be possible, although waste composition may constrain this.
NH ₃ (air) mg/Nm ³ daily average	15	0-0.9	15	?	The peak NH₃ slip range was 0.9 which was significantly lower than the BAT ELVs limit 15mg/Nm³.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	10-14	A graph titled Ammonia vs N₂O is provided but no data given for N₂O emissions, or any discussion.
Residue quality	N	N	N	N	Throughout the trial, no detrimental effects were observed on cross-media aspects. There was no significant change in the ammonia/nitrogen content of the residues.

A.6.3 Key Observations

Key observations from the operator's trial include:

- The plant could meet a NO_x EAL of 180 mg/m³ with ammonia slip at 15mg/Nm³. A further EAL reduction to 170 mg/Nm³ may also be feasible in time, though waste composition could be a limiting factor.
- The viability of achieving an EAL lower than 170 mg/Nm³ not demonstrated due to issues including short trial duration and feedstock variability.
- Reagent (urea) consumption increased by 45% at the lower NO_x set point of 150 mg/Nm³ compared to a set point of 190 mg/Nm³ limit, equating to 0.5 l/tMSW.
- The peak ammonia (NH₃) slip was 0.9 mg/Nm³, substantially lower than Emission Limit Values (ELVs) of 15 mg/Nm³.
- Flue gas recirculation (FGR) was operational at normal levels, with a flow rate of approximately 38,000 Nm³ at a pressure set point of 9.5 m bar.
- Operational stability was maintained, with no observed detrimental effects on cross-media aspects or change in the ammonia/nitrogen content of residues.
- No information provided on N₂O emissions.

A.6.4 EA Recommended Actions

Evaluation of the IC return information suggests:

- A permit (EAL) of 180mg/Nm³ can be complied with.
- Further consideration may be given to a lower EAL iro 160mg/Nm³ after further longer term testing and data collection.
- A lower Ammonia (NH₃) EAL may be considered, possibly around 5mg/Nm³.
- Data on Nitrous Oxide (N₂O) is required to inform the context of work at lower NO_x set point and identify the optimal overall NO_x position.



- To follow up on the Operator findings to further optimize NOx EAL at lower levels, which may include SNCR system optimizations, combustion control systems and Flue Gas Recirculation (FGR) rates in further optimization.
- The operator should also complete the suggested investigations additional injection nozzles and pump upgrades as part of the future work.



A.7 Allington

A.7.1 Basic Data

The table below summarises basic installation data.

Table A-25: Basic installation data

Subject Area	Data
Name	• Allington Quarry Waste Management Facility
Operator	• FCC/Kent Enviropower Limited
Location / Address	• Laverstoke Rd, Maidstone ME16 0LE
Location Character (Industrial/ Urban/Rural/ Mixed)	• Rural
Capacity tonnes / annum total	• 560 ktpa MSW
Number of lines	• 3
First operation date	• 2008
Main supplier / OEM (grate/boiler/furnace lead)	• Lenties- fluidised bed
Main supplier SNCR/ FGT	• No information

A.7.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.7.2.1 Techniques Deployed

Table A-26: Techniques deployed

Category	Technique	Pre-trial	Post Trial / proposed	Comments
Primary	Air control	N	Y	• Optimization of the combustion process through stable temperature management and the use of flue gas recirculation (FGR) was presented by the Operator.
	Oxygen set point (% excess)	N	Y	
	Waste feed control	N	N	• The plant is a fluidised bed – three lines.
	FGR	Y	Y	• The FGR system is a key part of their strategy to control furnace temperatures and, consequently, NO _x formation.
Secondary	SNCR	Yes	Yes	• The SNCR system injects a urea-water solution into the Rowitec using four injection points at the upper Freeboard, with compressed air aiding the injection.



Category	Technique	Pre-trial	Post Trial / proposed	Comments
				- The process's effectiveness hinges on maximizing the contact surface area between urea droplets and flue gas, achieved through two-phase atomizing injection nozzles that produce a fine mist in the incineration zone. - The urea droplet size can be adjusted by altering the water dilution ratio.
	SCR	No	No	
	Catalytic filter bags	No	No	
	Wet scrubber (NH ₃ polish)	No	No	

A.7.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-27: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea solution	Urea solution	
Concentration etc	40% urea, 0.5% Carbamin	40% urea, 0.5% Carbamin	
Dose rate kg/tMSW	3.4 x 10 ⁻⁵	3.4 x 10 ⁻⁵	Operator stated that no increase in reagent consumption recorded
Number of injection levels	1	1	
Number of injection points (total)	4	4	
SNCR control system	Y	Y	Over time, the SNCR system evolved from a constant dosing method to a feedback-controlled approach, with integration of FGR system, enhancing its efficiency significantly. This evolution has notably decreased both ammonia slip and reagent use.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	N	N	

A.7.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-28: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	180	180	?	160	The plant already routinely delivers emissions 100 mg/Nm³ to 120 mg/Nm³ and is therefore already optimised.
NH ₃ (air) mg/Nm ³ daily average	15		15	Below 1	The Operator fine-tuned the SNCR system to curb ammonia slip and substantially cut NO_x emissions, asserting that current ammonia slip levels are minimal and within regulatory bounds.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	0-5	The Operator mentions that nitrous oxide (N₂O) emissions at the Allington facility have been recorded below 4 mg/Nm³ along the three incineration lines.
Residue quality	N	N	N	N	During the trials, no cross-media effects on residue quality were detected despite the changes in operational parameters aimed at meeting the new NO_x emission level (ELV) of 180 mg/Nm³.

A.7.3 Key Observations

Key observations from the operator's report:

- The plant already complies with an EAL of 180mg/Nm³.
- Achieved emissions are already low and routinely between 100 to 120 mg/Nm³.
- Current ammonia slip levels are low at below 1mg/Nm³.
- N₂O emissions at the Allington facility are below 4 mg/Nm³.
- FBC design and combustion control measures, including stable temperature management and FGR, effectively reduce NO_x, ammonia slip, and N₂O.
- SNCR system operates by injecting urea solution based on stack NO_x readings, maintaining compliance with ELVs.
- There was no evidence of residue contamination constraints.

A.7.4 EA Recommended Actions

Evaluation of the IC return information suggests:

- The plant already delivers low average emission levels (100-120 mg/Nm³) when complying with an EAL of 180mg/Nm³.
- However, the trial data also suggests some significant “head room” such that an EAL between 160-150 mg/Nm³ might be explored, subject to longer-term testing to ensure sustainable compliance.
- Lowering the EAL for ammonia slip further to 5 mg/Nm³ also appears manageable, with a target of below 2 mg/Nm³ feasible without significant modifications.



A.8 Newhaven ERF

A.8.1 Basic Data

The table below summarises basic installation data.

Table A-29: Basic installation data

Subject Area	Data
Name	• Newhaven Energy Recovery Facility
Operator	• Veolia UK
Location / Address	• N Quay Rd, Newhaven BN9 OAB
Location Character (Industrial/ Urban/Rural/ Mixed)	• Mixed
Capacity tonnes / annum total	• 240 ktpa
Number of lines	• 2
First operation date	• 2011
Main supplier / OEM (grate/boiler/furnace lead)	• HZI
Main supplier SNCR/ FGT	• No information

A.8.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and doses rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.8.2.1 Techniques Deployed

Table A-30: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	N	Y	• O ₂ % levels and flue gas recirculation were optimised prior to the trial.
	Oxygen set point (% excess)	N	Y	
	Waste feed control	N	N	
	FGR	Y	Y	• Flue gas is recirculated from just before the stack back into the combustion chamber, aiding in deNO_x efforts. • This recirculation mixes the flue gas, reducing both temperature and oxygen content, which collectively helps to diminish NO_x formation.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Secondary	SNCR	Yes	Yes	- The deNO_x system has 36 nozzles across three levels, each with 12 nozzles, operating one level at a time based on roof temperature or manual adjustments for combustion issues. - A 25% ammonia solution is injected with 3.5 bar steam from the LP turbine header, acting as a carrier and coolant.
	SCR	No	No	
	Catalytic filter bags	No	No	
	Wet scrubber (NH ₃ polish)	No	No	

A.8.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-31: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Ammonia solution	Ammonia solution	
Concentration etc	25%	25%	
Dose rate kg/tMSW	0.64	0.64-1.33	The ammonia consumption is doubled compared against the historic data set when operating at the current IED limits.
Number of injection levels	3	3	
Number of injection points (total)	36	36	
SNCR control system	Y	Y	(SNCR) system included fine-tuning various aspects including the adjustment of oxygen (O₂) percentage levels and the optimization of flue gas recirculation prior to the trial.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	N	N	

A.8.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-32: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180	?	170	While the Newhaven ERF can technically operate at an emission level below the Emission Limit Value (ELV) of 180mg/m³ without major operational challenges, the substantial increase in ammonia consumption and the associated risks to supply make it unsustainable for the plant to operate below 160 mg/m³ over the long term.
NH ₃ (air) mg/Nm ³ daily average	15	0-0.5	15	?	Ammonia slip level generally around 0.2 mg/Nm³ during all trials, and a maximum of 0.5.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	Not given	N₂O (nitrous oxide) was not measured by the Continuous Emission Monitoring Systems (CEMS) at the time of trials.
Residue quality	N	N	N	N	The samples for Total Kjeldahl Nitrogen and Ammoniacal Nitrogen were taken throughout 2021, providing a baseline against which the impact of operating at the new emission level of 180 mg/Nm³, implemented in 2023, can be compared. The results will be provided to the EA later.

A.8.3 Key Observations

- The report suggests that the plant can comfortably comply with an ELV of 180mg/m³
- During trials the ammonia reagent dosing required for targets of 170 mg/Nm³ and 180 mg/Nm³ is almost the same, and a stable average NO_x level of 150 mg/Nm³ was achieved with an EAL target of 160, while ammonia consumption rose from 0.75 to 1.32 L/TMSW.
- Ammonia slip levels were low at around 0.2 mg/Nm³, peaking at 0.5 mg/Nm³ during trials.
- N₂O measurements were not conducted at the time of the NO_x trials.
- The FGR system at the facility plays a key role in NO_x reduction in tandem with the SNCR system, which uses 25% liquid ammonia.
- The SNCR system's optimization involved adjusting O₂ levels and the FGR system.
- No plans for de-NO_x system modifications were identified post a 2019 study.
- No cost data was provided.
- The facility's SNCR system was designed for original daily ELVs of 200 mg/Nm³ NO_x and 20 mg/Nm³ NH₃

A.8.4 EA Recommended Actions

Evaluation of the IC return information suggests:

- There is evidence to suggest that a longer-term a lower EAL of iro 160 mg/Nm³ may be achievable, along with a longer term average target emission set point of iro 150 mg/Nm³.



- The above would need to be confirmed via a longer term assessment with full consideration of wider factors.
- Low NH₃ slip results suggests that a lower EAL may be complied with, potentially around 5 mg/Nm³. This would also need to be considered the context of an overall assessment of lower NO_x running, as NH₃ levels may increase.
- N₂O assessment is required in the long-term evaluation of compliance at reduced NO_x levels.
- The findings from the combustion optimization study should be integrated to also explore any potential primary NO_x reduction enhancements.
- Future assessments should include a thorough evaluation of the DeNO_x system since the last assessment was in 2019.
- Overall, the trials show that the plant appears capable of achieving emission levels below the 180mg/Nm₃ level and further investigations targeted on lower levels may reveal that lower still levels are sustainable.



A.9 Eastcroft EFW

A.9.1 Basic Data

The table below summarises basic installation data.

Table A-33: Basic installation data

Subject Area	Data
Name	• WasteNotts (Reclamation) Limited, Eastcroft EfW
Operator	• FCC Environment
Location / Address	• Incinerator Road Off Cattle Market Rd Nottingham NG2 3JH
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial
Capacity tonnes / annum total	• 185 ktpa
Number of lines	• 2
First operation date	• 1970
Main supplier / OEM (grate/boiler/furnace lead)	• CNIM
Main supplier SNCR/ FGT	• Yara system

A.9.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.9.2.1 Techniques Deployed

Table A-34: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	N	N	• There is no flue gas recirculation system.
	Oxygen set point (% excess)	N	N	
	Waste feed control	N	N	
	FGR	N	N	



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Secondary	SNCR	Yes	Yes	The SNCR system, which uses ammonia as a reagent, was subjected to various trials to optimize injector positions and dosing rates. The results indicated a successful reduction in NO_x emissions, albeit with a corresponding increase in ammonia consumption.
	SCR	No	No	
	Catalytic filter bags	No	No	
	Wet scrubber (NH ₃ polish)	No	No	

A.9.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-35: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Liquid ammonia	Liquid ammonia	
Concentration etc	25%	25%	
Dose rate kg/tMSW	2.5	2.5-3.5	At maximum dose rate NO_x emissions were seen to drop to 103mg/Nm³ on Line 1 and 119mg/Nm³ on line 2 when a mean of daily averages was taken over a period of 7 days.
Number of injection levels	2	2	
Number of injection points (total)	8	8	
SNCR control system	Y	Y	- Throughout 2023, the SNCR system underwent extensive in-house optimization. - An initial trial aimed to find the best position for injectors, concluding that an upward orientation was optimal. - Additionally, ammonia dosing was refined by reducing the rate by 1 litre per hour at each step, staying within the 180mg/Nm³ limits. - These adjustments were made weekly, with periodic increases to ensure compliance with the new BAT AELs.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	N	N	Before the main trial, an initial optimization test was conducted to identify the injectors' most effective positioning. This test determined that an upward orientation was best for the injectors.

A.9.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-36: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	170	?	160 ?	The Operator achieved significant reductions in NO_x emissions, with levels dropping to 103 mg/Nm³ and 119 mg/Nm³ on different lines. However, they faced challenges such as an excessive buildup of sticky fly ash due to higher ammonia dosing rates, which poses a risk to combustion and plant operation.
NH ₃ (air) mg/Nm ³ daily average	15	0.5-1.8	15	?	- At the highest dosing rate, NO_x emissions decreased to 103 mg/Nm³ on Line 1 and 119 mg/Nm³ on Line 2, based on a 7-day average of daily means. - Typically, ammonia slip averages around 0.5 mg/Nm³, but at the maximum dosing rate, it increased to about 1.8 mg/Nm³, remaining significantly below the 15 mg/Nm³ AEL limit.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	?	The document does not provide continuous monitoring data for nitrous oxide (N₂O) emissions during the trials.
Residue quality					there was a noticeable increase in ammonia-related compounds in the IBA during the trial period. The levels of total Kjeldahl nitrogen, ammoniacal nitrogen, and total free ammonia in the IBA increased significantly compared to pre-trial values.

A.9.3 Key Observations

- During the trials NO_x emissions were reduced to levels between 103 mg/Nm³ and 119 mg/Nm³ across different lines by increasing ammonia dose rates, but with challenges such as an excessive buildup of sticky fly ash at higher ammonia dosing rates.
- At maximum dosing levels, ammonia slip was still relatively low at approximately 1.8 mg/Nm³ but elevated from the normal (pre-trial) operational rate of 0.5 mg/Nm³.
- To achieve the target daily average NO_x level of 180 mg/Nm³, the average ammonia consumption increased to approximately 3.5 litres per tonne of waste, up from the usual 2.5 litres. Given the facility processes an average of 555 tonnes of waste per day, this increase in dosing rate would result in a daily increase of 0.55 m³ of ammonia.
- The Operator supplied cost information suggested a daily increase of 0.55 m³ will increase daily reagent costs by £124/day (approx. £0.2 / tonne of waste) to comply with 180 mg/Nm³ compared to 200 mg/Nm³.
- Evidence of some increase in IBA contamination at higher dose rates.
- SNCR system optimisation has focused on adjusting injector positions and ammonia dosing rates.
- The Operator is proposing further investigations, including consideration of injection locations to further optimise, which is reasonable given the issues encountered in the trials.
- No further combustion control modifications were implemented since a 2019 study.



- The system does not include a flue gas recirculation system.
- No N₂O data provided.
- This is an older facility (1970) that has already undergone several refits and upgrades during its lifetime, which usually introduces performance and feasibility compromises/constraints.

A.9.4 EA Recommended Actions

Evaluation of the IC return information suggests:

- Compliance with an EAL of 180 mg/Nm³ can be achieved, and cost factors do not appear a significant barrier at this level.
- A longer-term average target NO_x level of iro 170 mg/Nm³ may be applicable.
- Low NH₃ emissions during the trials and routine operations suggests a lower ammonia (NH₃) ELV may be considered.
- Include Nitrous Oxide (N₂O) and residue contamination in future optimisation assessments.
- Revisit EAL and TEV levels following the further investigations proposed by the operator.
- These investigations should consider a full range of NO_x reduction techniques, although the age / remaining lifetime of the facility (each line) is likely to have an influence on what can be achieved, along with other normal feasibility factors.
- Overall, a strategy of compliance with 180 mg/Nm³ with further optimisation investigations appears reasonable.



A.10 Lincolnshire Recycling and Energy Recovery Facility

A.10.1 Basic Data

The table below summarises basic installation data.

Table A-37: Basic installation data

Subject Area	Data
Name	• Lincolnshire Recycling and Energy Recovery Facility
Operator	• FCC Environment
Location / Address	• Kirkby Lane, Lincoln LN4 4PD
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial/Mixed
Capacity tonnes / annum total	• 190 ktpa
Number of lines	• 1
First operation date	• 2013
Main supplier / OEM (grate/boiler/furnace lead)	• CNIM Martin
Main supplier SNCR/ FGT	• Yara Milijo

A.10.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.10.2.1 Techniques Deployed

Table A-38: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	N	N	• Not noted in trial report.
	Oxygen set point (% excess)	N	N	
	Waste feed control	N	N	
	FGR	N	N	• There is no flue gas recirculation system.
Secondary	SNCR	Yes	Yes	• The facility operates a Yara Milijo system, using ammonia mixed with softened water in a mixing cabinet before nozzle injection.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
				Two pumps each for ammonia solution and softened water, one in use and one standby.
	SCR	No	No	
	Catalytic filter bags	No	No	
	Wet scrubber (NH ₃ polish)	No	No	

A.10.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-39: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Liquid ammonia	Liquid ammonia	
Concentration etc	24.5%	24.5%	
Dose rate kg/tMSW	2.1	2.1-2.99	The average consumption at the highest dosing rate tested during the trials was 2.99 litres per tonne of waste.
Number of injection levels	2	2	
Number of injection points (total)	8	8	The denox system includes 8 nozzles across two levels, automatically switching between levels based on furnace roof temperature.
SNCR control system	Y	Y	- The SNCR system primarily controlled by monitoring flue-gas ammonia levels, with NO_x emissions as a secondary measure, operated successfully within new emission limits. - Trials suggested room for further enhancement, such as recalibrating the main reagent flowmeter for accurate consumption data and exploring technical upgrades to stabilize NO_x levels after startup.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	N	N	

A.10.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-40: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	180	160	?	150	- The plant has operated within the new 180 mg/Nm³ limit for two years. - Trials were carried out at set points from 160 mg/Nm³ down to 140 mg/Nm³, which gave an average NO_x level decline from 152 to 117 mg/Nm³.
NH ₃ (air) mg/Nm ³ daily average	15	3.78-5.9	15	10?	At the maximum dosing rate, the ammonia slip was approximately 5.9 mg/Nm³, compared to the usual rate of about 3.78 mg/Nm³.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	?	Not discussed.
Residue quality	N	N	N	N	IBA analysis from the trial indicated higher ammonia levels as, though not alarmingly high. A noticeable ammonia odour was detected from the IBA upon discharge, however, that can also occur under standard conditions.

A.10.3 Key Observations

- The plant has already operated within the new NO_x limit of 180 mg/Nm³ for two years.
- Trials ranging from 160 to 140 mg/Nm³ resulted in an average NO_x level drop from 152 to 117 mg/Nm³, with ammonia (NH₃) rates under 6 mg/Nm³.
- Over this range the (ammonia) reagent consumption increased from 2.1 to 3 litres per tonne of waste (l/tMSW), costing an additional £82 per day.
- An annual average NO_x level of 160 mg/Nm³ is reported, with instability following startup suggested as a reason why an ELV of 180 mg/Nm³ is more appropriate.
- Maximum ammonia slip observed was 5.9 mg/Nm³ during the trials, compared to a normal rate of 3.78 mg/Nm³, still below the AEL of 15 mg/Nm³.
- The plant has maintained operational stability, with a tube leak incident highlighted as an example of the potential risks associated with the NO_x reduction process.
- No information given on N₂O levels or on combustion optimisation / primary NO_x reduction measures.

A.10.4 EA Recommended Actions

Evaluation of the IC return information suggests:

- EAL of 180 mg/Nm³ can be complied with. A longer-term average target of 160 mg/Nm³ appears possible.
- Consideration may be given to applying a lower Ammonia (NH₃) Emission Limit Value (ELV), possibly in the range of 8-10 mg/Nm³.
- To determine the optimum NO_x level an assessment of Nitrous Oxide (N₂O) level is also required.



- Further consideration of the contribution to NO_x reduction from optimizing combustion control parameters is required.
- At £82/day the additional cost of reagent appears low in relation to the NO_x reductions reported, but this may not include all costs / risks – see tube leak report for example.



A.11 Leeds Recycling and Energy Recovery Facility

A.11.1 Basic Data

The table below summarises basic installation data.

Table A-41: Basic installation data

Subject Area	Data
Name	• Leeds ERF
Operator	• Veolia UK
Location / Address	• Newmarket Approach, Leeds LS9 0RJ
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial
Capacity tonnes / annum total	• 190 ktpa
Number of lines	• 1
First operation date	• 2016
Main supplier / OEM (grate/boiler/furnace lead)	• CNIM
Main supplier SNCR/ FGT	• No information

A.11.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and doses rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.11.2.1 Techniques Deployed

Table A-42: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	N	Y	• The plant operates with a low oxygen setpoint to optimize combustion.
	Oxygen set point (% excess)	N	Y	
	Waste feed control	N	N	
	FGR	N	N	• There is no flue gas recirculation system.
Secondary	SNCR	Yes	Yes	• This system employs the injection solid urea prills mixed with diluted water, into the combustion chamber.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
				The process is managed by a Distributed Control System (DCS), which regulates the dosing screw's rotation speed for accurate urea injection.
	SCR	No	No	
	Catalytic filter bags	No	No	
	Wet scrubber (NH ₃ polish)	No	No	

A.11.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-43: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea prills	Urea prills	
Concentration etc			
Dose rate kg/tMSW	1.06	1.06-1.23	The facility estimated an increase in reagent usage of approximately 0.22kg/tMSW, which is 21% more than when operating to the existing ELV of 200 mg/m³.
Number of injection levels	2	2	
Number of injection points (total)	8	8	
SNCR control system	Y	Y	This system employs the injection solid urea prills mixed with diluted water, into the combustion chamber. The process is managed by a Distributed Control System (DCS), which regulates the dosing screw's rotation speed for accurate urea injection.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	N	N	

A.11.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-44: Emissions data

Criteria	EAL		Target / Set-point		Comments / constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180	?	180	The facility can effectively reduce NO_x emissions to meet the new BAT-AEL of 180 mg/m³. However, reagent usage is estimated to increase.



Criteria	EAL		Target / Set-point		Comments / constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
					The increases in urea dosing provide very little abatement beyond this level but increase the ammonia emissions significantly.
NH ₃ (air) mg/Nm ³ daily average	15	9.96-22	15	?	- Initially, the average ammonia slip was 9.96 mg/m³, demonstrating effective control of ammonia emissions. - However, from March 28, 2023, a gradual increase in NH₃ emissions was noted, reaching a peak of 22 mg/m³ on line 2.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	7-25	- N₂O emissions varied between 7 and 25 mg/Nm³, showing an increase in emissions with higher urea dosing. - The operator noted that furnace temperature and waste composition also influenced N₂O emissions, with higher temperatures resulting in lower emissions.
Residue quality	N	N	N	Y	The trial has had negligible impact on the concentrations of Nitrogen (Total and Ammoniacal) in the APCr and has reduced the concentrations of Nitrogen in the IBA.

A.11.3 Key Observations

- The facility can reduce NO_x emissions to meet the new BAT-AEL of 180 mg/m³. However, urea reagent usage is estimated to increase by 21% over a set point of 200 mg/Nm³.
- Ammonia slip levels are somewhat high than other similar installations (average just under 10mg/Nm³). The maximum ammonia slip recorded was 22 mg/Nm³.
- The Operator has proposed a daily average NO_x level of 180 mg/Nm³, with an annual average of 160 mg/Nm³.
- N₂O emissions varied, averaging around 16 mg/Nm³, correlating with urea dosing rates, and ranging from 7 to 25 mg/Nm³.
- The Operator reports that the plant utilizes a low % oxygen setpoint and a urea prill injection system without a flue gas recirculation system.
- A significant challenge was the increased urea consumption required to achieve the new NO_x levels, which led to operational issues like blockages and higher maintenance requirements.
- The Operator has proposed further SNCR system optimisation.

A.11.4 EA Recommended Actions

Evaluation of the IC return information suggests:

- Setting a new EAL of 180 mg/Nm³ with a target of below 170 mg/Nm³, while also investigating issues like reagent dosing blockages and temperature zone calibrations.
- The operator should follow up on the SNCR optimisations proposed.



- As well as the further SNCR optimisation the scope of further NO_x optimisation should include assessment of combustion control parameters to reduce NO_x emissions, NH₃ slip, and N₂O levels.
- Overall, the plant NO_x (and N₂O/NH₃) optimisation opportunity reported is not at the level noted by other relatively new installations, indicating that (unless constrained by design issues) there may remain optimisation opportunities – the Operator report suggests this may centre on the urea SNCR system. Improvements may be targeted via regulation focussed on optimisation and continuous improvement approaches in various areas including those suggested in the report e.g. addressing reagent dosing blockages, optimisation of injection locations vs temperature zones, pyrometer calibrations, etc.



A.12 Staffordshire Energy Recovery Facility

A.12.1 Basic Data

The table below summarises basic installation data.

Table A-45: Basic installation data

Subject Area	Data
Name	• Staffordshire Energy Recovery Facility
Operator	• Veolia UK
Location / Address	• Four Ashes, Wolverhampton WV10 7DF
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial
Capacity tonnes / annum total	• 340 ktpa
Number of lines	• 2
First operation date	• May 2014
Main supplier / OEM (grate/boiler/furnace lead)	• CNIM
Main supplier SNCR/ FGT	• No information

A.12.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.12.2.1 Techniques Deployed

Table A-46: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	?	?	• Before trials oxygen set point was maintained at 7.3%. • Limited information in trial report.
	Oxygen set point (% excess)	Y	Y	
	Waste feed control	?	?	
	FGR	N	N	• There is no flue gas recirculation system.
Secondary	SNCR	Yes	Yes	• This SNCR system dilutes 25% ammonia with demineralized water for combustion chamber injection. • It has two levels with six nozzles, operating one level based on NO_x levels and roof temperature.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	SCR	No	No	• Not noted in report.
	Catalytic filter bags	No	No	• Not noted in report.
	Wet scrubber (NH ₃ polish)	No	No	• Not noted in report.

A.12.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-47: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Liquid ammonia	Liquid ammonia	
Concentration etc	25%	25%	
Dose rate kg/tMSW	2.3	2.3-3.3	• At the TEV of 170 mg/Nm ³ , an increase of approximately 17% in reagent consumption was observed compared to the consumption at the initial setpoint of 200 mg/Nm ³ . Specifically, the consumption increased to 2.8 kg/tMSW for Line 1 and 3.3 kg/tMSW for Line 2.
Number of injection levels	2	2	
Number of injection points (total)	6	6	
SNCR control system	Y	Y	• The SNCR system's efficacy is optimized by adjusting the ammonia concentration and the orientation of the injection nozzles to ensure effective dispersion and reaction with the flue gases.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	N	Y	• When the roof temperature is below 700C, the system injects the reagent using the lower nozzles, whereas above this temperature the upper nozzles will be in service.

A.12.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-48: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180	?	160	• Staffordshire ERF is able to operate for long periods at emission levels below 170 mg/Nm ³ although due to the reasons mentioned below it is not able to operate at lower target emission levels on a permanent basis.



Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
					Reasons given include lack of safety margin, feedstock variation impacts, and increased reagent consumption (+17% at 170 than 200 mg/Nm³ rate), increased ammonia slip.
NH ₃ (air) mg/Nm ³ daily average	15	3-9	15	?	- On line 2 at the maximum dosing rate, the ammonia slip was approximately 9 mg/Nm³ compared to the usual rate of about 5 mg/Nm³. - Line 1 performance better, with slip below 5 at lower set points and usually 2-3mg/Nm³.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	0-3.5	During the NO_x trials nitrous oxide (N₂O) emissions were not measured continuously. However, a representation of the N₂O emissions throughout 2022, as presented in the document, indicates that these values were recorded as low and stable over the year.
Residue quality	N	N	N	N	During the trials, no cross-media effects on residue quality were detected despite the changes in operational parameters aimed at meeting the new NO_x emission level (ELV) of 180 mg/Nm³.

A.12.3 Key Observations

- Staffordshire ERF can comply with new BAT-AEL standards of 180 mg/Nm³ NO_x and 15 mg/Nm³ NH₃ slip without capital modifications.
- Trials were stopped at 150 mg/Nm³ because NH₃ slip (line 2) had increased from a usual rate of around 5mg/Nm³ to 9 mg/Nm³ and an increase in reagent consumption of approx. 17%.
- Ammonia slip peaked at 9 mg/Nm³ on Line 2 during maximum dosing, below the 15 mg/Nm³ limit. Line 1 typically registered 2-3 mg/Nm³.
- Nitrous oxide (N₂O) emissions in 2022 were reported as low and stable, although not continuously monitored.
- Optimisation prior to trials improved nozzle orientation and reagent dilution, with an oxygen set point of 7.3%.
- The system employs two levels of nozzles, activated based on NO_x emissions and roof temperature.
- A spare injection level is present but unused (no explanation provided).
- Lowering the NO_x setpoint increased reagent consumption with a 0.5 kg/tMSW increase for Line 1.
- Overall, the trial appears to have been stopped somewhat short i.e. with a limited indication of changes / compromise / optimisation points having been reached. In particular this is the case for line 1, where NH₃ slip remained low at the lowest NO_x set points investigated.



A.12.4 EA Recommended Actions

Evaluation of the IC return information suggests:

- As the trials have been stopped at a relatively high NO_x target / set point, without clear indication of constraint points being reached, there is a case for further trials to investigate lower NO_x emission set points.
- This is particularly the case for line 1, where low NH₃ slip was noted.
- The reasons for different line performance needs further investigation, with the potential to pass on learning points and achieve lower overall plant emissions.
- There is already some evidence that a lower ammonia ELV may be considered, around 10 mg/Nm³ although this will be dependent upon the outcome of the further investigations suggested here.
- Further areas for investigation / consideration during further trials and reporting include:
 - why the third injection level is not used / how it may contribute
 - the role of combustion optimization / primary measures
 - justify the absence of Flue Gas Recirculation (FGR).
 - assess NO_x reduction benefits versus plant operational cost increments



A.13 Exeter Energy from Waste

A.13.1 Basic Data

The table below summarises basic installation data.

Table A-49: Basic installation data

Subject Area	Data
Name	• Exeter Energy from Waste
Operator	• Paprec Energies Cyclerval Ltd
Location / Address	• Grace Rd S, Marsh Barton, Exeter EX2 8QE
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial
Capacity tonnes / annum total	• 60 ktpa
Number of lines	• 1
First operation date	• July 2014
Main supplier / OEM (grate/boiler/furnace lead)	• Cyclerval oscillating kiln
Main supplier SNCR/ FGT	• Fuel Tech

A.13.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.13.2.1 Techniques Deployed

Table A-50: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	Y	Y	• Continuous optimization of combustion parameters. • Balancing waste bed depth with waste feed, gas flow, and cell rotation. • Oxygen content at the Continuous Emission Monitoring Systems (CEMS) platform was closely monitored and upheld at optimal levels.
	Oxygen set point (% excess)	Y	Y	
	Waste feed control	Y	Y	
	FGR	N	N	• No flue gas recirculation system.
Secondary	SNCR	Yes	Yes	• Injectors operating at two levels.
	SCR	No	No	



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	Catalytic filter bags	No	No	
	Wet scrubber (NH ₃ polish)	No	No	

A.13.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-51: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Liquid urea	Liquid urea	
Concentration etc			
Dose rate kg/tMSW	0.86-1.49	1.49-2.71	Urea consumption during the trial was 81% higher than usual.
Number of injection levels	2	2	
Number of injection points (total)	4	4	
SNCR control system	Y	Y	Injectors operating at two levels, allowing for a balanced injection of the urea solution.
Injection location optimisation applied. Y/N (e.g., for temperature zones)	N	Y	DENOX has been subject to minor adjustments since commissioning to improve response to detected emissions and optimise resource use.

A.13.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-52: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180	160	150	Plant achieved the future target of 180 mg/m³ and reduced further to 145 mg/m³. However, at this level, the operator noted negative effects.
NH ₃ (air) mg/Nm ³ daily average	?	0.10-0.3	?	?	The half-hourly average NH₃ emission was 0.2 mg/Nm³, with a maximum of 0.3 mg/Nm³ and a minimum of 0.1 mg/Nm³.
N ₂ O (air) mg/Nm ³ daily average	?	7-11.8	?	?	Daily average level increased from 7 to 11.8 mg/Nm³ when moving from 188 to 145 mg/Nm³ NO_x
Residue quality	N	N	N	N	During the trials, no cross-media effects on residue quality were detected despite the changes in operational parameters aimed at meeting the new NO_x emission level (ELV) of 180 mg/Nm³.



A.13.3 Key Observations

- The plant is of a different design to others in the fleet, which appears to introduce certain constraints.
- The plant appears to be capable of meeting the NO_x target of 180 mg/m³.
- At an average target of 145 mg/m³, there are potential adverse impacts including increases in reagent consumption, N₂O, and NH₃ emissions, exceeding the design capacity of the NO_x system.
- The operator optimizes combustion and emission control by managing several key parameters and maintaining consistent waste input.
- There is no flue gas recirculation system in place.
- The DeNO_x system uses a two-level injector system for urea injection, optimized by SCADA which led to lower NO_x emissions but a slight increase in ammonia slip.
- The system's urea consumption during trials was 81% higher than usual, which would mean an additional annual consumption of about 55 tonnes.
- There was no negative impact on bottom ash composition; the APCr showed an increase in compounds of ammonia and reduced nitrogen but not enough to affect treatment processes.
- The plant maintained operational stability during trials.

A.13.4 EA Recommended Actions

Evaluation of the IC return information suggests:

- An AEL of 180 mg/Nm³ would appear appropriate combined with longer-term investigations for operating at lower target levels, although basic design of the facility appears to limit opportunity for major improvements without substantial investments.
- These longer-term assessments may include assessment of optimization of combustion conditions and controls, and the role of the SNCR system, as well as the long-term impacts on residue quality.
- Very low slip level on the trials indicates there is room to apply a lower NH₃ ELV.



A.14 SELCHP

A.14.1 Basic Data

The table below summarises basic installation data.

Table A-53: Basic installation data

Subject Area	Data
Name	• South East London Combined Heat & Power Ltd
Operator	• Veolia UK
Location / Address	• Landmann Way, London SE14 5RS
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial
Capacity tonnes / annum total	• 464 ktpa
Number of lines	• 2
First operation date	• 1994
Main supplier / OEM (grate/boiler/furnace lead)	• CNIM ?
Main supplier SNCR/ FGT	• No information

A.14.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and doses rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.14.2.1 Techniques Deployed

Table A-54: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	?	Y	• Control of (Primary) and (Secondary) air. • The excess O ₂ level was maintained at 8.0% (wet) at the combustion chamber outlet.
	Oxygen set point (% excess)	?	Y	
	Waste feed control	?	N	
	FGR	N	N	• No flue gas recirculation system.
Secondary	SNCR	Yes	Yes	
	SCR	No	No	
	Catalytic filter bags	No	No	



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	Wet scrubber (NH ₃ polish)	No	No	

A.14.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-55: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Liquid ammonia	Liquid ammonia	
Concentration etc	33%	33%	33% ammonia solution with no dilution.
Dose rate kg/tMSW	3.26	3.26-4.3	During the trials, the average ammonia consumption was 33% more than pre-trial average consumption.
Number of injection levels	2	2	
Number of injection points (total)	36	36	Two levels with 18 nozzles on each level.
SNCR control system	Y	Y	The control system was optimized by adjusting the spray level flow ratio between the upper and lower-level ammonia lances, with the upper-level flow ratio varying between 50% and 70%.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	?	N	

A.14.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-56: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180	180	170	- The plant, initially designed for NO_x emissions above 450 mg/Nm³ and retrofitted in 2005 to meet 200 mg/Nm³, faces challenges in achieving the new 180 mg/m³ target. - Achieving levels between 160 and 170 mg/m³ is considered unsustainable long-term due to a 33% increase in ammonia consumption.
NH ₃ (air) mg/Nm ³ daily average	15	2-9	15	?	This data indicates that the emissions were generally low, with occasional higher peaks but still maintaining an overall low average.



Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
N ₂ O (air) mg/Nm ³ daily average	?	?	?	?	Not discussed.
Residue quality	N	N	N	N	During the trials, no cross-media effects on residue quality were detected.

A.14.3 Key Observations

- Trials indicate that the current design configuration is unlikely to achieve more than marginal emission reductions without significant change & investment, although that compliance with 180 mg/Nm³ can be achieved.
- Both Line 1 and 2 exceeded the trial target emission values, with ammonia consumption increases taken as the trigger for trial termination.
- A 45% increase in ammonia slip was observed, along with the risk of depleting ammonia supply and potential equipment failures.
- No substantial increase in N₂O levels was noted.
- No negative cross-media effects were detected, and there were no significant changes in residue content.
- Control of primary and secondary air was used to maintain an 8.0% excess O₂ level for NO_x control.
- No flue gas recirculation system is present.
- The NO_x reduction system, retrofitted in 2005, uses ammonia as a reagent for emissions reduction.
- The control system's flow ratio between the upper and lower ammonia lances was adjusted for optimization.
- Ammonia consumption increased by 33% during the trials to 4.9 L/tMSW.

A.14.4 EA Recommended Actions

Evaluation of the IC return information suggests:

- EAL of 180 mg/Nm³ is appropriate given the current plant configuration and constraints noted e.g. NH₃ slip increase and peaking.
- Further assessment of potential additional / optimisation measures, including the current SNCR system to determine the potential for upgrades or enhancements.
- Consider in this the plant's scale, location, and environmental context when assessing the justification for additional measures against the plant's age and remaining operational lifetime.



A.15 Ferrybridge 1

A.15.1 Basic Data

The table below summarises basic installation data.

Table A-57: Basic installation data

Subject Area	Data
Name	• Ferrybridge 1
Operator	• Enfinium
Location / Address	• Knottingley WF11 8DX
Location Character (Industrial/ Urban/Rural/ Mixed)	• Mixed
Capacity tonnes / annum total	• 725 ktpa
Number of lines	• 2
First operation date	• May 2014
Main supplier / OEM (grate/boiler/furnace lead)	• HZI
Main supplier SNCR/ FGT	• No information

A.15.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.15.2.1 Techniques Deployed

Table A-58: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	Y	Y	• During trials multiple combustion controls were employed including, the NO_x set point, steam flow, oxygen levels at the boiler exit, flue gas flow/ID fan flow, boiler temperature, and the ammonia injection rate. • In addition, WIC (waste incineration system) This system was last optimized as part of the NO_x reduction system in July 2022.
	Oxygen set point (% excess)	Y	Y	
	Feed rate control	?	N	



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	FGR	N	Y-?	A portion of the furnace flue gas is recirculated back into the main combustion chamber.
Secondary	SNCR	Yes	Yes	
	SCR	No	No	
	Catalytic filter bags	No	No	
	Wet scrubber (NH ₃ polish)	No	No	

A.15.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-59: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Liquid ammonia	Liquid ammonia	
Concentration etc	25%	25%	
Dose rate kg/tMSW	0.79	0.79- 4744	- At a NO_x setpoint of 150 mg/Nm³, the ammonia consumption increased on average by 887 litres every 20 mg/Nm³ reduction from the 150 mg/Nm³ setpoint. - The peak ammonia consumption was 4744 litres at a setpoint of 80 mg/Nm³, representing a 650% increase compared to the 150 mg/Nm³ setpoint.
Number of injection levels	4	4	
Number of injection points (total)	8	8	
SNCR control system	Y	Y	The SNCR system is controlled to optimize the injection rate and distribution of the reagent.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	?	?	Dynor Injection System, to target effective injection of ammonia into the furnace.

A.15.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-60: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180	?	150	- The trials explored a range of NO_x set points, starting from the normal operation set point of 180 mg/Nm³. The set point was then progressively reduced in stages, reaching as low as 60 mg/Nm³. - A level of 150 mg/Nm³ is considered too low for various reasons including on account for calculated additional CO₂ emissions (not validated).
NH ₃ (air) mg/Nm ³ daily average	15	4.39	15	?	Maximum 4.39 mg/Nm³ at 80 mg/Nm³ NO_x.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	?	The operator mentioned the daily average concentration of N₂O measured below the limit of analyser resolution throughout the trial. However no exact figures are discussed.
Residue quality	N	N	N	N	- Nitrogen-containing in the IBA increased in concentration as the dosing increased, peaking at a NO_x setpoint of 120 mg/m³. This indicates that beyond this setpoint, the nitrogen compounds in the residue start to increase, potentially affecting the quality of the IBA. - As the NO_x set point was reduced further, these nitrogen containing determinants started to decrease in concentration. - However, the trial was terminated at the 80 mg/m³ set point, suggesting that there might be a carry-over of excess nitrogen compounds into other media, such as APCr (air pollution control residue) emissions, at higher dosing levels.

A.15.3 Key Observations

- Trials covered NO_x set points down to as low as 60 mg/Nm³.
- The trial confirmed compliance with 15 mg/Nm³ limits for ammonia down to a set point of 150 mg/m³; significant slip increases were not observed until below 130 mg/m³.
- N₂O levels remained below analyser resolution limits throughout the trial.
- Combustion controls were optimized, including flue gas recirculation to aid in NO_x control.
- The SNCR system uses precise ammonia injection methods and was part of the plant's strategy to meet new NO_x targets.
- Ammonia consumption escalated by 887 litres for every 20 mg/Nm³ reduction from a 150 mg/Nm³ NO_x set point.
- Exponential increases in ammonia slip occurred when the set point was reduced beyond 130 mg/Nm³, peaking at 4.39 mg/Nm³ at an 80 mg/Nm³ NO_x set point.
- Nitrogen compounds in IBA increased with dosing, potentially affecting residue quality.



- Operational and financial challenges related to ammonia storage and handling do appear to pose constraints on lower NOx set point reductions.
- A boiler tube leak caused a trial suspension, but overall, the plant maintained operational stability during trials.

A.15.4 EA Recommended Actions

Evaluation of the IC return information suggests:

- A new NOx EAL of 180mg/Nm³ would appear to be relatively easy to comply with at this plant.
- Trial suggests target a set point (TEV) around 150mg/Nm³ achievable without significant challenges.
- A long-term goal of moving towards an EAL of 150mg/Nm³ may be evaluated.
- The EA may consider implementing a lower NOx ELV with iro 5mg/Nm³.
- The operator reported a low cost of compliance with 180mg/Nm³ (£532/yr) so any increase then appears significant. Data reported was £387k / year to achieve 150 mg/Nm³ set point, £948K for 130 set point (and incrementally up to £2.5M for 80 set point).
- Comparison of the above direct reagent cost vs NOx damage costs¹⁸ may be appropriate when assessing the optimum.
- The unusually low emission levels suggest there may be a need to verify reported N₂O emission levels.

¹⁸ UK average NOx damage cost are in the range of £1500 to £30,000/t of NOx have been estimated (ref https://uk-air.defra.gov.uk/assets/documents/reports/cat09/2301090900_Damage_cost_update_2023_Final.pdf)



A.16 Beddington ERF

A.16.1 Basic Data

The table below summarises basic installation data.

Table A-61: Basic installation data

Subject Area	Data
Name	• Valencia - Beddington Power Plant
Operator	• Viridor
Location / Address	• 105 Beddington Ln, Croydon CR0 4TD
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial
Capacity tonnes / annum total	• 350 ktpa
Number of lines	• 2
First operation date	• 2018
Main supplier / OEM (grate/boiler/furnace lead)	• CNIM
Main supplier SNCR/ FGT	• No information

A.16.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and doses rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.16.2.1 Techniques Deployed

Table A-62: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	?	?	• Not noted in report.
	Oxygen set point (% excess)	?	?	
	Feed rate control	?	?	
	FGR	N	N	• There is no flue gas recirculation system.
Secondary	SNCR	Yes	Yes	• Injecting solid urea prills into the combustion chamber. • Double-skinned 60m³ Silo.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
				Dosing hopper for feeding urea pneumatically to the combustion chambers, and nozzles at two operating levels in the furnace for even distribution of Urea.
	SCR	No	No	Not noted in report.
	Catalytic filter bags	No	No	Not noted in report.
	Wet scrubber (NH ₃ polish)	No	No	Not noted in report.

A.16.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-63: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea prills	Urea prills	
Concentration etc	25%	25%	
Dose rate kg/tMSW	1.6t/d	2.35-2.61t/d	- At the 120 mg/Nm³ setpoint, the urea consumption increased to about 2.35 tonnes per day, and further increased to 2.61 tonnes per day at the 110 mg/Nm³ setpoint. - At a set point of 165mg/Nm³ NO_x, NH₃ was under 2mg/Nm³ and urea consumption mostly in the 30-40 kg/h range.
Number of injection levels	2	2	
Number of injection points (total)	6	6	
SNCR control system	Y	Y	- The system has two different levels of injection available on the boiler walls. These nozzles are installed on the boiler front wall with adjustable supports to change the angle of injection. - The high level has 2 rows x 3 nozzles for high boiler loads, and the low level also has 2 rows x 3 nozzles for low boiler loads.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	N	N	Not discussed.

A.16.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-64: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180	180	160	- Staffordshire ERF is able to operate for long periods at emission levels below 170 mg/m³ although due to the reasons mentioned below it is not able to operate at lower target emission levels on a permanent basis. - Reasons given include lack of safety margin, feedstock variation impacts, and increased reagent consumption (+17% at 170 than 200 mg/Nm³ rate), increased ammonia slip.
NH ₃ (air) mg/Nm ³ daily average	15	2-8	15	?	Tests in 120 - 100 mg/Nm³ range, gave NH₃ in range 2 - 5 mg at 120 and 5-8 at 100, with Urea consumption increasing to 50-65 kg/h.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	?	Not given.
Residue quality	N	N	N	N	During the trials, no cross-media effects on residue quality were detected.

A.16.3 Key Observations

- The facility has a current NO_x limit of 165 mg/m³.
- Trials considered set points of 120, 110 and 100 mg/Nm³. No data provided in the range 165 to 120 mg/Nm³.
- N₂O is not reported or considered.
- Ammonia slip increased in the trials reaching 8 mg/m³ at the stack when attempting to achieve a NO_x level of 100 mg/m³.
- At a NO_x setpoint of 165 mg/m³, NH₃ was under 2mg/Nm³, and urea consumption was mostly in the 30-40 kg/h range.
- Urea consumption rose to 2.35 tonnes per day at a 120 mg/Nm³ setpoint and further to 2.61 tonnes per day at 110 mg/Nm³.
- Adjustments to injection angles proposed to optimize the system.
- The plant generally operated within normal design and operational ranges during trials.
- The Operator suggests that further NO_x reductions might not be feasible due to increased operational costs and reagent usage.

A.16.4 EA recommended Actions

Evaluation of the IC return information suggests:

- The Operator should explore the NO_x range of 165-120 mg/Nm³.
- Conduct further tests on injection angles and assess NO_x set points between 165 to 120 mg/Nm³ to find the optimal setting.
- Include assessment of N₂O in new trials to fill the current information gap and provide an overall assessment.



- Further trial should consider a full range of approaches, primary combustion as well as abatement.
- Current trials emission data suggests a possibility of setting a lower NH₃ Emission Limit Value (ELV) than the current 12 mg/Nm³.
- Establish a new NO_x ELV based on trial outcomes and consider long-term impacts on residue quality.



A.17 Rookery South Energy Recovery Facility

A.17.1 Basic Data

The table below summarises basic installation data.

Table A-65: Basic installation data

Subject Area	Data
Name	• Rookery South ERF
Operator	• Encyclis Limited
Location / Address	• Green Ln, Stewartby, Bedford MK43 9TH
Location Character (Industrial/ Urban/Rural/ Mixed)	• Semi-rural
Capacity tonnes / annum total	• 585 ktpa
Number of lines	• 3
First operation date	• 2022
Main supplier / OEM (grate/boiler/furnace lead)	• HZI
Main supplier SNCR/ FGT	• DyNOR®

A.17.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.17.2.1 Techniques Deployed

Table A-66: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	N	N	• Oxygen set points were maintained at 3.6% at the boiler exit.
	Oxygen set point (% excess)	N	Y	
	Waste feed control	?	?	
	FGR	N	N	• There is no flue gas recirculation system.
Secondary	SNCR	Yes	Yes	• The first boiler pass is segmented for optimal NO _x reduction, with DyNOR® modules and ammonia injections across six sections.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
				- Ammonia flow is regulated based on NO_x levels, aiming for flue gas temperatures between 850°C and 950°C. - If optimal conditions span two levels, ammonia is injected at both to maximize efficiency.
	SCR	No	No	
	Catalytic filter bags	No	No	
	Wet scrubber (NH ₃ polish)	No	No	

A.17.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-67: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Liquid ammonia	Liquid ammonia	
Concentration etc	Ammonia solution concentration ranges from 10% to 35%	Ammonia solution concentration ranges from 10% to 35%	
Dose rate kg/tMSW	?	0.7 l/tw at 190 2.5 - 3 at 100 3.5 to 4 at 80	The ammonia consumption varied significantly with the setpoints. For instance, at the 100 mg/Nm³ setpoint, the ammonia usage was 3.79 times the normal dosing rate, and at the 80 mg/Nm³ setpoint, it was 5.51 times the normal rate.
Number of injection levels	3	3	
Number of injection points (total)	36	36	
SNCR control system	Y	Y	- The system features three different injection levels in six sections within the post-combustion chamber. - The activation of each level is determined by the temperature measurements at the ceiling of the post-combustion chamber. - Compressed air is used both as a carrier medium for the ammonia water and to cool and clean the nozzles at all injection levels.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	N	N	Not discussed.

A.17.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-68: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	190	100	?	80	190 mg/Nm³ is indicated as the daily average guarantee value. - Trials were carried out at set points of 100 & 80 mg/Nm³ NO_x, with emission levels close to the set points achieved at each. - Increases in reagent consumption (Ammonia) and NH₃ slip were seen at each of 100 and 80 mg/Nm³ set points.
NH ₃ (air) mg/Nm ³ daily average	15	0-17	15	?	- Lowering the NO_x set point below 100 significantly increased ammonia consumption and emissions, peaking at 17 mg/m³ during a set point of 80 mg/m³. - This effect was pronounced during soot-blowing, as ammonia deposited on economiser tubes was dislodged, resulting in emission spikes.
N ₂ O (air) mg/Nm ³ daily average	?	0-8	?	?	- One minute average data is reported and shows good stability across full range of tests. Levels 1.5 mg/Nm³ at 190 increases to 3 and then close to 4 at 100 and 80 mg/Nm³ NO_x set points. - Very few peaks noted, with highest around 8 mg/Nm³ (at 100 NO_x set point).
Residue quality	N	N	N	N	During the trials, no cross-media effects on residue quality were detected.

A.17.3 Key Observations

- Operator confirmed compliance with 180 (and 15 mg/Nm³ NH₃).
- Further reduction trials were only carried out at NO_x set points of 100 and 80 mg/Nm³.
- At the 100 mg/m³ NO_x set point, ammonia consumption increased to 3.79 times the normal rate, and at 80 mg/m³, it increased to 5.51 times the normal rate.
- Ammonia emissions were more “spiky” at the 80 mg/m³ NO_x set point, peaking at a one-minute average of 17 mg/m³ during soot-blowing operations.
- Oxygen set points were maintained (low) at 3.6% at the boiler exit; the ammonia flow was regulated by a control valve and injected for optimal distribution and reaction with NO_x gases.
- The system utilizes different injection levels and was adjusted based on temperature measurements in the post-combustion chamber.
- An increase in nitrogen and ammonia compounds was observed in the IBA over the trial period.
- The APCr showed a fluctuating trend with significant increases in nitrogen and ammonia compounds from the first to the second set point.
- The plant maintained operational stability throughout the trial periods, and it was suggested that further NO_x emission reductions might not be feasible due to the limitations of the current system and the potential for increased operational costs.



A.17.4 EA Recommended Actions

Evaluation of the IC return information suggest that:

- There is a “gap” in trial information between the range from 190 to 100 mg/Nm³, which may be where the true “optimal” level is located.
- This is supported by the main supplier (HZI) calculation table suggesting consumption rates much lower at set points for 125 and 150 mg/Nm³.
- **Further trials in this “gap” range are needed to determine if NO_x reduction can be achieved without the reagent consumption and residue contamination issues noted.**
- Current (incomplete range) trials data suggests some evidence that a NO_x (TEV) set point close to 100 mg/Nm³ may already be considered, with an Emission Limit Value (EAL) within the range of 120 to 140 mg/Nm³ but subject to further trials in the range that was not assessed.
- NH₃ slip levels appear manageable at NO_x target of 100mg/Nm³ but not below that.
- Evaluate the significance of any N₂O increase observed during the trials.
- Noting reported reagent increase rates, compare reagent consumption costs with NO_x damage cost savings.
- Review the long-term impacts on residue quality.



A.18 MVV Environment Devonport Ltd Energy Recovery Facility

A.18.1 Basic Data

The table below summarises basic installation data.

Table A-69: Basic installation data

Subject Area	Data
Name	• MVV Environment Devonport Ltd
Operator	• MED
Location / Address	• Devonport EfW CHP Facility, Creek Road,, Plymouth PL5 1FL
Location Character (Industrial/ Urban/Rural/ Mixed)	• Mixed urban / industrial
Capacity tonnes / annum total	• 275 ktpa
Number of lines	• 1
First operation date	• 2015
Main supplier / OEM (grate/boiler/furnace lead)	• No information
Main supplier SNCR/ FGT	• No information

A.18.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.18.2.1 Techniques Deployed

Table A-70: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	?	Y	• The excess oxygen in the boiler is controlled and maintained by the combustion control system at 6% between ECO (Economizer) 1 and ECO 2 and 7% at the stack.
	Oxygen set point (% excess)	?	Y	
	Feed rate control	N	N	
	FGR	N	N	• There is no flue gas recirculation system.
Secondary	SNCR	Yes	Yes	• This urea is mixed with demineralized water in a metering station and then injected into the first pass of the system. • The injection occurs at two different levels, depending on the temperature.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	SCR	No	No	
	Catalytic filter bags	No	No	
	Wet scrubber (NH ₃ polish)	No	No	

A.18.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-71: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Liquid Urea	Liquid Urea	
Concentration etc	25%	25%	
Dose rate kg/tMSW	600 kg/h	600-4525 kg/h	Urea usage increased from a daily average of 757 kg to 4525 kg, a factor of 6 increase, to reduce the NO_x daily average from 187 mg/Nm³ to 70.5 mg/Nm³.
Number of injection levels	3	3	
Number of injection points (total)	?	?	
SNCR control system	Y	Y	Adjustments to flow calculations and manual valves improved system efficiency at reduced NO_x setpoints.
Injection location optimisation applied. Y/N (e.g. for temperature zones)		Y	SNCR system with temperature-optimized urea injection and flue gas recirculation.

A.18.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-72: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180	?	165	- The trial concluded that the lowest daily average NO_x level achievable with the installed SNCR system is approximately 70 mg/Nm³. - Operator suggests 165 mg/Nm³ set point for an ELV of 180.
NH ₃ (air) mg/Nm ³ daily average	?	15.98	?	?	During the trial, ammonia slip increased from a daily average of 0.6 mg/Nm³ to 3.2 mg/Nm³. The latter figure at set point of 70 mg/Nm³ NO_x. This level led to heavy Ammonia Chloride salt buildup within five days. This buildup caused damage to dust probes



Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
					and was expected to cause similar corrosive effects in other parts of the plant. AT set points from 110 to 180 mg/Nm³ NO_x NH₃ daily average slip levels ranged from 0.97 mg/Nm³ down to 0.60 mg/Nm³.
N ₂ O (air) mg/Nm ³ daily average	?	0.30-9.64	?	?	- AT 30 mg/Nm³ there was a significant increase in N₂O production. - Normal daily average 0.3mg/Nm³ to 9.64mg/Nm³. N₂O is a far more significant greenhouse gas than CO₂.
Residue quality	N	N	N	N	During the trials, no cross-media effects on residue quality were detected.

A.18.3 Key Observations

- The trial was thoroughly conducted to test system limits in order to reveal potential optimisation areas.
- Trial NO_x emissions were reduced below 100 mg/m³, but with increased reagent consumption and ammonia slip, and indication of higher operational costs and equipment corrosion risks.
- The lowest daily average NO_x level achievable with the installed SNCR system is around 70 mg/m³; however, this level of operation leads to issues such as NH₃ salt formation and rapid corrosion.
- The boiler operates with a low oxygen content but this presents operational challenges over extended periods.
- FGR is used to enhance combustion efficiency and control NO_x levels.
- A notable trial incident involved the failure of a dust probe due to ammonium chloride salts build-up, a direct consequence of increased ammonia slip.
- Urea usage increased sixfold when trying to reduce the daily average NO_x level from 187 to 70.5 mg/Nm³.

A.18.4 EA Recommended Actions

Evaluation of the IC return information suggest that:

- Set the permit Emission Limit Value (EAL) at 180 mg/Nm³.
- EA may request the operator to perform a longer-term assessment of a NO_x set point in the range of 140-160 mg/Nm³.
- Consider setting a lower NH₃ Emission Limit Value (ELV) – noting the plant trial demonstrated low and stable ammonia levels down to a 110 mg/Nm³ NO_x set point.
- Evaluate the sensitivity of N₂O emissions at NO_x set points below 120 mg/Nm³ and compare it with the stability at a 150 mg/Nm³ set point.
- Assess whether the costs associated with achieving NO_x set points between 140-160 mg/Nm³ are justified compared to the damage costs avoided by lower NO_x emissions.



A.19 Ferrybridge 2

A.19.1 Basic Data

The table below summarises basic installation data.

Table A-73: Basic installation data

Subject Area	Data
Name	• Enfinium Ferrybridge 2
Operator	• Enfinium Ferrybridge 2 Ltd
Location / Address	• Fryston Ln, Knottingley WF11 8AJ
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial
Capacity tonnes / annum total	• 725 ktpa
Number of lines	• 2
First operation date	• 2019
Main supplier / OEM (grate/boiler/furnace lead)	• HZI
Main supplier SNCR/ FGT	• No information

A.19.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.19.2.1 Techniques Deployed

Table A-74: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	Y	Y	• In March 2022, Hitachi Zosen Inova carried out an optimisation of the combustion control system, demonstrating successful operation with less excess air. • This was confirmed by an internal test by enfinium staff in October 2022. The rate of ammonia injection is automatically controlled based on continuous analysis of the NO_x concentrations in the flue gas. • Secondary combustion air is injected into the combustion chamber above the fuel, ensuring good mixing of flue gases and controlling combustion.
	Oxygen set point (% excess)	Y	Y	
	Feed rate control	?	?	



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	FGR	Y	Y	A portion of the furnace flue gas is recirculated into the main combustion chamber, reducing peak combustion temperature and lowering the oxygen percentage in the combustion air/flue gas mixture, thus retarding the formation of thermal NO_x.
Secondary	SNCR	Yes	Yes	- This urea is mixed with demineralized water in a metering station and then injected into the first pass of the system. - The injection occurs at two different levels, depending on the temperature.
	SCR	No	No	
	Catalytic filter bags	No	No	
	Wet scrubber (NH ₃ polish)	No	No	

A.19.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-75: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Liquid ammonia	Liquid ammonia	
Concentration etc	25%	25%	
Dose rate kg/tMSW	0.65 to 0.8 l/tmsw	0.8-3.33 l/tmsw	The average ammonia consumption during the trials at reducing set points was 2.17 litres per tonne of waste. Peak ammonia consumption at the set point of 70 mg/Nm³ was 3.33 litres per tonne of waste, which was between 4 and 6.5 times the consumption rate at normal operational levels.
Number of injection levels	4	4	
Number of injection points (total)	8	8	
SNCR control system	Y	Y	- The rate of ammonia injection is automatically controlled based on the continuous analysis of NO_x concentrations in the flue gas. - This ensures that the amount of ammonia injected is appropriate for the level of NO_x present, optimizing the reduction process while minimizing ammonia slip.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	?	N	Not given.



A.19.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-76: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	170	160	?	150	(ELV) of 180 mg/Nm³ is achievable with the installed SNCR technology. - Operating below the current ELV of 180 mg/Nm³ would significantly increase operational costs and risk negative environmental impacts.
NH ₃ (air) mg/Nm ³ daily average	?	1-6.7	?	?	- The ammonia slip increases from a NO_x setpoint of 130 mg/Nm³ and lower. - The peak ammonia slip was observed at 6.7 mg/Nm³ at a NO_x setpoint of 80 mg/Nm³.
N ₂ O (air) mg/Nm ³ daily average	?	2-2.5	?	?	- The APCr showed increased nitrogen and ammonia, indicating SNCR system carryover beyond a 90 mg/Nm³ setpoint. - Nitrogen determinants in IBA rose with dosing down to 110 mg/Nm³, peaking at 90 mg/Nm³, suggesting carryover at high dosing levels into other media.
Residue quality	N	N	N	N	During the trials, no cross-media effects on residue quality were detected.

A.19.3 Key Observations

- With the current combustion / SNCR design configuration, lowering the daily average NO_x value to 150 mg/Nm³ appears already technically possible.
- Such a reduction is associated with a 36% increase in ammonia reagent use, and minimal impact on N₂O and NH₃ emissions (which do not escalate more significantly until the NO_x setpoint is below 130 mg/Nm³).
- N₂O levels remained consistent across the entire range tested, and no substantial increase was reported.
- Optimizations carried out by Hitachi Zosen Inova on the combustion control system in March 2022 showed successful operation with reduced excess air, which may provide a basis for further NO_x reductions without / with reduced constraints reported.
- The average ammonia consumption during trials at reducing setpoints was 2.17 Liters per tonne of waste, with peak consumption at 3.33 Liters per tonne at a setpoint of 70 mg/Nm³, significantly higher than normal operational levels.
- Interruptions during the trial due to ammonia supply issues and safety concerns highlighted operational and safety challenges associated with higher ammonia levels.
- The Operator reported that further NO_x reductions beyond current levels might lead to an unsustainable increase in operational costs, with ammonia consumption significantly rising with each reduction in NO_x setpoint, presenting a substantial financial impact.



- The extrapolated annual costs (2022) operating at setpoint 170mg/Nm³ are £409,580.81, increasing to £1,591,450.22 when operating at setpoint 70mg/Nm³.
- Conversely, the combustion optimisation report suggests that lower NO_x levels might be achieved without such SNCR reagent cost increases.

A.19.4 EA Recommended Actions

Evaluation of the IC return information suggest that:

- Whilst the Operator suggests an NO_x set point (TEV) of 170mg/Nm³, the trial data (including the combustion optimisation work) appears to show that a somewhat lower TEV may already be achievable. The trial data suggests a NO_x set point around 150 mg/Nm³ and lower ammonia (NH₃) ELV around 5 mg/Nm³ is achievable – the EA should collaborate with the operator to explore this lower level.
- There is a possibility of combining combustion optimization, such as O₂ reduction, with SNCR strategies the goal of achieving NO_x set points below 150 mg/Nm³, while evaluating the long-term impacts on plant operations and maintenance, including stability regarding fuel variations, and short-term spikes in CO and VOC emissions.
- When pursuing a combustion optimization approach, it would also be prudent to also conduct additional checks for nitrous oxide (N₂O) emissions (although low levels were already reported in trials to date).
- If targeting NO_x set points in the range of 110 to 170 mg/Nm³, also assess the quality of residues produced within this range.



A.20 Lakeside Energy from Waste Ltd

A.20.1 Basic Data

The table below summarises basic installation data.

Table A-77: Basic installation data

Subject Area	Data
Name	• Lakeside Energy From Waste Ltd
Operator	• Lakeside EFW
Location / Address	• Lakeside Rd, Slough SL3 0FE
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial
Capacity tonnes / annum total	• 464 ktpa
Number of lines	• 2
First operation date	• 2010
Main supplier / OEM (grate/boiler/furnace lead)	• ?
Main supplier SNCR/ FGT	• No information

A.20.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and doses rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.20.2.1 Techniques Deployed

Table A-78: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	?	?	• No information given.
	Oxygen set point (% excess)	?	?	
	Feed rate control	?	?	
	FGR	N	N	• There is no flue gas recirculation system.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Secondary	SNCR	Yes	Yes	Flue gas treatment is handled by an SNCR system using ammonia currently, injected into the furnace at a fixed location, followed by a flue gas recirculation system returning a percentage of the flue gas to lower the furnace oxygen concentration and help lower the NO_x level.
	SCR	No	No	
	Catalytic filter bags	No	No	
	Wet scrubber (NH ₃ polish)	No	No	

A.20.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-79: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Liquid ammonia	Liquid ammonia	
Concentration etc	30%	30%	
Dose rate kg/tMSW	?	?	Not given.
Number of injection levels	3	3	
Number of injection points (total)	6	6	
SNCR control system	Y	Y	- Adjustments to flow calculations and manual valves improved system efficiency at reduced NO_x setpoints. - MED installed a SNCR system with temperature-optimized urea injection and flue gas recirculation, maximizing efficiency.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	?	N	Report conclusions propose modifications to the SNCR system based upon B&W assessments.

A.20.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-80: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	?	?	?	?	Report contains no trial results, but does discuss CFD work carried out by B&W to investigate SNCR optimisation, with a focus on location of appropriate temperature zones and reagent types.



Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NH ₃ (air) mg/Nm ³ daily average	?	0.01-0.18	?	?	The daily average is 0.01 mg/Nm³ with a high of 0.18 and a low of 0.00 mg/Nm³.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	?	Not given.
Residue quality	N	N	N	N	During the trials, no cross-media effects on residue quality were detected.

A.20.3 Key Observations

- The trial report includes CFD work by B&W to optimize SNCR with emphasis on temperature zones and reagent types for emissions control, but it **does not include NO_x reduction trial results**.
- Historical emission data presented indicates a NO_x daily average of 159.24 mg/Nm³ with a peak of 179.26 mg/Nm³ and a minimum of 137.43 mg/Nm³, which is compliant with the new EAL of 180 mg/Nm³.
- Ammonia emissions are relatively low, with a daily average of 0.01 mg/Nm³, peaking at 0.18 mg/Nm³ and at times dropping to 0.00 mg/Nm³.
- There are plans to modify the SNCR system based on B&W assessments which consider a range of factors in the SNCR system. Potential enhancements to the existing system may also include: transitioning from urea to ammonia, updating control systems, flue gas recirculation, and retrofitting the SNCR system based on AGAM.
- Leachability data for IBA and APC indicates historically low levels for nitrate, nitrite, and ammoniacal nitrogen, suggesting that ammonia slip or reduction is unlikely to impact the ash negatively.

A.20.4 EA Recommended Actions

Evaluation of the IC return information suggest that:

- EA to engage with the operator to understand why the trial results have not been provided & determine whether the absence of trials indicates non-compliance, noting the system upgrade proposed.
- Overall, the scale and air quality location sensitivity of this installation combined with the lack of trial data and questions over the objective the NO_x work carried out to date suggest that this site may be a priority for the EA.
- Explore whether the B&W studies' goal was "*compliance with a 180 EAL*" or optimization to a lower level (as is implied by the permit Improvement Condition).
- Understanding the objective of the B&W assessment will help the EA to understand whether the IC has been complied with. It should be noted that the design basis / emissions target for retrofit works may set constraints for future operations and emissions.
- Consider the possibility of applying a lower ammonia Emission Limit Value (NH₃ ELV) and evaluate the performance of the proposed new system in practice.



- Ask the operator to consider a fuller range of NOx reduction measures and targets levels including CNR optimisation as well as combustion/ primary-related matters.



A.21 Newlincs EfW Facility

A.21.1 Basic Data

The table below summarises basic installation data.

Table A-81: Basic installation data

Subject Area	Data
Name	• Newlincs EfW facility
Operator	• Newlincs Developments, TIRU
Location / Address	• Yorkshire and the Humber
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial
Capacity tonnes / annum total	• 56 ktpa
Number of lines	• 1
First operation date	• 2004
Main supplier / OEM (grate/boiler/furnace lead)	• Tiru – oscillating kiln
Main supplier SNCR/ FGT	• ?

A.21.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.21.2.1 Techniques Deployed

Table A-82: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	Y	Y	• The homogenization of MSW ensures a steady burn, careful control of combustion temperatures, the use of low-NO _x secondary burners, and the automatic control of combustion air.
	Oxygen set point (% excess)	Y	Y	
	Feed rate control	Y	Y	
	FGR	N	N	• There is no flue gas recirculation system.
Secondary	SNCR	Yes	Yes	• The SNCR system was installed before 2004 with the primary objective of reducing NO _x emissions from 300 mg/m ³ to 200 mg/m ³ .



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
				Operating close to its lower limit, this system has historically performed well without the need for upgrades or optimization.
	SCR	No	No	
	Catalytic filter bags	No	No	
	Wet scrubber (NH ₃ polish)	No	No	

A.21.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-83: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Liquid Urea	Liquid Urea	
Concentration etc	30%	30%	
Dose rate kg/tMSW	1.31	1.31-2.54	- Under normal operating conditions, the urea consumption was 1.31 kg per tonne of waste. - However, when the ELV was adjusted to 180 mg/m³ (with a DeNO_x system setpoint of 170 mg/m³), the urea consumption rose to 2.09 kg per tonne of waste, marking a 60% increase in reagent consumption.
Number of injection levels	2	2	
Number of injection points (total)	4	4	
SNCR control system	?	?	There was a consideration to increase the concentration of the urea solution from 30% to 32.5%, but this was not expected to significantly reduce emissions beyond the lowest level achieved during the trial.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	?	?	Not given.

A.21.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-84: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180	?	170	- Initially, baseline data was collected at a NO_x setpoint of 190 mg/Nm³ to meet the current Emission Limit Value (ELV) of 200 mg/Nm³. - Subsequently, trials were conducted at two additional setpoints: 170 mg/Nm³ to meet an ELV of 180 mg/Nm³, and 160 mg/Nm³ to meet an ELV of 170 mg/Nm³.
NH ₃ (air) mg/Nm ³ daily average	?	0.01-0.02	?	?	
N ₂ O (air) mg/Nm ³ daily average	?	9.66-15.9	?	?	At 190 daily averages approx. 10 mg/Nm³, 11-13 at 170, and 11-16 at 160 mg/Nm³ (set point 170 mg/Nm³).
Residue quality	?	Y	?	Y	- The content of ammoniacal nitrogen and total Kjeldahl nitrogen in the samples varied with different NO_x Emission Limit Values (ELVs). - For instance, on October 12, 2023, at an ELV of 170 mg/m³, the ammoniacal nitrogen content was significantly higher at 61.8, compared to 5.8 on September 29, 2023, at an ELV of 200 mg/m³. - Similarly, total Kjeldahl nitrogen content also fluctuated, being as low as 2.5 on October 6, 2023, at an ELV of 180 mg/m³, and reaching 7.8 on October 9, 2023, at an ELV of 170 mg/m³.

A.21.3 Key Observations

- The SNCR system, which was designed for an ELV of 200 mg/Nm³, appears to have been pushed to its (current configuration) limits to reach lower NO_x levels, with increases in urea consumption and N₂O noted.
- Attempting to meet an ELV of 170 mg/Nm³ led to a 94% increase in urea use compared to normal operations.
- Lower NO_x levels resulted in higher concentrations of ammoniacal nitrogen and total Kjeldahl nitrogen in residues.
- Trials were halted at the lowest set point due to the SNCR system reaching maximum design limits (pump capacity).
- Operational stability was maintained during trials, but further NO_x reduction appears infeasible without altering system design and additional costs.

A.21.4 EA Recommended Actions

Evaluation of the IC return information suggest that:

- An EAL of 180 mg/Nm³ is achievable, but further reductions are constrained by current plant configuration.
- The operator may explore pump upgrade feasibility as this was a constraint on urea dose rate. In addition, the Operator may be requested to further evaluate costs, sustainability, environmental impact, and safety for potential SNCR upgrades.



- A lower NH₃ ELV may be considered as levels reported were very low across full range tested.
- Assess the trade-off between N₂O and NO_x levels, as N₂O levels were noted to rise.



A.22 Kemsley Energy Recovery Facility

A.22.1 Basic Data

The table below summarises basic installation data.

Table A-85: Basic installation data

Subject Area	Data
Name	• Enfinium Kemsley
Operator	• Enfinium
Location / Address	• Grovehurst Rd, Kemsley, Sittingbourne ME10 2FP
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial
Capacity tonnes / annum total	• 657 ktpa
Number of lines	• 2
First operation date	• 2020
Main supplier / OEM (grate/boiler/furnace lead)	• CNIM
Main supplier SNCR/ FGT	• SAMAT CONSTRUCTIONS MECANIKES – CHAUDRONNERIE

A.22.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.22.2.1 Techniques Deployed

Table A-86: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	?	Y	• The system adjusts air flows, grate speeds, and feeder ram stroke lengths based on the plant's performance at any given time. • The adjustments are made according to feedback from live instrumentation. • This system includes primary, secondary, and tertiary air injection techniques to control NO_x formation.
	Oxygen set point (% excess)	?	Y	
	Feed rate control	?	Y	
	FGR	N	N	• There is no flue gas recirculation system.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Secondary	SNCR	Yes	Yes	- Urea is injected on the front wall of the furnace by one of two separate injection systems (high or low level). - The level selector can be managed in Local/Manual, remote/manual and remote/automatic modes.
	SCR	No	No	Not noted in report.
	Catalytic filter bags	No	No	Not noted in report.
	Wet scrubber (NH ₃ polish)	No	No	Not noted in report.

A.22.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-87: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea	Urea	
Concentration etc	?	?	
Dose rate kg/tMSW	0.42	0.42-1.08	Urea consumption increases immediately from NO_x setpoint 206mg/m³. It peaks at 1.08kg/tonne of waste at setpoint 150mg/m³.
Number of injection levels	3	3	
Number of injection points (total)	30	30	
SNCR control system	Y	Y	- The SNCR system, managed by a DCS, automates NO_x emission control by adjusting the urea dosing screw speed based on flue gas NO_x levels at the stack. - It employs a pneumatic system for urea injection, targeting a QAL2-adjusted NO_x compliance value of approximately 130 mg/Nm³. - Trials on Line 1 (21 days) and Line 2 (7 days) explored NO_x setpoint reductions. - The system adjusts dosing based on a 5-minute moving average of NO_x, with manual setpoint adjustments by operators. - Urea dosing screws have multiple operational modes, and an ammonia threshold of 8mg/Nm³ in stack flue gas triggers setpoint reduction.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	?	?	The level selector can be managed in Local/Manual, remote/manual and remote/automatic modes.



A.22.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-88: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	219	140	?	120	- During the NO_x reduction trials, setpoints ranged from 219 to 120 mg/Nm³, adjusted bi-daily. - The trials showed Line 1 could reach a compliance-adjusted NO_x value of 120 mg/Nm³, surpassing the design goal of 130 mg/Nm³. - Line 2's lowest compliance-adjusted value was 131.97 mg/Nm³, constrained by both dosing screws running at full capacity.
NH ₃ (air) mg/Nm ³ daily average	?	2.74 peak in trial	?	?	Ammonia slip quadrupled from a NO_x setpoint of 206 mg/Nm³, peaking at 2.74 mg/Nm³ when the setpoint was reduced to 169 mg/Nm³, marking the highest daily average in ammonia slip observed.
N ₂ O (air) mg/Nm ³ daily average	4.1	4.1- 12.8	?	?	
?	N	Y	?	Y	- The trial indicated a rising trend in all monitored Air Pollution Control residues (APCr) parameters, implying that heightened urea dosing for reduced NO_x setpoints might elevate ammonia concentrations in the residues. - Conversely, Incinerator Bottom Ash (IBA) concentrations on 22/08/2023 for Line 1 eventually returned to below benchmark levels from standard operations, while Line 2 showed consistent ammonia levels throughout the trial.

A.22.3 Key Observations

- Trial NO_x reduction to 120 mg/Nm³ for Line 1, with Line 2 maxing out dosing capacity.
- Increased ammonia slip was noted as reagent was increased, peaking at a (relatively low level of) 2.74 mg/Nm³ at a NO_x setpoint of 169 mg/Nm³.
- Urea dosing adjustments are based on flue gas NO_x level observations during operations.
- Higher urea usage noted at lower NO_x setpoints, with cost implications also noted. The extrapolated annual costs at a setpoint of 150 mg/Nm³ were £268,755 pa, increasing to £726,915 pa at lower NO_x levels tested (increase approx. £0.8/tw).
- Stable ammonia levels in IBA, but increased ammonia in APCr at higher urea doses may be a constraint on lower NO_x levels.
- No immediate issues from the trial, but long-term operational effects of higher dosing noted as a potential issue.
- Urea site storage and deliveries are noted as a constraint.



- Trials were constrained by urea reagent availability, affecting setpoint goals.
- The plant achieved operational stability within design parameters during trials.
- The operator reported that further NO_x emission reductions may not be feasible due to system limitations and cost concerns. These concerns may be valid, although the test results also appear to indicate that target levels iro 150 mg/Nm³ may be investigated.
- Combustion control (Primary) NO_x reduction measures appear well managed.
- SNCR system design adopts a modern approach, with multiple injection points and NO_x level reagent dose rate control, although exceeding SNCR design capacity is noted as a risk at reduced NO_x levels.

A.22.4 EA Recommended Actions

Evaluation of the IC return information suggest that:

- Noting potential for constraints there appears to be a case to further explore these as part of a longer term “continuous improvement” investigation of NO_x reduction towards an operational target iro 150 mg/Nm³.
- There is already evidence that a reduction in the ammonia ELV may be achieved.
- Assess use of automated reagent dosing link to reagent injection (rather than manual as reported).
- Further assessment / explanation of non-use of FGR by the operator may be sought.
- Further optimisation should include consideration of the long-term impacts on (APCr) residue quality, urea storage and delivery constraints, and gathering more data on the longer-term costs and operational impacts. These may be compared with NO_x damage cost savings.



A.23 Peterborough ERF

A.23.1 Basic Data

The table below summarises basic installation data.

Table A-89: Basic installation data

Subject Area	Data
Name	• Peterborough ERF
Operator	• Viridor
Location / Address	• Fourth Drove, Peterborough PE1 5UR
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial
Capacity tonnes / annum total	• 110 ktpa
Number of lines	• 1
First operation date	• 2015
Main supplier / OEM (grate/boiler/furnace lead)	• ?
Main supplier SNCR/ FGT	• No information

A.23.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.23.2.1 Techniques Deployed

Table A-90: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	?	?	• No discussion.
	Oxygen set point (% excess)	?	?	
	Feed rate control	?	?	
	FGR	?	?	• No information.
Secondary	SNCR	Yes	Yes	• The system utilizes ammonia solution injection at multiple heights in the boiler through ammonia injection lances positioned at strategic heights.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
				This injection process is tailored based on the average temperature at the top of the boiler's first pass, aiming to effectively combat NO_x formation through selective non-catalytic reduction (SNCR).
	SCR	No	No	
	Catalytic filter bags	No	No	
	Wet scrubber (NH ₃ polish)	No	No	

A.23.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-91: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Liquid ammonia	Liquid ammonia	
Concentration etc	25-35%	25-35%	
Dose rate kg/tMSW	2-3 l/t MSW	4-6 l/t MSW	The consumption of the reagent increased over the period of the trials.
Number of injection levels	4	4	
Number of injection points (total)	12	12	
SNCR control system	Y	Y	The SNCR injectors have been elevated to ensure that the ammonia reducing reagent is injected at a point in the boiler where flue gas temperatures are within the optimal range for NO_x reduction efficiency.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	?	Y	The SNCR injectors have been elevated.

A.23.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-92: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	140	140	?	125	- Under normal operating conditions with a set point of 140 mg/Nm³, emissions around 110 mg/Nm³ are achieved, ammonia slip is approximately 1-2 mg/Nm³, and reagent dosing rate is 2-3 L/tMSW. - Reducing the set point to 100 mg/Nm³ results in NO_x emissions around 80 mg/Nm³.



Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NH ₃ (air) mg/Nm ³ daily average	?	1.5-6.1	?	?	- The ammonia slip increases significantly from a NO_x setpoint of 130 mg/m³ and lower. - The peak ammonia slip was observed at 6.1 mg/m³ at a NO_x setpoint of 100 mg/m³.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	?	Not given.
Residue quality	N	N	N	N	During the trials, no cross-media effects on residue quality were detected.

A.23.3 Key Observations

- Plant operation was already compliant with an ELV below 180 mg/Nm³, having an EAL of 150 mg/Nm³, currently achieving NO_x emissions around 110 mg/Nm³ with a normal set point of 140 mg/Nm³.
- Daily average NO_x levels are maintained between 100 and 115 mg/Nm³, below the permit requirement of 150 mg/Nm³.
- During tests the NO_x emissions reduced to iro 80 mg/Nm³ at a set point of 100 mg/Nm³, but NH₃ slip increased.
- Ammonia slip peaked at a NO_x setpoint of 100 mg/Nm³.
- SNCR system appears well optimized with ammonia injections at calculated boiler heights.
- Reagent consumption increased during trials.
- Potential constraints on further NO_x reductions were reported due to system design / operational limitations and increased operational costs.

A.23.4 EA Recommended Actions

Evaluation of the IC return information suggest that:

- Limited additional NO_x target emission values (and indeed EAL) may be achievable, subject to longer term assessment (include N₂O levels), but existing daily average in the range of 100-115mg/Nm³ suggest current performance is good.
- Consideration may be given to reducing the NH₃ ELV without compliance issues.
- Lack of N₂O data undermines test results – consider assessment during routine operations.



A.24 Greatmoor EfW

A.24.1 Basic Data

The table below summarises basic installation data.

Table A-93: Basic installation data

Subject Area	Data
Name	• Greatmoor EfW
Operator	• FCC Recycling (UK) Limited
Location / Address	• Greatmoor Road off, Creighton Rd, Woodham, Aylesbury HP18 0QE
Location Character (Industrial/ Urban/Rural/ Mixed)	• Rural
Capacity tonnes / annum total	• 345 ktpa
Number of lines	• 1 (large) single line
First operation date	• May 2014
Main supplier / OEM (grate/boiler/furnace lead)	• HZI
Main supplier SNCR/ FGT	• No information

A.24.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.24.2.1 Techniques Deployed

Table A-94: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	Y	Y	• The Operator has adopted a "new NO_x control philosophy," adjusting primary/secondary airflows and grate speed for NO_x reduction. • This approach utilizes a turbulent primary combustion chamber to avoid NO_x-forming hot spots, with primary air passing through the grate from the waste bunker.
	Oxygen set point (% excess)	Y	Y	
	Feed rate control	?	?	



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
				- In the secondary chamber, combined secondary air and exhaust from the ash extractor mix with hot gases to enhance combustion, improving flue gas burnout and reducing Carbon Monoxide and corrosion while preventing dioxins and Furans. - This setup ensures optimal SNCR conditions by achieving the correct temperature for NO_x reaction in the secondary chamber.
	FGR	Y	Y	The plant is fitted with recirculation system.
Secondary	SNCR	Yes	Yes	The SNCR system injects a 25% aqueous ammonium hydroxide solution to reduce NO_x to N₂ and H₂O.
	SCR	No	No	
	Catalytic filter bags	No	No	
	Wet scrubber (NH ₃ polish)	No	No	

A.24.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-95: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Liquid ammonia	Liquid ammonia	
Concentration etc	25%	25%	
Dose rate kg/tMSW	1.75l/tMSW	1.75-2.95	- To maintain a daily NO_x emission average of 180 mg/Nm³, ammonia usage was approximately 1.75 litres per tonne of waste. - During the trial's seventh week, aiming for a NO_x set point of 100 mg/Nm³, ammonia consumption peaked at an average of 2.95 litres per tonne, marking a 69% increase from the usage at the 180 mg/Nm³ NO_x level.
Number of injection levels	3	3	
Number of injection points (total)	27	27	
SNCR control system	Y	Y	Injection rates are dynamically controlled based on flue gas NO_x levels, ensuring optimal reduction and minimal ammonia slip.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	?	?	Not given.

A.24.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-96: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180	180	165	The trial explored various NO_x set points ranging from 180 mg/Nm³ down to 100 mg/Nm³.
NH ₃ (air) mg/Nm ³ daily average	?	0.19-2.08	?	?	Low slip to air across range of test.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	?	Operator says that N₂O was measured, but no reported data or discussion.
Residue quality	N	N	N	N	During the trials, no cross-media effects on residue quality were detected.

A.24.3 Key Observations

- Trials in steps down to 100 mg/Nm³ NO_x with ammonia slip under 2 mg/Nm³.
- Ammonia reagent consumption increased at lower NO_x set points.
- At the lowest NO_x set point, ammonia usage increased by 69%.
- Operator suggests a feasible NO_x target of 165 mg/Nm³ without major cost or environmental concerns.
- NO_x control strategy includes a comprehensive approach involving both primary and secondary NO_x measures.
- Large number of injection points and control system is good practice.
- Fine-tuning of SNCR via ammonia injection rates based on NO_x monitoring was performed.
- APCr contamination and operational issues were identified during trials.
- No significant impact on IBA ammonia levels.
- APCr showed increased ammonia and lead levels at lower NO_x set points.
- Operational stability was generally maintained, but lowest NO_x levels appear constrained by the system and cost implications.
- A potential annual increase in operating costs of about £215,000 pa due to higher ammonia usage was noted when targeting 100mg/Nm³.
- Lack of N₂O data undermines overall study conclusions.

A.24.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- An EAL of 180 mg/Nm³ can be complied with and data suggests that a longer-term TEV in the region of 165 mg/Nm³ is currently appropriate.
- The operator should further assess at TEV between 150 to 130 mg/Nm³, considering broader impacts to re-evaluate the feasibility of operating at this lower set point over the long term.



- This should include N₂O assessment to provide a more complete assessment, as well as APCr contamination (already some indication of constraint).
- Very low NH₃ slip suggests that an NH₃ EAL below 15mg/Nm³ may already be considered, but should be reconsidered during further trials targeting 150-130 mg/Nm³ TEV.
- In addition to good practice already deployed for NO_x control, the Operator may consider the integration of thermal monitoring at injection ports.
- Explore reagent storage/delivery issues as part of a broader long-term operational assessment.
- As well as operational, and logistical issues, the further assessment of the lower TEV level suggested should also consider the financial and environmental aspects of emissions management strategies.



A.25 Riverside

A.25.1 Basic Data

The table below summarises basic installation data.

Table A-97: Basic installation data

Subject Area	Data
Name	• Riverside
Operator	• Cory
Location / Address	• Norman Road North, Belvedere DA17 6JY
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial
Capacity tonnes / annum total	• 850 ktpa • Municipal, commercial & industrial waste
Number of lines	• 3 • 90m stack
First operation date	• 2012
Main supplier / OEM (grate/boiler/furnace lead)	• HZI
Main supplier SNCR/ FGT	• No information

A.25.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.25.2.1 Techniques Deployed

Table A-98: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	Y	Y	• Boiler optimisation project has been on-going since 2020 and is due to be completed in 2024. This project reduces the areas in the boiler where NO_x formation occurs. • Primary measures of NO_x reduction optimised prior to commencement of this trial.
	Oxygen set point (% excess)	Y	Y	
	Feed rate control	?	?	



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
				- Beside the optimal adjustment of the ammonia injection an even operation of the incineration process is crucial for an optimum NO_x separation by means of the SNCR process. This is ensured by the following measures: - Integrated combustion control system including an automatic adjustment to the quality of the waste incinerated. - Even oxygen and temperature profiles by means of a swirl created by the secondary air injection. - A prolonged reaction zone for the NO_x-reduction. - Trial O₂ set point 5.29 to 5.71%, normal / design 5%
	FGR	?	?	Not described.
Secondary	SNCR	Yes	Yes	
	SCR	N	N	
	Catalytic filter bags	N	N	
	Wet scrubber (NH ₃ polish)	N	N	

A.25.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-99: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Liquid ammonia	Liquid ammonia	
Concentration etc	24.5%	24.5%	24.5% aqueous ammonium hydroxide solution.
Dose rate kg/tMSW	24-33 @ 170 set point	27-43 @ 150 set point	- Trial used dose rates from 24 to 77 kg/hr. 59 to 77 kg/hr used for 100 mg/Nm³ set point.
Number of injection levels	3	3	Three level on first pass (where NO_x reduction temp range 900-950 C exists).
Number of injection points (total)			No information.
SNCR control system	Y	Y	Regardless of the operating status of the plant, injection takes place at the level in which optimum reaction temperatures prevail.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	Y	Y	Within the first pass, three injection levels exist at different heights.

A.25.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-100: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average			170	150	The trial explored NO_x set points of 150, 135, 120 & 100 mg/Nm³.
NH ₃ (air) mg/Nm ³ daily average	?	?	?	?	Slip increase from iro 3 to 6 mg/Nm³ across trial range.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	?	N₂O levels reported 0.03 to 0.08 mg/Nm³ across three lines, but no association with dose rates.
Residue quality	N	N	N	N	During the trials, no cross-media effects on residue quality were detected.

A.25.3 Key Observations

- Compliance with 180 mg/Nm³ NO_x and 15 mg/Nm³ confirmed.
- 150 mg/Nm³ NO_x set point identified as new set-point from 2024.
- Proposal to repeat NO_x optimisation trial in 2024 after other boiler optimisation projects completed.
- Note that observation of longer-term operational impacts need consideration.
- Trials down to 100 mg/Nm³ NO_x on all lines.
- Ammonia reagent consumption approximately doubled from higher to lower trial NO_x set points.
- NH₃ slip increase from 3-6 mg/Nm³ well within 15 mg/Nm³ EAL.
- NO_x control strategy includes both primary and secondary NO_x measures.
- Multiple injection levels position for temperature zones but number of ports not known.
- Fine-tuning of SNCR via ammonia injection rates based on NO_x monitoring was performed.
- No negative effects were found in the IBA, APCr or filter bag analysis.
- Limited N₂O information and no cost information presented.
- Operator presently developing large scale carbon capture project.

A.25.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- Operator to trial new 150 mg/Nm³ set point, which should include consideration of longer-term operational issues.
- New trial needs to more closely consider & report on N₂O and may provide basis for NO_x EAL reduction in due course – apparent low risk of NH₃ slip issues at present.



- Costs & benefits of maintaining lower emission levels to be explored in new trials – large scale of facility means reductions have greater potential to deliver environmental benefits, but consideration of wider operation risks / cost also needed.
- Consideration of carbon capture project may influence the required NOx emission level (and reduction approaches) from the EFW plant to the carbon capture plant 7 new release points / substances – to be discussed with operator.



A.26 Suez – Tees Valley

A.26.1 Basic Data

The table below summarises basic installation data.

Table A-101: Basic installation data

Subject Area	Data
Name	• STV (SUEZ Tees Valley)
Operator	• SUEZ
Location / Address	• Tees Valley Hwrc, Haverton Hill Road, Billingham TS23 1PY
Location Character (Industrial/ Urban/Rural/ Mixed)	• Urban / industrial
Capacity tonnes / annum total	• L1 &2 259 ktpa (total) • L3 143 ktpa • L4&5 313.6 ktpa (total) • MSW. Mostly HHW, some C&I
Number of lines	• 5
First operation date	• L1&2 1997 • L3 2009 • L4&5 2014
Main supplier / OEM (grate/boiler/furnace lead)	• Various – different phases L1&2 BW Volund, and HZI L3,4&5
Main supplier SNCR/ FGT	• Various – different phases

A.26.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.26.2.1 Techniques Deployed

Table A-102: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control			• L1 The flowrate of primary and secondary air is controlled from WiC, a widely employed combustion control system, to supply adequate oxygen for the combustion process.
	Oxygen set point (% excess)			
	Feed rate control			



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	FGR	N/Y	N/Y	Only on L4 & 5.
Secondary	SNCR	Y	Y	All lines have SNCR.
	SCR	N	N	Not noted in report.
	Catalytic filter bags	N	N	Not noted in report.
	Wet scrubber (NH ₃ polish)	N	N	Not noted in report.

A.26.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-103: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Ammonia	Ammonia	All lines.
Concentration etc	24.5%	24.5%	- All lines. - Diluted for injection.
Dose rate kg/tMSW	L1: 0.879 L2: 1.358 L3: 3.23 L4/5: 1.13-1.31		- Some system errors resulting in higher Ammonia use have been successfully corrected. - L1/2 1.18 – 1.92 (set points 140/136). - L3 0.25 – 0.35 (set points 156-132). - L4 1.02 – 1.58 (set points 175-145). - L5 1.86 – 2.41 (set points 175-145).
Number of injection levels			- L1&2 3 each line – 2 used. - L3 – three levels. - L4&5 – three levels each line.
Number of injection points (total)			- L1&2 20 installed, 4 in use over 2 levels to target optimal T zones. - L3 34 installed, 22 in use over 3 level. - L4&5 72, 36 each line.
SNCR control system	Y	Y	- L1&2 – local temp & CEMs feed via DCS. - L3 – injection locations / rates controlled via DCS – temp & CEMS. - L4&5 – similar to L3. - All have PPM in place.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	Y	Y	- L1&2 <i>Only 4 points are actively used now on each line due to this commissioning and ongoing operational experience regarding the temperature profile of the flue gas.</i> - L3 – dynamic system switches location / dose rates. - L4&5 – as L3.

A.26.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-104: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average			L1&2: 144 to target 180 ELV L3: 156 for 200 ELV	L1/2 set point 144 proposed	- Trials tested various set points down to 132 mg/Nm³ (L3) based upon plant performance history. - CEMs emissions broadly tracked set points during trials (L1 exception where reducing set point from 140 to 135 mg/Nm³ marginal impact).
NH ₃ (air) mg/Nm ³ daily average					- NH₃ levels generally in the range 1-2 mg/Nm³ across all lines, although L5 rises to 7-9 when set point reduced from 165 to 150 mg/Nm³ (and below). - L 4 stable 1-2 mg but increasing when set point reduced from 155 to 145 and more so when reduced below 135 mg/Nm³. - L1 low and stable below 1mg/Nm³ across range tested, line 2 similar but more instability.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	?	No information.
Residue quality	- Some (but inconsistent & limited) evidence of residue contamination at lower trial set points across all lines. - Correlations not clear.				

A.26.3 Key Observations

- Complex site with multiple lines, ages and supplier history but comprehensive trials and reports provided for all lines, although the lowest trials were set at conservative levels (but based upon a balance of known operational risks).
- All lines demonstrated capability to comply with new BATAELs of 180 and 15mg/Nm³, although Nitrous Oxide data requires confirmation.
- Current trial data suggests longer term average target emissions iro 140-150 mg/Nm³ are achievable on all lines (except line 5) with increased reagent use of 30-40%, limited NH₃ slip increases and low risk of residue contamination.
- Line 5 had higher reagent consumption levels and NH₃ slip levels much higher than other lines, which may limit NO_x reduction if further controls / optimisation cannot reduce this. Further internal optimisation investigations (nozzles) can only be carried out during outages.
- Operator suggests that L1 & 2 (older lines) may have reached their limits of optimisation (set point 144 noted) and that further reductions would require larger scale investments.
- Combined installation scale means that total site mass emissions (and impact risks) may be significantly reduced via the achievable NO_x concentration emissions reduction suggested.



A.26.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- Lines 1,2,3 & 4 already appear capable of achieving a longer-term average emission iro 140-150 mg/Nm³
- Further investigation of line 5 limitations may reveal optimisation opportunities, but present performance appears constrained to comply with the new BATAEL. In a relatively new installation with the installed design & control features it is reasonable to expect this line may also be optimised and emission reduced (e.g. similar to Line 4) via the approaches the operator has noted.
- Assessment of Nitrous Oxide emissions and incorporation of findings is required.



A.27 Cornwall

A.27.1 Basic Data

The table below summarises basic installation data.

Table A-105: Basic installation data

Subject Area	Data	Comment
Name	• Cornwall Energy Recovery Centre	
Operator	• Suez	
Location / Address	• St Dennis, Saint Austell, Cornwall PL26 8DY	
Location Character (Industrial/ Urban/Rural/ Mixed)	• Rural	• Minerals industry locally
Capacity tonnes / annum total	• 240,000	
Number of lines	• 2	
First operation date	• March 2017	
Main supplier / OEM (grate/boiler/furnace lead)	• No information	• Vinci combustion diagram presented
Main supplier SNCR/ FGT	• Yara	

A.27.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.27.2.1 Techniques Deployed

Table A-106: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control			• Primary and secondary air control measures are deployed. • Trial O₂ set points were 5.6 to 6.1 vs 7.1 week before average. • Large differences in combustion & control between lines 1 and 2.
	Oxygen set point (% excess)			
	Feed rate control			
	FGR	N	N	
Secondary	SNCR	Y	Y	



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	SCR	N	N	
	Catalytic filter bags	N	N	
	Wet scrubber (NH ₃ polish)	N	N	

A.27.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-107: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Ammonia	Ammonia	
Concentration	24.5%	24.5%	Adapted to NO_x emissions and slip level.
Dose rate kg/tMSW	L1 0.52 kg/tw @ 190 L2 1.34 kg/tw @ 187 NO _x set point		- L1 increased to 1.29 kg/tw by 140 set point. But minimal at 170 mg/Nm³. - L2 increased to 1.96 kg/tw by 140. With large initial increase to 180 mg/Nm³. - L2 variant combustion, control and temperature distributions explain.
Number of injection levels	3	3	3 of 5 levels used. 1 & 5 not used due to temp profiles.
Number of injection points (total)	4	4	4 points per level. 12 ports per line used.
SNCR control system	Y	Y	- Reagent dose dilution controlled by the steam flow rate measured at the boiler outlet, which is associated with boiler T from commissioning. - Also NO_x emission level control.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	Y	Y	- Temperature probes and injection locations not the same but have been associated via commissioning and operational experience. - Overall confidence that correct T zones are in use, and options to use additional levels not taken up. - L2 suggestion to investigate the impact of moving the SNCR injection system higher up where the flue gas is cooler.

A.27.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-108: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average			L2 187 L1 190	170?	Trials at 190/187, 170, 160, 150, 140 mg/Nm³.
NH ₃ (air) mg/Nm ³ daily average	10			Below 2.5	- L1 minimal (average 0.04mg/NM³) across full trial range. - L2 some increase at 140 set point, but still low <2.5 mg/NM³.
N ₂ O (air) mg/Nm ³ daily average				Below 4	- Range 0-4 mg/Nm³ reported in trials and erratic but suggestion of increases at lower NO_x set points in the range. - Lower N₂O line – may be due to higher combustion T?
Residue quality					- L1 minimal changes IBA and APCR. - L2 some evidence of increased APCR contamination at lower NO_x set points.

A.27.3 Key Observations

- 2019 trials targeting set points of 125 mg/Nm³ achieved average NO_x levels of below 105 mg/Nm³ with NH₃ below 2 mg/Nm³, with reagent consumption increasing from 0.68-0.83 kg/tw to close to 2 kg/tw, but with fouling issues.
- Very different response to trials at each line owing to different combustion set ups.
- 2022 Line 2 efficiency improvement measures have adversely impacted ammonia consumption vs NO_x set point.
- Both lines can operate at reduced NO_x emission levels – less so for Line 2.
- L1 “setpoint drop to 170 mg / Nm³ would be easily achievable with a minimal increase in ammonia usage, and no increase in ammonia slip”.
- L2 trial showed it was unable to comfortably meet the setpoint drops during the trial period.
- Very low NH₃ slip levels, especially line 1.
- Nitrous oxide levels below 4mg/Nm³ line 1 and lower still line 2. Some evidence of increase with greater does rates.

A.27.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- Line 1 set point of 170 mg/Nm³ achievable.
- Line 2 more constrained and further investigations / optimisation required, including consideration of use of currently unused injection levels.
- Possibility to reduce NH₃ EAL.



A.28 Blackburn Meadows

A.28.1 Basic Data

The table below summarises basic installation data.

Table A-109: Basic installation data

Subject Area	Data	Comment
Name	Blackbourn Meadows Renewable Energy Plant	
Operator	E.ON UK Infrastructure Services Limited	
Location / Address	Tinsley, Sheffield S9 1HF	
Location Character (Industrial/ Urban/Rural/ Mixed)	Urban / mixed	
Capacity tonnes / annum total	200,000 waste wood 30 MWe + up to 25 MW heat	
Number of lines	- No information - Fluidised bed plant	
First operation date	2015	
Main supplier / OEM (grate/boiler/furnace lead)	Andritz (Boiler OEM)	
Main supplier SNCR/ FGT	ERC	

A.28.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.28.2.1 Techniques Deployed

Table A-110: Techniques deployed

Category	BREF Techniques	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control			The boiler utilises secondary air and de-oxygenated flue gas recirculation air as primary NO_x control measures. Optimisation of these primary NO_x reduction techniques was carried out during commissioning of the plant by Andritz.
	Oxygen set point (% excess)			
	Feed rate control			



Category	BREF Techniques	Pre-trial	Post Trial / Proposed	Comments
				- Further optimisation of the primary NO_x reduction techniques was performed ...in April 2022 by Andritz, with positive results achieved with regards to NO_x formation, which also resulted in a reduction of the amount of Urea required to control NO_x emissions within the ELV. - The further optimisation measures were then reversed after boiler slagging issues emerged which required shut downs and lost operations (temperature related). - Slagging issues are being addressed using fuel additive, with repeat of primary and secondary optimisation trials planned for 2024.
	FGR	Y	Y	See above.
Secondary	SNCR	Y	Y	See SNCR system description.
	SCR	N	N	
	Catalytic filter bags	N	N	
	Wet scrubber (NH ₃ polish)	N	N	

A.28.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-111: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea	Urea	Urea.
Concentration etc	40%	40%	40% urea solution.
Dose rate kg/tMSW			"The urea delivery rate fluctuates as changes in fuel quality change the emissions profile, but a range of 250kg/h – 350kg/hr is considered within normal operations."
Number of injection levels	2	2	2
Number of injection points (total)	8	8	4 on each of east & west walls, with two different elevations available.
SNCR control system	Y	Y	"The urea delivery rate fluctuates as changes in fuel quality change the emissions profile, but a range of 250kg/h – 350kg/hr is considered within normal operations." "The urea injection rate is controlled directly by the NO_x emissions measured at the stack. The control system automatically controls the amount of urea being delivered, responding to a 30 min average and daily average emission levels that has been input into the control system by the operator."



Criteria	Pre-trial	Post Trial / Proposed	Comments
Injection location optimisation applied. Y/N (e.g. for temperature zones)	Y	Y	“The SNCR system injects a 40% urea solution into the Post Combustion Chamber of the furnace, where the optimum temperature range for the most efficient SNCR reaction to occur is present.” - Historical (2015) lance position trials provide a basis for current injection / temp location optimisation, with changes made to suit conditions by operators.

A.28.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-112: Emissions data

Criteria	EAL		Target / Set-point		Comments / constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	235				Trials planned 2024.
NH ₃ (air) mg/Nm ³ daily average	?				Trials planned 2024.
N ₂ O (air) mg/Nm ³ daily average	?				Trials planned 2024.
Residue quality	?				Trials planned 2024.

A.28.3 Key Observations

The operator IC return report key observations are:

- The plant IC sets a requirement to “...perform a study to determine the extent to which the operation of the systems in place at the plant to minimise NO_x emissions can be further optimised such that emissions are reduced as far as possible below 235 mg/Nm³ as a daily average.....”. As such the current permitted numerical ELV is higher than the 180mg/Nm³ for the remainder of the sector (due to different correction factor).
- Whilst over a number of years, various investigations have been carried out which target NO_x reduction, the issues encountered mean that NO_x optimisation trials are ongoing.
- As such, with trials planned for 2024, the results will need to be further assessed when available
- Overall approach to optimising stages of the plant in turn is appropriate i.e. primary then secondary (SNCR), and the need and approach to addressing slagging issues encountered since earlier trials is appropriate, but has delayed final trials and reporting.



A.28.4 EA Recommended Actions

Evaluation of the IC return information suggests the EA should consider:

- Securing trials results, review & assessment.
- Further consider whether design fundamentals (including FBC and fuel type & consistency) and operator NO_x trials report suggest lower NO_x levels may be achieved, noting also historically higher ELV at this plant and local AQMA sensitivity.



A.29 Templeborough Biomass

A.29.1 Basic Data

The table below summarises basic installation data.

Table A-113: Basic installation data

Subject Area	Data	Comment
Name	Templeborough Biomass Power Plant	
Operator	BWSC Generation Service UK	
Location / Address	Sheffield Road, Templeborough, approximately 1.5km east of Rotherham, UK	
Location Character (Industrial/ Urban/Rural/ Mixed)	Mixed	
Capacity tonnes / annum total	320 ktpa waste wood - Moving grate	
Number of lines	No information	Supplied trial data suggests one line
First operation date	2018	
Main supplier / OEM (grate/boiler/furnace lead)	BWV	
Main supplier SNCR/ FGT	?	

A.29.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.29.2.1 Techniques Deployed

Table A-114: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control			- No details provided but report notes need to optimise combustion during the trial, although this was suspended with intention of carrying out in 2024 Q2. - Boiler O₂ of iro 4% is low.
	Oxygen set point (% excess)			
	Feed rate control			



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	FGR			
Secondary	SNCR	Y	Y	Injection of 25 % ammonia water (NH₄OH) mixed with water (Deionate) spray into the flue gas in the first pass of the boiler together with compressed air.
	SCR	N	N	Not described.
	Catalytic filter bags	N	N	Not described.
	Wet scrubber (NH ₃ polish)	N	N	Not described.

A.29.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-115: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Ammonia	Ammonia	
Concentration etc	25%	25%	
Dose rate kg/tMSW	1-2 l/t	No change	- Due to the variable nature of the fuel burnt at Templeborough, the ratio of Ammonia reagent used per tonne of fuel burnt ranges between 1-2 Litres p/Ton. - Trial increased dose rate from 1.41 to 2.86l/ton fuel. - Daily cost increase from £237.77 to £505.60 noted (in xls) and overall annual cost increase of £98k. - Supply reliability constraints noted associated with lack of UK production.
Number of injection levels	3	3	
Number of injection points (total)	20	20	20 lances total. - Spares held on site & monthly inspection.
SNCR control system			IR pyrometers used to determine injection level during commissioning, but not clear whether further dynamic operational control is used.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	y	y	- Temperature sensitivity noted. - See comments re IR pyrometers.

A.29.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-116: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	180		177		180 ELV since first operation. - Trials conducted at set points of 177, 170 & 165 mg/Nm³. - Measured emissions 128 – 146 mg/Nm³ during trial.
NH ₃ (air) mg/Nm ³ daily average	?		15		- Highest level reported in trial was 0.25 mg/Nm³, majority below 0.1 mg/Nm³. - Slip not correlated to increased dose rates over trial range.
N ₂ O (air) mg/Nm ³ daily average					- Highest level reported in trial was 0.75 mg/Nm³, majority below 0.3 mg/Nm³. - Recorded value decreased with increased dose rates over trial range (?).
Residue quality					No information provided.

A.29.3 Key Observations

The operator IC return report key observations are:

- Achieved NO_x levels of 128 – 146 mg/Nm³ during trial are comfortably below 180 mg/Nm³ level set as ELV.
- The combustion optimisation that was to be carried out with the SNCR trial was postponed, with intention to carry out in 2024 Q2.
- Trial aborted at 165mg/Nm³ NO_x set point when Ammonia consumption increased approx. 3 fold, noting stock levels and cost issues.
- Generally Low NO_x reduction effect across trial range, although one data point at highest does rate tested suggests that NO_x was reduced (to 128 mg/Nm³).
- NO_x and N₂O do not appear to provide a constraint, even at lowest NO_x tested.
- No information provided regarding residue impacts.

A.29.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- Plant already achieves NO_x emission levels below 180mg/Nm³.
- The proposed repeat of the trials with combustion optimisation appears valid.
- This should explore the lower set points as originally intended (perhaps below 150, towards 120/100 mg/Nm³?) – note no evidence of NH₃ or N₂ increases, but also need to check residue and any other operational matters.
- The increase in cost for Ammonia consumption needs consideration in comparison with avoided NO_x damage costs from reductions.
- Explore whether additional storage capacity might overcome supply constraint reported (although at 75m³ the tank is already large).



A.30 Newhurst

A.30.1 Basic Data

The table below summarises basic installation data.

Table A-117: Basic installation data

Subject Area	Data	Comment
Name	• Newhurst ERF	
Operator	• Encyclis Ltd	
Location / Address	• Shepshed, Leicestershire	
Location Character (Industrial/ Urban/Rural/ Mixed)	• Rural	
Capacity tonnes / annum total	• 455,000 tpa residual municipal waste	
Number of lines	• 2	
First operation date	• 2023	
Main supplier / OEM (grate/boiler/furnace lead)	• HZI	
Main supplier SNCR/ FGT	• HZI	

A.30.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.30.2.1 Techniques Deployed

Table A-118: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	Y	Y	Various measures described to reduce NO _x production and consumption: • FGR • "Swirl injection" air mixing • Staggered air injection • Combustion control system
	Oxygen set point (% excess)			
	Feed rate control			
	FGR	Y	Y	• Passive system



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Secondary	SNCR	Y	Y	Design requirement to meet 120 mg/Nm³ was demonstrated during commissioning.
	SCR	N	N	
	Catalytic filter bags	N	N	
	Wet scrubber (NH ₃ polish)	N	N	

A.30.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-119: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Ammonia	Ammonia	
Concentration etc	25%	25%	
Dose rate l /tMSW	0.041 l/t	@ 100 <1.8 l/t @80 < 2 l/t	Reported: 0.3 @ 185 0.39 @ 165 0.89 @ 140 1.17 @ 120 1.56 @ 100 1.99 @ 80
Number of injection levels	3	3	Dynamic selection linked to SNCR performance monitoring and control system.
Number of injection points (total)	36	36	Dynamic selection of ports to optimise injection of reagent.
SNCR control system			Comprehensive monitoring and control of the SNCR system is described.
Injection location optimisation applied. Y/N (e.g. for temperature zones)			Multiple injection locations and levels with variable direction controlled by temperature and NO_x monitoring.

A.30.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-120: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200		185	165	180 mg/Nm³ reported “easily achievable” – set point 165 mg/Nm³. - plant commissioning demonstrated a guarantee of 120 mg/Nm³.



Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NH ₃ (air) mg/Nm ³ daily average			~0	~0	- Prior to trial close to zero (@185 NO_x set point). - Trial NH₃ slip is below 1.5 mg/Nm³ at set points and NO_x emission levels down to 100mg/Nm³, and 1-2 mg/Nm³ at 80.
N ₂ O (air) mg/Nm ³ daily average			<0.2		CEMs measured emission level increased from 0-02 nmg/Nm³ (@185) to 1.1 mg/Nm³ (@ 100) and 1.4 mg/Nm³ @ 80 NO_x set point.
Residue quality					APCr contamination at 100 mg/Nm³ set point led to redirection from recovery to disposal.

A.30.3 Key Observations

- Plant can easily achieve 180 NO_x & 15 mg NH₃ without compromise.
- Modern plant designed with good control features that has demonstrated ability to meet a guaranteed NO_x value of 120mg/Nm³.
- Whilst dose rates increase consumption levels remain relatively low due to other design and control optimisations. Cost not explored.
- Rising but still low ammonia and nitrous oxide levels across the NO_x set points tested.
- Contamination of APCr reported @ 100 NO_x set point, resulting in diversion from recovery to disposal.

A.30.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- The operator has suggested a set point of 165 mg/Nm³, but the trial report data appears to show that a lower emission level can be targeted without significant compromise.
- Scale of plant also means mass emissions are likely to be significant.
- Operator may be reasonably requested to explore targeting 100-140 NO_x target range on a longer-term basis, noting there may be some constraints related to residue recovery.



A.31 Bolton

A.31.1 Basic Data

The table below summarises basic installation data.

Table A-121: Basic installation data

Subject Area	Data
Name	• Bolton Energy Recovery Centre (ERC)
Operator	• Suez Recycling and Recovery UK Ltd
Location / Address	• Bolton, Lancashire, UK
Location Character (Industrial/ Urban/Rural/ Mixed)	• Mixed
Capacity tonnes / annum total	• 128,000 tpa
Number of lines	• 1
First operation date	• 1971 (WID upgrade 2001)
Main supplier / OEM (grate/boiler/furnace lead)	• No information
Main supplier SNCR/ FGT	• Petro Miljö – now called NO _x -Sol (installed 1999)

A.31.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and doses rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.31.2.1 Techniques Deployed

Table A-122: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control			• Various works undertaken to improve plant combustion control. • Trial average reduced from 6.5 to 5.8 as target lowered in trial. • Primary air flow is controlled using a multi-faceted control philosophy in the automated Waste Incineration Control (WiC) System supplied by Technikgruppe. • Secondary air flow is increased manually when furnace temperatures are elevated to support combustion control.
	Oxygen set point (% excess)			
	Feed rate control			
	FGR	N	N	• Not mentioned.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Secondary	SNCR	Y	Y	Since 1999.
	SCR	N	N	Not mentioned in report – assumed not used.
	Catalytic filter bags	N	N	Not mentioned in report – assumed not used.
	Wet scrubber (NH ₃ polish)	N	N	Not mentioned in report – assumed not used.

A.31.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-123: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Ammonia	Ammonia	65m³ site storage capacity.
Concentration etc	24.5%	24.5%	Diluted 2.1% vol % for use.
Dose rate kg/tMSW			
Number of injection levels	2	2	1st pass.
Number of injection points (total)	7	7	- In 2022, the number of the ammonia injection points was reduced from 8 down to 7 to enable the installation of an oxygen measurement probe. - This instrument was necessary to measure the oxygen concentration from the furnace to feed into the WiC combustion control system to improve combustion control.
SNCR control system	Y	Y	The flow of ammonia solution through the nozzles is varied subject to PI (proportional & integral) control from the CEMS (Continuous Emissions Monitoring System), where high NO_x readings lead to an increase in ammonia solution flow.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	Y	Y	2 levels used and selected according to steam flow to target optimal reaction temperature zone > 950C.

A.31.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-124: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average			160		- Trial set points 160, 150, 140, 130 mg/Nm³. - Trial suspended week 3 due to unplanned shut down. - The NO_x daily average value emissions, irrelevant of set point and slip were maintained between 110 and 120 mg/Nm³ and 0.3 and 0.5 mg/Nm³ respectively.
NH ₃ (air) mg/Nm ³ daily average	10		3		3mg/Nm³ used as threshold to reduce Ammonia flow. - All trial data below 1mg/m³ (mostly below 0.5).
N ₂ O (air) mg/Nm ³ daily average					No clear change in N₂O emission levels over trial set points tested.
Residue quality					Uncertainty in the results is noted.

A.31.3 Key Observations

- NO_x level remained consistent between 100 & 120 mg/Nm³ at all set points, with similarly consistent NH₃ and N₂O emission levels – all well below ELVs.
- Ammonia usage was also relatively stable throughout the trial.
- Major plant improvements are planned for the 20-week outage that will commence in October 2025. This significant investment will increase reliability, increase throughput and improve combustion – these may also provide opportunity to consider further emissions optimisations.
- There is uncertainty over the reported residue contamination results.
- The operator concludes that: *This trial has proven that SUEZ Bolton ERC can effectively and reliably comply with the new BAT-AEL's of 180 mg/Nm³ for NO_x and 10 mg/Nm³ for NH₃ slip as the ammonia SNCR NO_x abatement system has demonstrated effective daily control to below 150 mg/Nm³. Regarding ammonia slip, it remained below the limit of 10 mg/Nm³, so is also not envisioned to cause an issue. For emission levels of between 180 to 150 mg/Nm³ there were minor differences between average emission figures and reagent usage rates. As the NO_x system regularly controls at well below the limit of 180 mg/Nm³ it is not expected to cause any problems.*
- The lack of emission sensitivity at different set points is unusual. The lack of change in Ammonia consumption rate / dose rate may imply the control system is making other variations to try to change the NO_x level?



A.31.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- The plant is already achieving comparably low emission levels iro 120 mg/Nm³ without other air emission difficulties. This, combined with the reported lack of increased reagent consumption or other issues suggests there is not a barrier to seeking optimisation at such lower levels.
- The lack of change in reagent dose rates is unusual. Further optimisation trials may be considered which do alter dose rates, although current relatively low emission achieved, and relatively small plant size, may suggest further emissions reductions are not a major / urgent priority unless specific local drivers or they can be achieved without risk / cost issues.
- The lack of confidence in the solid residue results needs to be followed up and optimisation levels considered accordingly.
- The planned outage may provide opportunity for implementing emissions as well as other optimisations.



A.32 Suffolk

A.32.1 Basic Data

The table below summarises basic installation data.

Table A-125: Basic installation data

Subject Area	Data
Name	• Suffolk EFW
Operator	• Suez R&R UK
Location / Address	• Great Blakenham, Suffolk, UK
Location Character (Industrial/ Urban/Rural/ Mixed)	• Rural
Capacity tonnes / annum total	• 295,000 tpa • 26MWe
Number of lines	• 2
First operation date	• 2014
Main supplier / OEM (grate/boiler/furnace lead)	• CNIM
Main supplier SNCR/ FGT	• No information

A.32.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and doses rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.32.2.1 Techniques Deployed

Table A-126: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	Y	Y	• Staged combustion through separated primary and secondary air to minimise the potential for the production of thermal NO_x and the combustion control is maintained through a supervisory control scheme utilising fuzzy logic to continually optimise the combustion process. • Control parameters such as the rate of waste feeding and the distribution of under fire air are controlled in order maintain stable combustion conditions and the excess oxygen content.
	Oxygen set point (% excess)	6.1	6.1	
	Feed rate control	Y	Y	



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
				- Combustion control optimisation by OEM in 2022/23 and ongoing. 34 page 2023 OEM report suggests 4 main optimisations for follow up, including some with NO_x implications.
	FGR	N	N	Not noted.
Secondary	SNCR	Y	Y	
	SCR	N	N	Not mentioned in report – assumed not used.
	Catalytic filter bags	N	N	Not mentioned in report – assumed not used.
	Wet scrubber (NH ₃ polish)	N	N	Not mentioned in report – assumed not used.

A.32.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-127: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea	Urea	Dry urea injection.
Concentration etc	dry	dry	History of reagent blockage issues has led to adoption of lower set point target so that averaging periods are achieved including periods when only one screw feeder is operating.
Dose rate kg/hr	40	40-50	- Urea demand on line 1 rises from ~40 kg/hr to 70 kg/hr approx. linear 165 – 135 mg/Nm³ target. - Line 2 urea demand increased from 50 to 70 kg/hr when targeting emissions of 155 mg/Nm³ and below.
Number of injection levels	2	2	
Number of injection points (total)	12	12	6 per level.
SNCR control system			The rate of urea consumption is varied by adjusting the screw speeds based on the NO_x concentration measured at the CEMs and the desired NO_x set point.
Injection location optimisation applied. Y/N (e.g. for temperature zones)			20-degree injection angle variable, but found not to influence performance. - The system was designed to switch between injector levels based on flue gas temperature measured via pyrometers. This has however been disabled for some years and the injection is fixed on the lower level of injectors as this is the only location to achieve the required NO_x emissions and optimal injection rates.



A.32.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-128: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180	180	165	- Trial target set points 165, 155, 145, 135 mg/Nm³ to achieve emission ELV compliance of 180, 170, 160, 150 mg/Nm³. - Achieved daily average dropped from ~165 to 138/146 mg/Nm³ (line 1/2) during trial.
NH ₃ (air) mg/Nm ³ daily average					The ammonia measured at the CEMs during the trial was seen to increase during the lowest NO_x set point but only to a maximum daily average of 3.8 and 5.5 mg/Nm³ dry @ 11% O₂ on line 1 and line 2 respectively.
N ₂ O (air) mg/Nm ³ daily average			?	?	No information presented.
Residue quality					APCr contamination increased at lower NO_x set points.

A.32.3 Key Observations

- The data presented from the trial shows that the DeNO_x system is capable of operating at a set point of 165 mg/Nm³ @ 11% O₂ in order to achieve an ELV of 180 mg/Nm³ whilst remaining well below the ELV for ammonia of 15 mg/Nm³ @ 11% O₂.
- Line 1 shows better performance than line 2. Line 1 appears capable of targeting a set point of 150 mg/Nm³, whereas line 2 165 mg/Nm³ was the lower limit. Line 2 limit associated with screw feed rate for urea.
- The ammonia measured at the CEMs during the trial was seen to increase during the lowest NO_x set point but only to a maximum daily average of 3.8 and 5.5 mg/Nm³ dry @ 11% O₂ on line 1 and line 2 respectively.
- Reasons for different line performance not clear.
- Good combination of primary and secondary approaches to NO_x reduction presented.
- History of reagent blockage issues has led to adoption of lower set point target so that averaging periods are achieved including periods when only one screw feeder is operating.
- Some evidence of residue contamination at lower NO_x set points, but only for APCr. Not clear whether residue contamination seen has any implications / provides a constraint.
- Lack of information / consideration of nitrous oxides.



A.32.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- Follow up on ongoing combustion optimisation plans to explore whether they reveal NO_x reduction opportunities.
- Better understanding of line performance differences may inform improvements on line 2. Urea blockages and line 2 screw feed rate limitations appear to be current key bottlenecks to achieving lower NO_x levels. Proposal to assess line 2 screw feed rate increases considering risk of non-compliance with a lower ELV and prioritisation of primary measures are reasonable.
- Good use of primary measures, but main secondary reduction constraints appear to arise from fundamentals regarding solid urea reagent – operator may be asked to report whether there is a replacement option (may be complex feasibility / cost).
- Future decisions also need to be informed by consideration on nitrous oxide emissions, and residue impacts. In mean time EAL 180 mg/Nm³ with targets of 150 for Line 1, and 165 Line 2 appropriate.



A.33 Ridham

A.33.1 Basic Data

The table below summarises basic installation data.

Table A-129: Basic installation data

Subject Area	Data
Name	• Ridham Biomass Facility
Operator	• MVV Environment Ridham
Location / Address	• Lord Nelson Road, Ridham Dock, Iwade, Sittingbourne, ME9 8FQ
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial / Rural
Capacity tonnes / annum total	• 195ktpa waste wood (grades B&C) • 28MWe gross/ 23 MWe net
Number of lines	• 1
First operation date	• 2015
Main supplier / OEM (grate/boiler/furnace lead)	• Grate: Kablitz, Boiler Duro Dakovic
Main supplier SNCR/ FGT	• No information

A.33.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.33.2.1 Techniques Deployed

Table A-130: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control			• Primary and secondary air control in place.
	Oxygen set point (% excess)	6%		
	Feed rate control			
	FGR	?	?	• No information.
Secondary	SNCR	Y	Y	
	SCR	N	N	• Not mentioned in report – assumed not used.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	Catalytic filter bags	N	N	Not mentioned in report – assumed not used.
	Wet scrubber (NH ₃ polish)	N	N	Not mentioned in report – assumed not used.

A.33.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-131: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea	Urea	
Concentration etc	Prills	Prills	46% N as prills. 35 tonnes storage (2 months).
Dose rate	604kg/day	787-1110 during trial	From the trial period the facility estimates an increase in reagent dosing in the order 40%.
Number of injection levels	3	3	3 injection lances on each level.
Number of injection points (total)	9	9	3 on each of 3 levels.
SNCR control system			- Initial optimisation of the control and dosing system was completed during commission and performance testing prior to handover. - Upgrade to the control system, Valmet integrated control to optimise combustion and consumable usage, expected installation July 24 during extended outage.
Injection location optimisation applied. Y/N (e.g. for temperature zones)			- Major scheduled maintenance is carried out annual and compete system checks and inspections are carried out, full instrument calibrations are performed to ensure drift and span remain within tolerance for the operating system. - Routine injection lance checks are carried out and a monthly basic during operation to replace burnt out tips restoring the correct distribution of prills within the flue gas path.

A.33.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-132: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	300	270			Trial results daily average emission levels reduced from ~ 210 to 176 mg/Nm³.
NH ₃ (air) mg/Nm ³ daily average					Trial results increased from 0.1 mg/Nm³ but all at or below 1mg/Nm³.
N ₂ O (air) mg/Nm ³ daily average					No information included in report.
Residue quality					- No data provided. - Operator reported: <i>During the course of the trial it became necessary for the facility to perform on line cleaning of the boiler pass 3rd and 4th passes of the boiler. The differential pressure across the passes increased to a point that became unmanageable for the induction fan to maintain a negative boiler pressure below boiler trip set point.</i>

A.33.3 Key Observations

- **Numerical NO_x emissions concentrations reported and historical AEL are higher than MSW fleet. With IC target set at 270 mg/Nm³ daily average.**
- Operator has confirmed 270 mg/Nm³ can be complied with but noted increased reagent consumption and instability at higher dose and lower NO_x emission levels, and the need to perform online cleaning.
- System design, control and optimisation description is complex - mixes standard template text and operator's own response. **Some drafting comments and incomplete sentences indicate the report is a draft.**
- Upgrade to the control system, Valmet integrated control to optimise combustion and consumable usage, expected installation July 24 during extended outage.
- Operator states:
 - *The system operated and maintained is from build and requires increasing amounts of maintenance, the high-level control system hardware is in need of upgrade to ensure technical support and security of the technology can be sustained into the future. No further optimisation of the system has been carried out since this point so all dosing reports relate to initial CFD and commissioning.*
 - *The likely reasons for the results observed are the plant age and sophistication of the SNCR system which is requiring additional maintenance and repair, Original plant design parameters limit the available range of dosing and the ability to optimise the dosing.*
- Second bullet above suggests fundamental current plant design constraints.
- Trial data reported for 8 days, with six testing increased dose rates – relatively short trial.
- No information on Nitrous Oxide or residue quality.



A.33.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- Check with operator whether an updated & finalised report is available (noting apparent lack of QA or finalisation observed in existing report). Review conclusions accordingly.
- Suggested system upgrade during July 2024 should be followed up. Optimisation of the new system may provide opportunity to review performance and options for revised emission targets / EALs, as well as consider whether noted operational and design constraints to lower emission remain.
- Once installed a more rigorous trial using stepwise reduction of NOx set points and monitoring of all parameters (in line with the IC requirements) should be carried out & actions set accordingly.



A.34 Ardley

A.34.1 Basic Data

The table below summarises basic installation data.

Table A-133: Basic installation data

Subject Area	Data	Comment
Name	• Ardley ERF	
Operator	• Viridor	
Location / Address	• Middleton Stoney Road, Bicester OX27 7AA	
Location Character (Industrial/ Urban/Rural/ Mixed)	• Rural	• 82m stacks
Capacity tonnes / annum total	• 378,000	
Number of lines	• 2	
First operation date	• 2014	
Main supplier / OEM (grate/boiler/furnace lead)	• CNIM / Martin	
Main supplier SNCR/ FGT	• No information	• Dry FGT system hydrated lime

A.34.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.34.2.1 Techniques Deployed

Table A-134: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control			• Primary approaches not discussed.
	Oxygen set point (% excess)	7	7	
	Feed rate control			
	FGR			
Secondary	SNCR	Y	Y	• Dry urea – PPM to avoid blockages. • £3m cost to replace with liquid ammonia seen as excessive.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
				Urea system optimisation planned 2024.
	SCR	N	N	Not mentioned in report – assumed not used.
	Catalytic filter bags	N	N	Not mentioned in report – assumed not used.
	Wet scrubber (NH ₃ polish)	N	N	Not mentioned in report – assumed not used.

A.34.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-135: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Y	Y	Dry urea prills.
Concentration etc	Dry	Dry	
Dose rate kg/tMSW	1.6 t/day to comply with 200 mg/Nm ³		@180 1.1-1.77 kg/tw, NH₃ 1mg/Nm³ @150 1.59-2.37 kg/tw, NH₃ 1.9mg/Nm³ @120 1.73 – 2.57kg/tw, NH₃ 4.08 mg/Nm³ @100 3.53- 5.4kg/tw, NH₃ 2.5 mg/Nm³
Number of injection levels	3	3	
Number of injection points (total)			No information.
SNCR control system	Y	Y	- Pyrometers used to determine urea injection rate. - NO_x / NH₃ level linked to dose rate screw feed speed. - PPM to avoid blockages.
Injection location optimisation applied. Y/N (e.g. for temperature zones)			Not discussed.

A.34.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-136: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200			150?	Reported NO_x instability below 150 mg/Nm³ but not evident in supplied data, although NH₃ increase from 1.9 @150 to 4.08 at 120 was evident.



Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NH ₃ (air) mg/Nm ³ daily average	15				Increase noted @120 set point.
N ₂ O (air) mg/Nm ³ daily average					- No data provided. - Operator conclusion: <i>Through the course of the trial N₂O emissions were observed to increase as the NO_x setpoint was decreased.</i>
Residue quality					no impact noted on either the IBA or APCr.

A.34.3 Key Observations

- Operator concludes: *“The trial was completed and demonstrated that the facility is able to operate at the BAT-AEL compliance levels of 180mg/m³ for NO_x and 15mg/m³ for ammonia.”*
- Focus on SNCR and primary measures not discussed.
- “The Urea system operating at 180mg/m³ functions reliably, blockages are rare and usually the result of poor quality Urea. The Urea from the current supplier Yara has been found to be of good quality and since the change to this supplier there have been no blockages.”*
- Trial set points used: 150, 120 & 100 mg/Nm³.
- Some blockages occurred as dose rate was increased.
- Ammonia slip & urea consumption notable increased at 100mg/Nm³ set point NO_x levels, but limited down to 120 mg/Nm³.
- Reported NO_x instability below 150 mg/Nm³ but not evident in supplied data, although NH₃ increase from 1.9 @150 to 4.08 at 120 was evident.
- @100 mg/Nm³ set point various adverse impacts seen including 20-30mg/Nm³ NH₃.
- No impact noted on either the IBA or APCr.
- Reagent cost / day increases with consumption – notably at 100 mg/Nm³ set point:
 - @180 base case £753 / day
 - @ 150 £1171
 - @120£1139
 - @100£2147
- Operator reports *“Through the course of the trial N₂O emissions were observed to increase as the NO_x setpoint was decreased”* although no data provided.
- Dosing system instability reported at lower setpoints.

A.34.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- Review results of planned urea system optimisation in 2024.
- Ask operator to also consider primary approaches NO_x control contribution.



- Result currently suggests a target / set point iro 150 mg/Nm³ may be achievable without excessive cost or emissions / cross media impacts, but this requires assessment over a longer term.
- Reported system instability, blockage risk/avoidance, and nitrous oxide levels need consideration in determining whether NO_x levels below 180 mg/Nm³ can be sustained.



A.35 Tyseley

A.35.1 Basic Data

The table below summarises basic installation data.

Table A-137: Basic installation data

Subject Area	Data
Name	• Tyseley Energy from Waste Plant
Operator	• Veolia ES Birmingham Limited
Location / Address	• James Road, Tyseley, Birmingham, West Midlands
Location Character (Industrial/ Urban/Rural/ Mixed)	• Urban / Industrial
Capacity tonnes / annum total	• 440,500tpa • 30MWe
Number of lines	• 2
First operation date	• 1996
Main supplier / OEM (grate/boiler/furnace lead)	• Steinmuller
Main supplier SNCR/ FGT	• Petro Miljö SNCR system (now YARA)

A.35.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and doses rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.35.2.1 Techniques Deployed

Table A-138: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control			• No information.
	Oxygen set point (% excess)	8.1% wet	8.1% wet	
	Feed rate control	?	?	
	FGR	N	N	• No.
Secondary	SNCR	Y	Y	• See description.
	SCR	N	N	• Not mentioned in report – assumed not used.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	Catalytic filter bags	N	N	Not mentioned in report – assumed not used.
	Wet scrubber (NH ₃ polish)	N	N	Not mentioned in report – assumed not used.
Other				

A.35.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-139: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Ammonia	Ammonia	- Ammonia (25% product concentration). - Total ammonia storage capacity of 170m³.
Concentration etc	25%	25%	25% concentration Ammonia is diluted with demineralised water in the mixing and metering modules prior to injection.
Dose rate kg/tMSW			- Some increase over trial range with lower set points (as expected), with some variation noted. - Increase from ~2 at 170 to 2.92 at 130.
Number of injection levels	?	?	No information.
Number of injection points (total)	?	?	No information.
SNCR control system	Y	Y	NO_x value control point varies concentration of reagent.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	Y	Y	Each injector pressure is controlled individually to distribute reagent across combustion chamber.

A.35.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-140: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average			180	160	- Line 1 Trial set points (emission level achieved) 170 (169-171), 160 (146-159), 150 (139-146), 140 (138-139), 130 (124-129) mg/Nm³. - Line 2 – similar results to line 1.
NH ₃ (air) mg/Nm ³ daily average				Below 3?	Generally below 3mg/Nm³ (one elevated value of 6.5mg/Nm³).



Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
N ₂ O (air) mg/Nm ³ daily average				Below 3?	Emissions generally between 1.5 – 2.5 mg/Nm³ and not increasing with variant set points.
Residue quality					Reagent content remained low throughout the trial periods and no increase was observed despite increased reagent dosing.

A.35.3 Key Observations

- New BREF AELs of 180 mg/Nm³ NO_x and 15 NH₃ can be complied with.
- The Operator has further identified a target emission value of 160mg/Nm³ is achievable with confidence and without significant down sides.
- Ammonia reagent consumption overall remains the same as an average between both lines at 160 mg/Nm³ than the consumption at the existing ELV of 180 mg/Nm³.
- No information provided on primary measures.
- Performance reasonable for an older facility.

A.35.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- A target emission value of 160 mg/Nm³ is already suggested and can already be implemented for longer term assessment, with expectation that it will be suitable.
- Results suggest that a lower target may also be considered in due course.
- Noting trial results indicating emissions reductions are possible, the large plant size (and likely location sensitivity), lower target emissions may warrant further investigation and optimisation approaches (including primary measures), although plant age may limit the business case for investments.



A.36 Runcorn

A.36.1 Basic Data

The table below summarises basic installation data.

Table A-141: Basic installation data

Subject Area	Data
Name	• Runcorn
Operator	• Viridor
Location / Address	• Barlow Way, Runcorn WA7 4HG
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial / urban
Capacity tonnes / annum total	• 1.1 Mtpa • Non-haz RDF and treated C&I / waste biomass / mixed MSW
Number of lines	• 4
First operation date	• 2015
Main supplier / OEM (grate/boiler/furnace lead)	• Keppel Seghers
Main supplier SNCR/ FGT	• No information

A.36.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and doses rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.36.2.1 Techniques Deployed

Table A-142: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control			• Not described.
	Oxygen set point (% excess)			
	Feed rate control			
	FGR			• Not noted in report.
Secondary	SNCR	Y	Y	
	SCR	N	N	• Not noted in report.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	Catalytic filter bags	N	N	• Not noted in report.
	Wet scrubber (NH ₃ polish)	N	N	• Not noted in report.

A.36.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-143: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Ammonia solution	Ammonia solution	
Concentration etc	25% wt	25% wt	• 25% solution mixed with water for use.
Dose rate (units not provided)	See right	See right	Trial range result span: • L1: avge rises ~1500 to 2000 /day • L2: avge rises ~ 1400 to 1800 (no 140) • L3: avge rises ~ 1600 to 2300 • L4: avge minimal change with NO _x reduction, mostly within 2000 2400 range
Number of injection levels	1	1	• <i>The reagent is injected on one level in the first empty pass of the boiler.</i>
Number of injection points (total)	6	6	• <i>For the reduction of NO_x the injection occurs in the first empty pass of the boiler via 6 lances.</i>
SNCR control system	No info	No info	• Constant volume flow of reagent solution. • <i>To get an optimized atomisation of the ammonia the reagent is mixed with polished water to get a constant liquid flow (independent of the different required amount of NH₃). This mixture of ammonia solution and water is atomized in the nozzles with plant air. Plant air serves also as cooling medium for the lances.</i>
Injection location optimisation applied. Y/N (e.g. for temperature zones)	No info	No info	Issue acknowledged but control not described: <i>The reagent needs to be distributed within this optimum temperature zone to obtain the best performance.</i>

A.36.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-144: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	?	180		150 or below?	- Trials at 170, 150 & 140 mg/Nm³ set points - At 140 dilution water pumps are at 100% Trial range emissions: - L1: 134.9 – 169.2 - L2: 142.9 – 166.1 170 & 150 only, (140 abandoned) - L3: 148.9 – 182 - L4: 141.7 – 179.6
NH ₃ (air) mg/Nm ³ daily average	?	15			Low NH₃ emissions across all results – highest reported value 1.7 mg/Nm³ and majority below 1mg/Nm³.
N ₂ O (air) mg/Nm ³ daily average					No information.
Residue quality					No appreciable effect on the quality of residues whilst reducing the NO_x value. (Both for IBA and APCr).

A.36.3 Key Observations

- Operator conclusions:
 - Confirmation of compliance with new BAT-AEL's of 180mg/m³ for NO_x and 15mg/m³ for ammonia, utilising the current SNCR system.
 - A reduction in NO_x concentration is possible for a relatively small additional ammonia solution consumption and small increase in ammonia slip (well below the ELV of 15mg/m³).
 - No appreciable effect on the quality of residues whilst reducing the NO_x value. (Both for IBA and APCr).
 - The current dilution water pumps in use limit the amount of solution that can be injected. In practice, this means that the lowest setpoint achievable is 140mg/m³.
 - Line 3 struggled to achieve the setpoints of 140 & 150mg/m³. Trial 2 averaged at 153.5 mg/m³ at a setpoint of 150mg/m³. Trial 3 averaged at 150.7mg/m³ at a setpoint of 140mg/m³.
- Operator observations made on each line:
 - Line 1 suffered a boiler tube leak and was unavailable for the last day of the first trial at 170mg/m³ and the first three days of the second trial at 150mg/m³.
 - Due to breakdown on Line 2, we were unable complete the third trial at 140mg/m³.
 - Line 3 struggled to achieve the setpoints of 140 & 150mg/m³. Generally, the ammonia consumption increased with each trial level. NH₃ slip was at an acceptable level.
 - Line 4 achieved all setpoints easily with minimal effect on ammonia slip or ammonia consumption. (Note: reagent dosing higher at lower levels?)



- Trial results suggests the plant can achieve NO_x levels below 180 mg/Nm³ without NH₃ slip or residues impacts.
- No information on primary measures or SNCR control – insufficient to judge degree of optimisation in place.
- No information on N₂O.
- No consideration of costs or long-term operational matters. Reagent dosing increase generally observed to be iro + 30 to 40% across trial test range.
- Very low NH₃ slip, even at lowest set point of 140 mg/Nm³.
- Some indication of rise in reagent consumption, although not line 4. Reasons why line 4 achieves this not explored, but higher start point at lower emission levels noted.
- Single level SNCR dosing via 6 lances in relatively large capacity lines indicates there may be some further enhancements available to target temperature zone optimisation using additional injection locations and enhanced control.
- The very large scale of the installation and expected long life indicates that investment in NO_x reduction may be cost-effective (vs gate fee impact). The IC report also notes the proximity of designated conservation sites.
- The plant is also developing a full-scale carbon capture project – additional EfW process emissions controls may be beneficial for the CC plant design / overall.

A.36.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- Present trial report indicates the plant may achieve a NO_x emission target some way below the 180 mg/Nm³ BATAEL, possible iro 140-150 mg/Nm³ although the items below require further consideration (e.g. pre-feasibility / BAT assessment):
 - Nitrous Oxide emissions.
 - Primary NO_x reduction – role and options.
 - SNCR control and optimisation development options e.g. additional injection locations and control feature to optimise temperature, mixing efficiency etc.
 - Assessment of further NO_x reduction below the 140 mg/Nm³ assessed including consideration of pump capacity expansion, which is presented as a constraint.
 - Consideration of alternative approaches to NO_x reduction and emission control (e.g. SCR, higher control and dose approaches?), including consideration of the carbon capture project interface.



A.37 Avonmouth (Viridor)

A.37.1 Basic Data

The table below summarises basic installation data.

Table A-145: Basic installation data

Subject Area	Data
Name	• Avonmouth ERF
Operator	• Viridor Energy Ltd
Location / Address	• Avonmouth, UK
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial
Capacity tonnes / annum total	• 320,000 tpa • 40 MWe gross
Number of lines	• 2
First operation date	• 2021
Main supplier / OEM (grate/boiler/furnace lead)	• CNIM / Martin
Main supplier SNCR/ FGT	• No information

A.37.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and doses rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.37.2.1 Techniques Deployed

Table A-146: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	?	?	• Primary measures for NO_x reduction are not discussed in the report. • O₂ set point reported – design and trial %.
	Oxygen set point (% excess)	6-7	6-7	
	Feed rate control	?	?	
	FGR	?	?	• Not mentioned in report.
Secondary	SNCR	Y	Y	• Dry urea system. • Stainless steel air-transport piping.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
				Temperature controlled storage/ feed system to manage humidity related agglomeration risk.
	SCR	N	N	Not mentioned in report – assumed not used.
	Catalytic filter bags	N	N	Not mentioned in report – assumed not used.
	Wet scrubber (NH ₃ polish)	N	N	Not mentioned in report – assumed not used.

A.37.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-147: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Dry urea	Dry urea	See below.
Concentration etc	N/A	N/A	The Urea is a dry solid formed of CO(NH₂)₂ with a prill size of around 2mm diameter. The prills contain 46% Nitrogen with around 0.5% formaldehyde for hardening. Loose bulk density is around 750 kg/m³ and compacted is around 800 kg/m³
Dose rate kg/tMSW			- Increased risk of blockages on the urea screws noted when the dosing rate is greatly increased. - See dose rate notes under emission data table for set points assessed.
Number of injection levels	2	2	<i>“only one of the 2 nozzle levels injects the product into the boiler, the other is cooled and kept unclogged by air..”</i>
Number of injection points (total)	6	6	3 on each of two levels
SNCR control system	Y	Y	<i>“The NO_x content (corrected value for 6.2% O₂, as moving average on 5 minutes) is an input for controller which has a fixed set point delivering a 4-20mA signal which controls the speed set point of the dosing screw inverter.”</i> <i>“The NH₃ content is compared to the NH₃ operational setpoint. The result operates as a correction of the NO_x controller set point to reduce the speed of the dosing screw. An alarm is generated on a high deviation between the measurements and setpoints.”</i>
Injection location optimisation applied. Y/N (e.g. for temperature zones)	?	?	Not discussed in report.



A.37.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-148: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average					- Set point 230 mg/Nm³ delivers emission level daily averages across both lines in range 167-183 mg/Nm³ (NH₃ below 0.4mg/Nm³, dose rates 6.9 to 7.5 kg/hr). - Trial at 150 set point gave NO_x d avg 116-120 mg/Nm³ (NH₃ 0.29 – 1.05 mg/Nm³, and dose rates 15-32 kg/hr) – minor blockages. - Trial at 145, NO_x d avg 113-117mg/Nm³ (NH₃ 0.33-1.29. dose rate 16.8-31.1 kg/hr) – more blockages.
NH ₃ (air) mg/Nm ³ daily average					As set point lowered the ammonia level increases on average from 0.34mg/Nm³ to 0.84mg/Nm³ on line 1 and from 0.04mg/Nm³ to 0.51mg/m³ on line 2.
N ₂ O (air) mg/Nm ³ daily average					Not reported.
Residue quality					Data suggests no change over trial.

A.37.3 Key Observations

The operator states that:

- The site can meet the current permitted limit for NO_x value of 160mg/m³ comfortably with the solid Urea SNCR system currently installed while maintaining a relatively low level of ammonia emission. This is below the BAT-AEL compliance levels of 180mg/m³. To drive NO_x abatement down further shows a relatively considerable increase in Urea consumption and ammonia slip; both of which come with their own environmental impacts.*
- Avonmouth ERF are currently operating NO_x levels on average 179mg/m³ which is below the BAT-AEL compliance levels of 180mg/m³ for NO_x. The trials show the site can comfortably achieve levels below the compliance level for NO_x of 180mg/m³ and 15mg/m³ of ammonia.*
- The trial also shows that there is an increased risk of blockages on the urea screws when the dosing rate is greatly increased.*
- The ammonia levels are still low on average there has been an increased amount of ammonia slippage while trying to achieve the lower set points on the NO_x.*

Key observations:

- Report states current ELV is 160mg/Nm³ and that this is comfortably met.
- Trial and report do not include results for a set point targeting the identified 160 mg/Nm³ ELV compliance.



- The set point of 150 shows urea dose rates above those when a set point of 230 mg/Nm³ was used, and blockages are noted.
- A set point in the range 200 to 160 mg/Nm³ may be expected to reveal a point where daily average NO_x emissions are 120-170 mg/Nm³, without blockages.
- Urea dosing blockages and increased consumption appear to provide the main constraints, whereas NH₃ levels are consistently very low and there is no evidence of residue contamination.
- No data provided for Nitrous Oxide emissions.
- Strong focus on avoiding reagent blockages, but no discussion or mention of primary NO_x measures or consideration of NO_x reagent temperature zone optimisation.

A.37.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- Optimisation of daily average emissions may be seen in the region 120-170 mg/Nm³, and likely below 150mg/Nm³ given the 160mg/Nm³ ELV reported and other trial data.
- Further trials to assess this range and identify the optimum are advised and should include consideration of nitrous oxide and primary measures, as well as approaches to avoid urea blockages, and reagent temperature & location optimisation & control.



A.38 Battlefield

A.38.1 Basic Data

The table below summarises basic installation data.

Table A-149: Basic installation data

Subject Area	Data
Name	• Battlefield Energy from Waste Facility
Operator	• Veolia ES Shropshire Limited
Location / Address	• Vanguard Way, Shrewsbury SY1 3TG, UK
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial
Capacity tonnes / annum total	• 102,000 tpa • 8MWe
Number of lines	• 1
First operation date	• 2015
Main supplier / OEM (grate/boiler/furnace lead)	• CNIM
Main supplier SNCR/ FGT	• LAB

A.38.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.38.2.1 Techniques Deployed

Table A-150: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control			• "Primary NO _x control is managed through combustion optimisation with the equipment manufacturer. The most recent visit prior to the trials was in June 2022"
	Oxygen set point (% excess)			
	Feed rate control			
	FGR	N	N	• Confirmed not.
Secondary	SNCR	Y	Y	• Injection of air blown delivered solid urea prills (100% urea) via a measuring screw from the urea silo; there is a backup injection dosing available.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
				PPM of SNCR system includes regular inspection and cleaning to target good operation including avoiding urea blockages (highest risk silo side).
	SCR	N	N	Not mentioned in report – assumed not used.
	Catalytic filter bags	N	N	Not mentioned in report – assumed not used.
	Wet scrubber (NH ₃ polish)	N	N	Not mentioned in report – assumed not used.

A.38.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-151 NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea	Urea	Solid urea prills (100% urea).
Concentration etc	N/A	N/A	Solid.
Dose rate kg/tMSW	1.4	2	Increased from approx. 1.5 to ~3 kg/tMSW over trial range.
Number of injection levels	2	2	The majority of the time, the site utilises the upper injection levels.
Number of injection points (total)	8	8	Each injection level has four injection nozzles and the angles of these are orientable if required for optimisation purposes.
SNCR control system	Y	Y	The measuring screw speed injection is determined by the NO_x levels measured in continuous by the CEMS equipment.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	Y	Y	urea is injected in either an upper or lower nozzle level, depending on the roof temperature measured via pyrometers in the furnace but not both at the same time.

A.38.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-152: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180	200	180	- Trial set points used: 190, 180, 170, 160 mg/Nm³. - NO_x emission reduced with each step from ~190 to 165-170 d avg.



Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NH ₃ (air) mg/Nm ³ daily average	?	15	15	Below 10 ?	- Slip to air increased to ~9mg/Nm³ at 180 set point but then reduced below 7 and then 5 at 170 and then 160. - Short term ammonia slip instability reported.
N ₂ O (air) mg/Nm ³ daily average	?	?	9-10	?	N₂O emission levels decreased over trial range from around 10mg/Nm³ to 6-7 mg/Nm³.
Residue quality					<i>No significant effect on residue composition was identified from the trial.</i>

A.38.3 Key Observations

- The plant can operate within the new BAT-AEL of 180mg/m³ for NO_x and the new ELV for ammonia slip of 15mg/m³ at stack.
- Urea consumption increased notably when NO_x set point was changed from 170 to 160 mg/Nm³.
- Unusually, both NH₃ slip to air and nitrous oxide emissions reduced at lower set points but increased when initial reductions to 180 mg/Nm³ were undertaken.
- Instability in short term NH₃ emissions noted and concentration levels, while compliant, are higher than some other installations.
- Countermeasures were needed to reduce reagent blockage risk at higher dose rates (rodding and vibration).
- Injection locations selected at design stage – not clear whether optimisation since has been considered.
- No significant residue impacts noted.
- Reagent consumption was noted and suggested as a constraint. The rationale was blockage risk, but no information provided on costs or change options explored to reduce blockages.

A.38.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- An initial AEL of 180mg/Nm³ NO_x and 15mg/Nm³ NH₃ appears suitable, to assess compliance & performance over a longer period. A daily average of 10mg/Nm³ may be achievable for NH₃.
- Performance is unusual, suggesting further assessment is required e.g. to assess why NH₃ and N₂O reduced when targeting lower NO_x set points.
- Current plant design configuration appears to present constraints on achieving lower emission levels. Operator might be requested to consider cost / benefits of alterations, but noting relatively small scale the achieved environmental benefits may be limited.



- Further investigations may include “*combustion variability and the usage of the urea prills as the reagent*” as the operator suggest these may explain current limited ability to achieve further reductions. Also, whether injection locations may be altered to further optimise.



A.39 Suez - Wilton

A.39.1 Basic Data

The table below summarises basic installation data.

Table A-153: Basic installation data

Subject Area	Data
Name	• Wilton 11 EfW
Operator	• Suez R&R UK
Location / Address	• Clifton Marsh Landfill Site, Lytham Road, Clifton PR4 0XE
Location Character (Industrial/ Urban/Rural/ Mixed)	• Rural
Capacity tonnes / annum total	• 500,000 • 46 MWe
Number of lines	• 2
First operation date	• 2016
Main supplier / OEM (grate/boiler/furnace lead)	• CNIM
Main supplier SNCR/ FGT	• Yara (NO _x -Sol)

A.39.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and doses rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.39.2.1 Techniques Deployed

Table A-154: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control			• <i>MICC (Martin) combustion control system is optimised to stabilise steam generation flowrates, rather than reduce NO_x emissions.</i> • <i>Influence of air flowrates on raw NO_x (and CO) is noted.</i> • <i>Overall, combustion optimisation and steam production are prioritised while ensuring emissions remain within permitted limits and are effectively controlled.</i>
	Oxygen set point (% excess)	7%	7%	
	Feed rate control	?	?	



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	FGR	N	N	Not noted in report.
Secondary	SNCR	Y	Y	See system description.
	SCR	N	N	Not noted in report.
	Catalytic filter bags	N	N	Not noted in report.
	Wet scrubber (NH ₃ polish)	N	N	Not noted in report.

A.39.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-155: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Ammonia	Ammonia	25% aqueous solution (delivery). 70m³ site storage.
Concentration etc	25% diluted	25% diluted	Normally diluted approximately 3:2 (water: ammonia solution), adapted to NO_x emissions.
Dose rate kg/tMSW		0.4 – 0.5	- Limited rise at set points 175 & 165 mg/Nm³, but 20% jump at 155 on Line 1. - Line 2 little change over trial range – suggestion that lower emission ranges may be achievable.
Number of injection levels	4	4	6 on each level each line. - Levels A to D approx. 2-3m between each.
Number of injection points (total)	48	48	24 per line.
SNCR control system	Y	Y	- Gas temperature measurements (IR pyrometer signals) are used to dynamically / automatically control injection rates and locations / levels. Levels C&D provide additional manual control back-up, but this has not been required. - CEMS data for NO_x & NH₃ are linked PLC and to NO_x set point to control reagent solution concentration/dilution. - Comprehensive SNCR system maintenance in place incl PPM.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	Y	Y	<i>Specifically, at Wilton EFW, the targeted range is 850°C up to 950°C...</i> - Dynamic system using multiple injection locations, rates, concentrations.

A.39.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-156: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180	?	140-150	- CEMS data showed trial set points delivered emissions approx. 30-40mg/Nm³ below set point values. - CEMS values iro 130-160 – lower end some instability both lines. - Indication both lines may target emissions iro 150 (L2 140?) without major compromises.
NH ₃ (air) mg/Nm ³ daily average				<1-2 ?	- L1 1-4 across trial range. - L2 0.5 – 2 across trial range. - Elevated at lower trial set points.
N ₂ O (air) mg/Nm ³ daily average	?	?		< 2?	Generally low (< 2 mg/Nm³) and stable across trial range, although some indication of elevation L1 at lowest trial point.
Residue quality	See report data	See report data	See report data	See report data	Some variations, but trends not obvious – possible indication of APCr contamination at some trial points.

A.39.3 Key Observations

The Operator concludes that:

- The trial has proven that both lines at Wilton 11 EfW can effectively and reliably comply with the new BAT-AEL's of 180 mg/Nm³ for NO_x while remain well below the ELV of 15 mg/Nm³ for NH₃ across both lines.*
- The SNCR abatement system has demonstrated that operating to lower set points can be achieved whilst maintaining good control, with Line 1 achieving a low of 138 mg/Nm³ (11% reduction) and Line 2 127 mg/Nm³ (8.9 % reduction) with a 4.1% and 1% addition, respectively, of extra reagent emphasising the systems operational efficiency.*
- The trial highlighted the different responses between the two lines. Line 2 continually achieved a lower daily average than Line 1 for the same set point, whereas Line 1 had greater control at the lower setpoints.*
- Both lines had relatively low ammonia slip levels across all setpoints.*
- Discrepancies in daily average emissions versus the setpoint for both lines prompt an in-depth investigation into operational variances, offering insights for targeted optimizations to enhance performance and resource utilisation.*
- Combustion optimisations will continue which provide scope for further improvement of the abatement system allowing lower emissions levels to be achieved or reduce reagent usage. This is planned in for the second half of 2024, as the site is carrying out a major Outage from April – June 2024.*
- This system itself will remain as is, with no plans for equipment changes or overall philosophy changes because the performance of the system has been positive so far.*



Other observations:

- Trial set points used were 185, 175, 165, 155 and CEM emissions iro 30-40 mg/Nm³ below set point resulted.
- Combustion optimisation approaches target stable steam generation, rather than reducing NO_x emission, with permitted NO_x (and other) emission levels as an overall constraint (NO_x then mainly controlled via the SNCR system). This implies there may be some room to further investigate NO_x (and other emission) reduction.

A.39.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- Trial data suggests a longer-term target NO_x emission average iro of 140-150 mg/Nm³ is achievable in the short term, without significant compromises.
- Indications that the plant may also have capacity to sustain still lower levels, subject to further testing & optimisation – possible opportunity areas include some integration in the NO_x reduction approach of primary measures (which currently target steam stability), and exploitation of apparent existing spare design capability in the SNCR system (e.g. spare level / injection locations, very stable reagent consumption rate Line 2). Such tests would also need to consider NH₃ slit, which shows some signs of increase at lower trial already undertaken.
- Operator has *“no plans for overall equipment or overall philosophy changes” but also indicates “scope for further improvement of the abatement system allowing lower emissions levels to be achieved or reduce reagent usage”*. This, and the relatively large scale and new design features of the installation suggest some further optimisation may deliver further economic emissions reductions.
- NH₃ & N₂O levels are currently low, so there may be a possibility to set a target emission below the BREF AEL.
- FGR not used, and although retrofit unlikely to be appropriate, should be justified (unless already in the original application).



A.40 Eye Power Station

A.40.1 Basic Data

The table below summarises basic installation data.

Table A-157: Basic installation data

Subject Area	Data
Name	• Eye Power Station
Operator	• EPR Eye Limited
Location / Address	• Eye Power Station, Oaksmere Business Park, Eye IP23 8BW
Location Character (Industrial/ Urban/Rural/ Mixed)	• Rural / Industrial
Capacity tonnes / annum total	• 160,000 (wood waste & chicken litter / biomass) • 12.5 MWe generation
Number of lines	• 1
First operation date	• 1992
Main supplier / OEM (grate/boiler/furnace lead)	• Aalborg Energie Technik
Main supplier SNCR/ FGT	• No information

A.40.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and dose rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.40.2.1 Techniques Deployed

Table A-158: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	Y	Y	<i>Primary control techniques that had been used in past years were:</i> • Waste fuel selection. <i>Combustion Control through:</i> • Adjustment of fuel feed. • Combustion Air control. <i>And:</i> • Low excess air ratios. • Air staging
	Oxygen set point (% excess)	Y	Y	
	Feed rate control	Y	Y	



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
				Temperature control. <i>Improvised water sprays were used as needed to provide an additional level of control for thermal NO_x.</i>
	FGR	N	N	Keywords not found in report.
Secondary	SNCR	N	Y	SNCR installed to meet reduced IED WI BATC's AELs.
	SCR	N	N	Not noted in report.
	Catalytic filter bags	N	N	Not noted in report.
	Wet scrubber (NH ₃ polish)	N	N	Not noted in report.

A.40.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-159: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent		Urea	Urea.
Concentration etc		35%	Urea solution 35%.
Dose rate kg/tMSW			Trial used 1 to 1.6 l/t waste.
Number of injection levels	0	1	- Single injection level enforced due to access issues. - Water spray used to control T at that location.
Number of injection points (total)	0	4	Original design constrains options.
SNCR control system			Water spray used to control T noted as important for SNCR optimisation.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	N	?	<i>The plant's relatively small size and operating temperatures limited the available urea injection zone to a single level near the roof of the furnace; to accommodate that limitation it was later discovered that prevailing process conditions had to be modified so that urea and NO_x reactions could occur.</i>

A.40.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-160: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180		170?	- From 2006 to 2013 the WID Daily Average ELVs for CO and NO_x were 50 and 200 mg/Nm³ at 11 vol% O₂ ref. - The ELVs for CO and NO_x in the permit variation issued in November 2023 are 50 and 180 mg/Nm³ at 11 vol% O₂; the CO ELV is unchanged, but the NO_x ELV is reduced by 10%. - That permit variation also set an ammonia ELV of 15 mg/Nm³ if an SNCR system is installed. Those ELVs were applied from December 2023. - The daily average of NO_x emissions over the trial was typically iro 170 mg/Nm³.
NH ₃ (air) mg/Nm ³ daily average	N/A	15			Results during the first two formal IC1 trials were encouraging, daily averages for NO_x and NH₃ were well below the new ELVs and N₂O emissions were near zero. There was a CO ELV breach that was caused by a solid fuel feed system defect.
N ₂ O (air) mg/Nm ³ daily average				Near zero	
Residue quality					- Changes in metal content not due to SNCR. - Low ammoniacal N data reported.

A.40.3 Key Observations

- Older facility, operating since 1992 and experiencing some constraints due to earlier design for different ELVs.
- Comprehensive investigations undertaken and report supplied, that appropriately covers a full range of combustion and SNCR issues.
- Plant faced various challenges meeting pre-BREF 2019 ELVS (NO_x and CO) when only primary controls were used.
- Seasonal fuel variations create challenges for NO_x and other emissions.
- SNCR was installed and “Use of Primary Control Techniques and the SNCR system were optimised in March and April 2024”.
- Results during the first two formal IC1 trials were encouraging, daily averages for NO_x and NH₃ were well below the new ELVs and N₂O emissions were near zero. There was a CO ELV breach that was caused by a solid fuel feed system defect.
- Boiler tube corrosion issues caused by Urea injection were addressed and SNCR was modified in summer 2024. Optimisation trials in July 2024 “did demonstrate that under normal operating conditions, at a more challenging time of year, that the new NO_x, NH₃ and CO ELVs can be met concurrently”.
- The variations in furnace temperatures driven by changes in seasonal and operational conditions, and the enforced use of a single injection level in the furnace, have resulted in adoption of a flexible approach to use of the SNCR system and water injection. It has not been possible to establish an optimised NO_x emission value that can be met consistently. Rather, use of the SNCR system has to be



adapted to deliver the best results that can be achieved for conditions actually encountered.

- It is intended that further trials will be undertaken to establish a nominal set of SNCR system parameters for a range of anticipated conditions. Those nominal settings will need to reflect seasonal changes, position in the off-line cleaning cycle and use of cooling options to moderate furnace temperatures. They will provide operators with a starting point for setting DCS and SNCR system controls, but it is anticipated that pragmatic adjustments will be needed.
- No evidence of relevant residue impacts during SNCR trials

A.40.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- New BREF AELS already present a challenge for this aged facility that was designed for higher emissions. Despite this compliance with BATEALS is achieved, with the recent new addition of SNCR.
- Further SNCR optimisation and trials are ongoing – EA to follow up. The results may reveal options for better overall control, but radical reductions in NO_x may be unlikely, given fuel and original design constraints. Ongoing trials will include better consideration for seasonal fuel variations.
- Fuel type and variation present particular difficulties, including for CO – fuel pre-treatment / blending / supply chain management may have a role to play and should be discussed further, although it is noted that mixing and storage is already undertaken.
- Different approaches to on-line cleaning may help to eliminate the issues experienced – operator review of market options appropriate.
- Overall, the trial and report suggests the Operator is making best efforts to optimise emissions and investigate opportunities, despite challenging fuel type and plant age. Plant scale and location mean NO_x sensitivity may be relatively low and not then a driver for further reductions beyond the BATAELS now complied with.



A.41 Javelin Park

A.41.1 Basic Data

The table below summarises basic installation data.

Table A-161: Basic installation data

Subject Area	Data
Name	• Javelin Park ERF
Operator	• Urbaser Environmental Ltd (FCC)
Location / Address	• Javelin Park, Stonehouse, Gloucestershire GL10 3ET
Location Character (Industrial/ Urban/Rural/ Mixed)	• Rural
Capacity tonnes / annum total	• 190 ktpa
Number of lines	• 1
First operation date	• 2019
Main supplier / OEM (grate/boiler/furnace lead)	• BWV
Main supplier SNCR/ FGT	• BWV

A.41.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.41.2.1 Techniques Deployed

Table A-162: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control			• Primary & secondary air control noted, with primary air "optimised before the trial was underway".
	Oxygen set point (% excess)			
	Feed rate control			
	FGR	N	N	• Not noted in return
Secondary	SNCR	Y	Y	
	SCR	N	N	• Not mentioned
	Catalytic filter bags	N	N	• Not mentioned



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	Wet scrubber (NH ₃ polish)	N	N	Not mentioned

A.41.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-163: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Ammonia	Ammonia	38,000 L storage on site.
Concentration etc			Ammonia solution 25%, further diluted for injection via lances.
Dose rate kg/tMSW	765 l/day at 190 NO _x daily average	1058 l/day at 165-175 daily average	During the trial : “daily ammonia usage ... noticeably increased, from an average of 765 litres a day up to 1058 litres a day on average, a 38% increase in raw material usage.”
Number of injection levels	3	3	3, with “2 used in normal operation”.
Number of injection points (total)	18	18	6 each level, and 12 used.
SNCR control system			“Injection system works by giving a desired set point of NO_x on control system.”
Injection location optimisation applied. Y/N (e.g. for temperature zones)			Not discussed.

The operator noted from the trial that:

- Whilst the facility was easily able to comply with the BAT AELs for both NO_x and NH₃ with relative ease, without adverse effect on the plant’s performance, the amount of ammonia being used and injected into the boiler was quite significant with a 38% increase for a reduction of around 20mg/m³. When the facility reduced the daily average of NO_x from 170mg/m³ to 165mg/m³ from the 10th February to the 15th February, there was a jump in the average daily ammonia usage from 996 litres a day to 1156 litres a day.

A.41.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-164: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180		165-175	Trial foreshortened but compliance with new BREF levels demonstrated.



Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NH ₃ (air) mg/Nm ³ daily average	15				Pre-trial emissions typical 0.27 mg/Nm³ increased to 0.79 mg/Nm³ during the trial.
N ₂ O (air) mg/Nm ³ daily average					"There was no change found in the daily average nitrous oxide emissions".
Residue quality					<i>There was no noticeable change in the composition of the IBA and APCr, with the pH and all other characteristics remaining in line with expected levels and previous results for the facility</i>
Other					

A.41.3 Key Observations

- Operator concludes that:
 - "The facility is comfortably able to comply with the BAT-AELs of 180mg/m³ for NO_x and 15mg/m³ for ammonia."
 - "The NO_x daily average was quite comfortably reduced below 180mg/m³, regularly finishing around 165mg/m³."
 - A sizeable reduction in NO_x was easily achievable, with minimal effect on NH₃ emissions, but a medium effect on ammonia usage.
- Trial was cut short due to ammonia supply issues
- Operator suggests:
 - "further investigations could look into the extremes the facility could reach without strongly adversely affecting emission or plant performance."
 - "Initial conclusions show that the facility has the potential to achieve below 160mg/m³ with scope to potentially be able to operate below 150mg/m³ under normal conditions." – although noting possible costs and adverse impacts
 - Further improvements could possibly be made with the facility looking into different 'recipes' of ammonia injection i.e. different blends of the ammonia solution and water to try and reduce the ammonia usage. Further, more advanced technical improvements could potentially be made on the abatement system with a large financial and technical cost to the facility.
- Overall, there would appear to be potential to investigate achieving further NO_x reductions, subject to consideration of the costs and consumption issues noted.

A.41.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- Compliance with 180 mg/Nm³ and 15 new BAT AELs is assured and appropriate pending further optimisation investigation noted.
- Operator should carry out the further investigations noted, and target and ELVs may then be re-assessed. Indications are that the facility has the potential to achieve below 160mg/m³ with scope to potentially be able to operate below 150mg/m³ under normal conditions.



- The trial was foreshortened, so additional investigations to consider lower NO_x levels appear appropriate and should include consideration of primary and other advanced / control techniques (these may reduce reagent consumption). The low NH₃ slip and (reported – no data) lack of N₂O sensitivity suggest some opportunity, although reagent consumption (cost) needs consideration.



A.42 Welland

A.42.1 Basic Data

The table below summarises basic installation data.

Table A-165: Basic installation data

Subject Area	Data
Name	• Welland Bio Power Limited
Operator	• Welland Operations Limited
Location / Address	• Welland Business Park, Spalding PE12 6BL
Location Character (Industrial/ Urban/Rural/ Mixed)	• Rural
Capacity tonnes / annum total	• 72,000 waste wood • 10.3 MWe gross design
Number of lines	• 4 pyrolysis units feed 1 combustion unit
First operation date	• 2017
Main supplier / OEM (grate/boiler/furnace lead)	• Nexterra
Main supplier SNCR/ FGT	• No information

A.42.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and doses rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.42.2.1 Techniques Deployed

Table A-166: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	Y	Y	• Pyrolysing stages produce syngas. • Trial O₂ levels 4.08 and 4.28% (normal operational 3-6%). • "syngas drawn into the Oxidizer by induced draft which is then combusted with a controlled amount of oxygen to allow for complete combustion by process of two air rings, a fresh air inlet and flue gas recirculation (FGR) valve. Utilising FGR in this manner also assists in secondary control in the reduction of NO_x production".
	Oxygen set point (% excess)			
	Feed rate control			



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	FGR	Y	Y	Urea.
Secondary	SNCR	Y	Y	
	SCR	N	N	Not noted in report.
	Catalytic filter bags	N	N	Not noted in report.
	Wet scrubber (NH ₃ polish)	N	N	Not noted in report.

A.42.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-167: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea	Urea	30m³ tank storage.
Concentration etc	40%	40%	The SNCR solution is pumped at 4-5 bar pressure and injected, utilising an air-atomised nozzle system into the flue gas.
Dose rate	32-25 l/hr Average 3.77 l/t	41.28 at 245 NO _x test level Est 0.45 l/t	During normal operation, operating at a 75-85% MCR, would see the plant consume around 32-35 litres per hour of urea (Figure 12). The dosing rate was 41.28 litres per hour during the first week of the trial which is unsustainable from a urea consumption, dosing rate and a financial viability perspective. The system can deliver rates of 60-100 litres per hour, but this would require using both levels of injection, which would remove the redundancy of the system and would likely lead to breaches of the ELV or require abnormal operation to remedy, if one of the systems was to fail.
Number of injection levels	2	2	Two, but second used as a redundancy to intervene and avoid ELV failures.
Number of injection points (total)	6	6	4 level one, 2 level two.
SNCR control system	Y	Y	- We have the dosing automated with a set point that aims to control the NO_x being created. The dosing is adjusted to optimise the amount of urea being dosed and reacted to minimise ammonia slip. - Each injection level has a control valve and flow meter to regulate and monitor the amount of urea entering the system. The control valves run in either manual - where the operator specifies the opening levels, or an automatic mode - where the control valves are positioned based upon information fed back from the NO_x level instruments and the firing rates of the gasifiers with a requested target value. - PPM in -place for de-NO_x system.



Criteria	Pre-trial	Post Trial / Proposed	Comments
			We have installed and commissioned a NO_x sensor that is positioned at the economiser of the HRSG to enable us to have a more rapid response in NO_x control as the feedback from the sensor is sent directly to the PLC, this also allows us to have a standby system to read and control NO_x.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	?	?	- introducing the urea solution with air to create a fine spray for rapid dispersion. This mixes with the flue gas stream more efficiently, where the precise temperature and residence time for reaction is provided. - Limited information supplied to demonstrate how T zones are optimised.

A.42.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-168: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	270		260	240 proposed	270mg/Nm³ IC target (assumed 6% O₂). - Trial set points 245 & 235 tested and gave CEM daily average levels of 240 and 225 mg/Nm³ respectively. - Elevated PM at end of 235 trial led to termination, along with dose rate increase.
NH ₃ (air) mg/Nm ³ daily average	?	?	?	?	Zero reported across all trials.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	Below 20	Nitrous Oxide emissions generally in the range 15-20 mg/Nm³.
Residue quality	- IBA content remains consistent throughout for both Kjeldahl and ammoniacal nitrogen and is unaffected by the trial. - The ammoniacal nitrogen shows a large increase during the trial in comparison to the pre-sample and continues to rise into the second week of the trial. This shows ammonia slip as the APCR is determined to have absorbed additional amounts of ammonia in the baghouse increasing the Ammoniacal Nitrogen to more than two times the pre-sample levels.				

A.42.3 Key Observations

- Normal set point is 260 for the 270 EAL. Trial set points 245 & 235 tested and gave CEM daily average levels of 240 and 225 mg/Nm³ respectively.
- Operator proposes a target set point of 240 mg/Nm³ daily average.
- Week 1 (245 set point) NO_x emissions were more stable than week 2 (225). Week 2 fluctuations have been associated with interventions required to manage additional dust accumulations.



- Increased reagent dose rates, cost and supplier delivery issues noted as constraints on higher reagent dosing levels.
- Operator notes that: *During normal operation, the cost of urea for one financial year would be an approximate £58,360. However, if we were to run at the NO_x setpoints during the trial period, we would see an annual Urea cost of £67,162 (prices subject to market variation). This would cost the company an **extra £8,802 per year**, not including the increased rate of APCR disposal and delivery costs. This would negatively impact the plant financially.*
- Reagent consumption reduction noted during week 2 (lower set point) associated by the operator with feedstock variations. Comments (IC report p12) on waste composition and NCV variation note that “fuel was not sampled during the trial” but available data for samples taken close to the trial indicate NCV variations 13.2-14.8 kJ/kg.
- Zero emissions of NH₃ is unusual – if correct this may indicate a low EAL can be set.
- Evidence of NH₃ accumulation on APCr is presented (IBA unaffected as upstream of dosing).
- Nitrous Oxide emissions generally in the range 15-20 mg/Nm³ are relatively stable across the trial range but appear higher than other facilities, possibly due to the unusual pyrolysis design and related combustion stage optimisation issues.
- Although the need to target reaction temperature window is noted as necessary for optimisation, information to demonstrate how this achieved is very limited.

A.42.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- The proposed NO_x target of 240 mg/Nm³ appears reasonable for the installation in its present configuration.
- Additional costs of £8,802 per year appear low, although increased contamination of APCr needs further assessment.
- NH₃ air emissions need to be checked as zero is unusual.
- Investigation may reveal combustion stage optimisation opportunities to lower the apparently high (but stable) N₂O levels.
- The report suggests there remain opportunities to achieve further NO_x reduction, including to ensure reagent dosing targets reaction temperature zones, which may also give potential for NO_x reduction without the limitations observed during the trials.



A.43 Birmingham Biopower

A.43.1 Basic Data

The table below summarises basic installation data.

Table A-169: Basic installation data

Subject Area	Data
Name	• Birmingham Bio Power
Operator	• Tyseley Operations Limited
Location / Address	• Tyseley, B25 8HT, England, United Kingdom
Location Character (Industrial/ Urban/Rural/ Mixed)	• Urban / industrial
Capacity tonnes / annum total	• 72,000 demolition wood
Number of lines	• 1 • Gasification - combustion
First operation date	• 2016
Main supplier / OEM (grate/boiler/furnace lead)	• Nexterra
Main supplier SNCR/ FGT	• Nexterra

A.43.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.43.2.1 Techniques Deployed

Table A-170: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control			• Trials were run at 5.38 & 6.14% O₂ at boiler exit (design / operating set point 4%) and reduced MCR (~78% vs 89% design). • Primary measures not discussed in connection with NO_x emissions (gasifier operation is noted).
	Oxygen set point (% excess)			
	Feed rate control			
	FGR	N ?	N ?	• Not noted in report.
Secondary	SNCR	Y	Y	
	SCR	N	N	• Not noted in report.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	Catalytic filter bags	N	N	• Not noted in report.
	Wet scrubber (NH ₃ polish)	N	N	• Not noted in report.

A.43.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-171: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea	Urea	
Concentration etc			• 40% urea solution.
Dose rate l/hr	32-35	Trial 40-50 //hr i.e. +25-30% Trial data 4.36 – 5.3 l/tw	• Trials at 255 & 240 increased dose rate by 25-30% vs “normal operation” (260 set point to comply with 270 mg/Nm³ ELV). • <i>As a result of the high urea consumption and the dosing control valve being nearly in the fully open position while attempting to achieve a 240mg/m³ setpoint, the test was terminated at the end of week two.</i> • <i>During normal operation, operating at a 75-80% MCR would see the plant consume around 32-35 litres per hour of urea (Figure 2). The dosing rate was 40-50 litres per hour during the trial which is unsustainable from a urea consumption, dosing rate and a financial viability perspective.</i>
Number of injection levels	?	?	• No information.
Number of injection points (total)	2/4	2/4	• Line 1 has 2 injection nozzles. • Line 2 has 4.
SNCR control system	?	?	• No information supplied.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	?	?	• No information supplied.

A.43.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-172: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	?	270		240 proposed	• Trial at 255 & 240 mg/Nm ³ set points (5 and 10 % emission reduction).
NH ₃ (air) mg/Nm ³ daily average	?	?	?	Below 0.5 ?	• Low NH ₃ emissions across all trials – max figure of 0.38 mg//Nm ³ , with most zero.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	Below 10?	• Daily average 7-13 mg/Nm ³ across trials. • 7-10 at 240, 10-13 at 255 NO _x set point.
Residue quality	N/A	N/A	N/A	N/A	• <i>trial results reflect a steady and consistent level of Kjeldahl and ammoniacal nitrogen in residues.</i>

A.43.3 Key Observations

- Urea dose rate constrained by dosing system limitations, and reason for trial being stopped at 240 set point.
- Cost of additional reagent consumption stated as a constraint, but no cost data provided & lowest consumption data presented at lower NO_x set point tested.
- Very low NH₃ and no apparent clear correlation to reduced NO_x.
- Nitrous Oxide data suggest emission level (marginally) lower at 240 than 255 mg/Nm³ set point.
- Urea consumption rate (Table 2) are (counterintuitively) LOWER at 240 mg/Nm³ set point than 255, whilst NO_x does reduce with set point (from ~230-24 to 220 to 230) – fuel variation was given as a reason.
- Both NO_x (daily average) and Urea consumption data trend downwards over the 14-day trial.
- Operator proposes “optimal NO_x level of 240 mg/m³ (daily average) strikes a balance between emissions reduction and practicality within the existing system's capabilities”.
- Primary measures not discussed in context of NO_x reduction – gasification approaches can have such opportunities.
- The operator states that: *reaching a lower NO_x level would have required a significant increase in urea consumption, leading to the depletion of the urea tank at an unsustainable rate and potential issues with the dosing control valve. Additionally, the system's dosing capacity was nearly at its maximum.* While dosing valve limitations are noted, no cost or feasibility evidence for overcoming this is provided, nor to support the statement regarding urea consumption constraining lower NO_x target. Trial data suggest the opposite.



A.43.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- The operator has indicated it can target a set point of 240 mg/Nm³, which is an advance on the 270 BATAEL level, but the current trial and report does not provide a robust basis for not also considering lower levels still i.e. reagent dosing was reduced, NH₃ low and N₂O lower.
- A reduced NH₃ ELV may be achieved.
- Consideration of primary measures, combustion and NO_x abatement system control approaches may lead to improvements. Alterations made to the O₂ set point need consideration – it is usual for lower air supply to reduce NO_x (with limitations) and the gasification approach may provide opportunity as close air control is usually a fundamental.
- Further information / assessment of the dosing constraint cost and feasibility to assess lower set points is required to demonstrate optimisation point and evidence to support the statement that: *“achieving even lower NO_x levels would require significant modifications or improvements to the dosing capacity and urea consumption rate, which may not be feasible or cost-effective at the current stage”*.
- Issues with fuel variation are noted and may be a factor given the gasification approach (possible sensitivity limitations), but further information is required to assess this, noting that over reducing the regulatory ELV may also place limitations on feedstocks or require pre-treatment (cost issues).



A.44 Milton Keynes

A.44.1 Basic Data

The table below summarises basic installation data.

Table A-173: Basic installation data

Subject Area	Data
Name	• Milton Keynes Waste Recovery Park
Operator	• Thalia MK ODC Ltd
Location / Address	• 9 Dickens Road, Old Wolverton, Milton Keynes, MK14 5QF
Location Character (Industrial/ Urban/Rural/ Mixed)	• Mixed
Capacity tonnes / annum total	• 93,600 tpa, 5.8 MWe export to grid.
Number of lines	• 2
First operation date	• 2018 (?)
Main supplier / OEM (grate/boiler/furnace lead)	• Energos
Main supplier SNCR/ FGT	• Energos (no SNCR system at this plant)

A.44.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.44.2.1 Techniques Deployed

Table A-174: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	?	?	• Gasification technology noted as reducing high temperature NO _x production, but no information provided to explain design and control approaches in more detail.
	Oxygen set point (% excess)	?	?	
	Feed rate control	?	?	
	FGR	Y	Y	• FGR used.
Secondary	SNCR	N	N	
	SCR	N	N	• Not noted in report.
	Catalytic filter bags	N	N	• Not noted in report.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	Wet scrubber (NH ₃ polish)	N	N	Not noted in report.

A.44.2.2 NO_x Abatement / SNCR System Data

The plant does not have an SNCR system.

A.44.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-175: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	?	?	?	80 – 100 ?	- Daily averages already typically below 80 mg/Nm³. - No trial information.
NH ₃ (air) mg/Nm ³ daily average	?	?	?	?	No data provided, but no SNCR so slip not an issue.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	?	No data provided – possible sensitivity due to gasification approach?
Residue quality	?	?	?	?	No information provided.

A.44.3 Key Observations

- Very brief response provided with very limited information about the process (design) and optimisation / control approaches in place.
- Trial not undertaken but report notes that “Given the lack of a SNCR system on site the team approached the EA to discuss potential alternatives to conducting a trial. The following methodology was proposed and is currently under review.”
- Existing emissions averages already compliant with new BREF EAL – highest daily NO_x emission over 2021 to 2023 period was 125.9 mg/Nm³ and line 1 & 2 typically achieve daily average figures below 80 mg/Nm³, which is low.
- Highest 30 min average period on record of 328.1 mg/Nm³ is below 400mg/Nm³ ELV and suggests short term averages also not an issue.
- Gasification design does not include SNCR, but uses primary NO_x reduction approaches and FGR.
- Operator has proposed to provide EA a quarterly report of NO_x emissions with additional gasifier and furnace exit temperature and flue gas / recirculation flow.
- No information provided on NH₃ slip (but no SNCR so reasonable), residue quality or Nitrous Oxide emissions.



A.44.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- As the plant already achieves very low NOx emissions using primary measures it is possible that there is no need for further optimisation, although a lack of information about the approaches used to control the existing process, and of Nitrous Oxide data suggest some further checks are required to confirm this.
- Noting consistent low NOx EA may consider lowering permit ELV or a target iro 80-100 mg/Nm³, although N₂O data needs consideration – see below.
- NH₃ slip not expected due to lack of SNCR system, so non-reporting is logical.
- Checks on nitrous oxide emissions should be undertaken and results considered along with suggested temperature / gas flow and possibly Oxygen excess post combustion stage, to more fully understand optimisation overall.
- More information is required to explain the approaches used within the gasification design and operation that control the NOx levels, although low NOx level and relatively small plant size suggest priority may not be high.
- An adapted trial approach that also measures N₂O whilst exploring the (primary) approaches used would provide better evidence of optimisation of existing approaches, but use of SNCR appears unnecessary.



A.45 North Midlands Stoke

A.45.1 Basic Data

The table below summarises basic installation data.

Table A-176: Basic installation data

Subject Area	Data
Name	• Stoke EfW (Hanford Waste Services)
Operator	• North Midlands Operations Ltd
Location / Address	• Campbell Road, Stoke on Trent, Staffordshire, ST4 4DX
Location Character (Industrial/ Urban/Rural/ Mixed)	• Mixed urban
Capacity tonnes / annum total	• 210 ktpa • 14.2 MWe gross
Number of lines	• 2
First operation date	• 1997
Main supplier / OEM (grate/boiler/furnace lead)	• CNIM
Main supplier SNCR/ FGT	• No information

A.45.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and doses rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.45.2.1 Techniques Deployed

Table A-177: Techniques deployed

Category	Technique	Pre-trial	Post trial / proposed	Comments
Primary	Air control			• Report states "It is confirmed that the current working practices optimize the combustion process to ensure complete combustion." And that combustion parameters were optimised prior to the tests. • And: "There were no changes in any other primary NO_x reduction methods (e.g. Fuel selection, Combustion Control, Flue Gas Recirculation (FGR), Staged Combustion, Auxiliary burners, Oxygen injection, Natural
	Oxygen set point (% excess)	7.2%	7.2%	
	Feed rate control			



Category	Technique	Pre-trial	Post trial / proposed	Comments
				<i>Gas injection (Reburn) or Water injection during the trials.</i> – although not clear which are deployed.
	FGR	Y	Y	
Secondary	SNCR	Y	Y	• Urea prills injected with compressed air.
	SCR	N	N	• Not noted in report.
	Catalytic filter bags	N	N	• Not noted in report.
	Wet scrubber (NH ₃ polish)	N	N	• Not noted in report.

A.45.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-178: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea	Urea	• Urea prills.
Concentration etc	Solid	Solid	• Urea prills.
Dose rate kg/tMSW	1.61	1.83 at 160 2.09 at 150	• Feed screw speed was at 100% with lowest set point (150 mg/Nm ³).
Number of injection levels			
Number of injection points (total)	2	2?	• 2 (per line?).
SNCR control system	Y	Y	• CEMS data control screw feed rate. • Injection nozzles inspected twice daily.
Injection location optimisation applied. Y/N (e.g. for temperature zones)			• Not discussed in report.

A.45.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-179: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180		130-150 ?	• Set point of 220 has delivered CEMS daily averages iro 180mg/Nm³. • Trials gave emissions ranging 124 – 180. • 150 set point generally 130-150, 160 set point 140 – 150 mg/Nm³.



Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NH ₃ (air) mg/Nm ³ daily average	15	tbc	~3	<10?	- Increased from iro 3 mg/Nm³ base operation to 7-12 at 160 and 150. - More peaks at 150 than 160 mg/Nm³.
N ₂ O (air) mg/Nm ³ daily average	Not set			<10 ?	8-10 and consistent across full range including base operation.
Residue quality	?	?	?	?	APCR and IBA Ash Samples taken and presented but results not interpreted.

A.45.3 Key Observations

- Reductions in NO_x daily average levels from iro 180 mg/Nm³ to iro 130-150 were undertaken, with trials at 160 already achieving the majority of the gain and some indications of limitations (instability) when using 150 set point.
 - The findings of both trials showed that the new Best Available Technique Achievable Emissions Levels (BAT- AELs) of 180mg/Nm³ for NO_x and 15mg/Nm³ for NH₃ can be achieved.*
- Trials showed N₂O was only marginally increased, but NH₃ more significantly, rising from base case iro 3 to mostly iro 8-10 mg/Nm³, and some additional peaks at the lower set point.
- Average reagent consumption increased from 1.61 to 1.83 kg/tw from base case (NO_x emissions iro 180) to set point 160 mg/Nm³ when NO_x reduced to iro 140-150.
- Report states: *"It was noted by site operators that urea usage rose from around 6 tonnes per week between both boilers to 8 or 9 tonnes per week during the trials. This is not considered to result in any significant cost implications to the operator."*
- PPM is used to avoid blockage risk (can be an issue with solid systems).
- At the 150 level the screw feed rate was at 100% and therefore a current design limitation, although some subsequent post-trial changes that further target blockage risk reduction are noted.
- No discussion or information provided on how optimal temperature zones are targeted, and discussion of dose rate control is limited to a note of link to CEMs results.
- Residue results are provided but are not discussed or interpreted in the context of the trial conclusions.

A.45.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- Trial suggests that new BAT AELS can be met (subject to confirmation of residue data interpretation, as are all of the conclusions – EA to discuss with the operator and re-confirm conclusions accordingly)



- Implementation of a lower 160 mg/Nm³ target appears possible noting the trial data and recommendation that *“the plant operate at a setpoint of 160mg/Nm³ to achieve future BAT-AELs, with a minimal risk of ammonia slip and without excessive urea consumption.”*
- Setting a set point at 160 mg/Nm³ appears appropriate with the present design configuration, but may be expected to deliver average target average NO_x emission iro 140-150. Acceptance of a raise in NH₃ to iro 8-10 mg/Nm³ would appear to be a consequence, unless temperature zone targeting (see below) addresses this additional slip (which may be possible).
- Although the operator report states that *“it is not considered that there are any further optimisation improvements worth pursuing at this time, given the findings of the study show that the new BAT-AEL can be achieved.”*. The lack of explanation given may suggest that further focus on optimisation of temperature zone targeting and dynamic monitoring and control approaches are appropriate.



A.46 Mersey BE Widnes

A.46.1 Basic Data

The table below summarises basic installation data.

Table A-180: Basic installation data

Subject Area	Data
Name	• Widnes Biomass CHP
Operator	• BWSC / Evero Energy
Location / Address	• Mathieson Rd, Widnes WA8 0PB
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial / Urban
Capacity tonnes / annum total	• 147,000 tpa biomass • 22 MWe generation & 7.75 MW steam
Number of lines	• 1
First operation date	• 2017
Main supplier / OEM (grate/boiler/furnace lead)	• BWSC / SKB furnace boiler
Main supplier SNCR/ FGT	• Urea / water system - ERC • Primary & secondary air control & FGR - SKG

A.46.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.46.2.1 Techniques Deployed

Table A-181: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	Y	Y	• Primary and secondary air and flue gas recirculation have been optimised to account for various objectives. • Specific consideration of primary measures regarding NO _x noted but not explored.
	Oxygen set point (% excess)	5.4	5.79	
	Feed rate control	?	?	• Noted in report.
	FGR	Y	Y	
Secondary	SNCR	Y	Y	• Urea/Demin water injection.
	SCR	N	N	• Not noted in report.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	Catalytic filter bags	N	N	Not noted in report.
	Wet scrubber (NH ₃ polish)	N	N	Not noted in report.

A.46.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-182: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent			- Urea/Demin water injection. - Carbamin 5722. - In addition to OEM installed, two further 10m³ tanks installed.
Concentration etc	40%	40%	- Diluted with water for injection. 267 kg/h reagent with 453 kg/h water.
Dose rate kg/t MSW			- Typical urea consumption is 100 – 120kg/hr as per design value. 224 mg/Nm³ NO_x – 98.8 kg/hr urea. - Other reported: @192 / 137kg/hr. - Estimated: 180/152, 170/165, 160/177. <i>The increase in Urea consumption remained within the design of the system which can dose up to 267kg/hr.</i>
Number of injection levels	2	2	Two levels.
Number of injection points (total)	12	12	6 on each of 2 levels.
SNCR control system	?	?	- Not discussed in report. - PPMs are as per OEM recommendations and include SNCR lance. inspections/cleaning and equipment service by OEM.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	?	?	Not discussed.

A.46.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-183: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	270 (at 6% O ₂)	180 (at 11% O ₂)			- New AEL 180 at 11% O₂ dry gas. - Design ELV 270mg/Nm³, Normal 245mg/m³.
NH ₃ (air) mg/Nm ³ daily average	?	15		5 ?	Trial results iro 2 to 3 mg/Nm³ and limited deviation.
N ₂ O (air) mg/Nm ³ daily average	?	?	?	10 ?	Data generally 8 to 12 mg/Nm³.
Residue quality	?				The results of the ash sampling have not been received at the time of writing.

A.46.3 Key Observations

- Operator notes that:
 - From the results obtained and with the fuel supplied during the trial, the new BAT-AEL's of 180mg/m³ for NO_x and 15mg/m³ for ammonia are achievable
 - For a reducing in NO_x of 14%, an increase in urea of 39% was required.
 - There was no discernible change in NH₃ emissions.
 - There were no detectable changes in operation, process parameters or maintenance requirements.
 - The results of the ash sampling have not been received at the time of writing.
- Variations in fuel specification were noted as constraints and further work suggested to explore this dependency link to the NO_x levels that can be achieved.
- The operator also notes that:
 - Based on observations during the trial, provided fuel of similar quality is supplied, Nox emissions of 180mg/Nm³ are within the design range of the installed equipment. An increase in urea consumption of approximately 55% would be required.
 - Further tuning of the installed control system could potentially reduce Urea consumption.
 - Installation of advanced temperature measurement and additional injection levels can increase effectiveness of Nox reduction (65 – 70% claimed) whilst minimising urea consumption.
- Lack of residue data and information to allow assessment of SNCR optimisation e.g. temperature zone and monitoring / injection control optimisations

A.46.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- Follow up required to check residue contamination results & review optimisation conclusions accordingly.



- Follow up with Operator to assess control system and temperature optimisations approaches suggested – these approaches were not discussed in the report (so not possible to assess current degree of optimisation), but potential was indicated in the report conclusions, which needs follow up.
- In the meantime, the BREF EALs can be applied.



A.47 Tilbury Green Power

A.47.1 Basic Data

The table below summarises basic installation data.

Table A-184: Basic installation data

Subject Area	Data
Name	• Tilbury Green Power
Operator	• Tilbury Green Power Limited
Location / Address	• Port of Tilbury, Tilbury, London
Location Character (Industrial/ Urban/Rural/ Mixed)	• Urban / industrial mixed
Capacity tonnes / annum total	• 238,831 tonnes in 2023 (woodchip) • 43 MWe generation
Number of lines	• 1
First operation date	• 2019
Main supplier / OEM (grate/boiler/furnace lead)	• AET BWSC
Main supplier SNCR/ FGT	• AET (?)

A.47.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.47.2.1 Techniques Deployed

Table A-185: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	?	?	Report focus is on SNCR optimisation, but operator notes: • <i>In addition to the SNCR system the design of the boiler combustion system is automated with a 2.2% set point for oxygen (O₂). This set point was set up when the plant was commissioned and helps combustion techniques in aiding the reduction of prompt and thermal NO_x.</i>
	Oxygen set point (% excess)	2.2%	2.2%	
	Feed rate control	?	?	
	FGR	N	N	• FGR not described.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Secondary	SNCR	Y	Y	Urea solution with injection rate trimmed to flue gas emission level.
	SCR	N	N	Not noted in report.
	Catalytic filter bags	N	N	Not noted in report.
	Wet scrubber (NH ₃ polish)	N	N	Not noted in report.

A.47.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-186: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Aq Urea	Aq Urea	Aqueous urea solution.
Concentration etc	See right	See right	40%-45% aqueous solution (further diluted with demin water to inject with compressed air).
Dose rate	10 kg/hr at 285 NO _x set point	28 at 235 37 at 180	<i>Current reagent storage volumes on site are 54.72m³. The Urea silo operational capacity from 100% full (with no deliveries made and a pump low level interlock trip at 5% capacity) is around 95 days at the current 1% usage per day</i>
Number of injection levels	3	3	See figure 4.
Number of injection points (total)	12	12	6 front and 6 rear.
SNCR control system	NO _x flue gas level related dosing	As left	- Flow control to front / rear injector set by operator. <i>"The total urea flow is controlled according to the flue gas NO_x measurement".</i> - Various O&M approaches applied to maintain SNCR system performance.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	?	?	T window noted but specific operational optimisation to discussed: <i>"The reducing agent is injected as an aqueous solution into the hot flue gas in the boiler room at temperatures between 900 to 1100°C. CO(NH₂)₂ reacts with NO_x in the flue gas at temperatures between 850 to 1150°C (950 to 1000°C roof temperature during this trial)".</i>

A.47.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-187: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	300	270			The Urea testing at emission set points: • 285 gave 195-210mg/Nm³ • 235 gave 187 mg/Nm³ • 180 gave 143 mg/Nm³
NH ₃ (air) mg/Nm ³ daily average	22.5				• 285 gave 3.69 mg/Nm³ • 235 gave 1.37 • 180 gave 1.65 Drop is unusual.
N ₂ O (air) mg/Nm ³ daily average					• No information.
Residue quality					• No major changes recorded during trials.

A.47.3 Key Observations

- Biomass plant so original ELV 300 (at 6% O₂) and BREF ELV 270 mg/Nm³ or below.
- Operator notes that: *“The Urea dosing system with the current desired control values works very well and does not cause any operational or maintenance issues. Most importantly the system is fully compliant in controlling NO_x emissions at the current daily and half hourly limits as outlined within the Tilbury environmental permit. No breaches have occurred for NO_x since the plant has been fully operational.”*
- 285 mg/Nm³ is current set point and is reported to *“comfortably produces NO_x daily average results between 180mg/Nm³ and 200mg/Nm³”*.
- Trial only showed limited NO_x emission reductions with initial set point reduction to 235 but notable increased reagent consumption (10 to 28 kg/hr).
- Unusually, NH₃ emission levels dropped during the trial. Ammonia daily averages were well below the daily ELV of 22.5mg/m³ set with the new BAT-AEL limit. There were no issues with Ammonia emissions as part of this trial.
- No information provided about Nitrous Oxide emissions discussion about combustion optimisation / primary NO_x measures.
- No impact on residue quality noted.

A.47.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- Operator trial reports that they already achieves below BREF level of 270 mg/Nm³ (180-200 daily average) and limited benefit from reagent dosing increases is evident from trial data.
- Ammonia slip reduction as urea was increased is unusual but compliance with BREF level or somewhat below is achievable. This unusual NH₃ change, the combustion optimisation role and nitrous oxide emission need to be considered and N₂O emissions considered – as part of operator routine performance BAT demonstration.



- Tripling of reagent consumption likely to result in excessive cost (and possible operational risks in longer term?). This, and reports that emission are routinely in the 180-200 mg/Nm³ average range, suggest low case for ELV reduction below the BREF level (270) but possible that an annual average target iro 200 or marginally below may be achievable.



A.48 Evero Ince

A.48.1 Basic Data

The table below summarises basic installation data.

Table A-188: Basic installation data

Subject Area	Data
Name	Ince Park Biomass
Operator	Evero Energy
Location / Address	Ince Park, Ellesmere Port, Cheshire, UK
Location Character (Industrial/ Urban/Rural/ Mixed)	Industrial
Capacity tonnes / annum total	176,500 tonnes of waste wood per year - generating capacity of 24.69MWe
Number of lines	1
First operation date	2015
Main supplier / OEM (grate/boiler/furnace lead)	Outotec (gasifier)
Main supplier SNCR/ FGT	- Outotec (SNCR system) - Scrubber spray system was supplied by OEM Dustex.

A.48.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.48.2.1 Techniques Deployed

Table A-189: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	Y	Y	- Gasifier. - Fuel is burnt within the gasifier and oxidised using Overfire Air and Flue Gas Recirculation Air, the flue gas is treated within the oxidiser using Selective Non-Catalytic Reduction (SNCR) for the reduction of NO_x. - The flue gas system has been optimised to achieve the following:
	Oxygen set point (% excess)	No info	No info	
	Feed rate control	No info	No info	



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
				- Overfire air and Flue gas recirculation air to reduce gasifier ash build up and thermal NO_x. - Ensure compliance with permit IBA LOI. - Compliance with permit ELVs. - Reduce UREA and Hydrated Lime usage.
	FGR	Y	Y	FGR used.
Secondary	SNCR	Y	Y	Used.
	SCR	N	N	Not noted in report.
	Catalytic filter bags	N	N	Not noted in report.
	Wet scrubber (NH ₃ polish)	N	N	Reference to "Scrubber spray system was supplied by OEM Dustex." Assumed to relate to the lime/act carbon baghouse rather than a specific NH₃ scrubber.

A.48.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-190: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea	Urea	
Concentration etc			
Dose rate kg/tMSW			During the trial "UREA usage was reduced by 48% and a hydrated lime reduction of 37%." With the plan to help at a set point of 250 mg/Nm³.
Number of injection levels	No info	No info	Not discussed.
Number of injection points (total)	16	16	8 east & 8 west side.
SNCR control system	?	?	Not discussed in the report.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	?	?	Not discussed in the report.

A.48.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-191: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	280		250		Data not presented in report but screen shot suggest 245 mg/Nm³ average.
NH ₃ (air) mg/Nm ³ daily average	22.5		?		Data not presented, but screen shot suggests NH₃ emission level is below 1.5 mg/Nm³.
N ₂ O (air) mg/Nm ³ daily average	?		?		No information.
Residue quality	?		?		Not discussed in conclusions but trial result suggests no / limited impact.

A.48.3 Key Observations

- Although compliance with AEL is noted, supporting NO_x data is not presented in the trial report (screen shot of CMS suggests 245 mg/Nm³ but data not clear).
- IC report described compliance with new BAT AELs of 180 & 15 mg/Nm³ (NO_x and NH₃) but conclusions present results in relation to compliance with 270 and 22.5 mg/Nm³ (daily), and note compliance with these (latter) levels, whilst identifying that: *“During the trial period the site was able to reduce several consumables while maintaining the normal running setpoints and running conditions of the plant.”*
- Trial altered reagent dose rates with a combination of screw feed and lance (scrubber) flow to maintain 155 C at baghouse inlet – the Operator notes that the scrubber water spray increment will reduce urea demand / allow further NO_x reduction.
- The operator has focussed the trial on reduction of thermal NO_x production in order to reduce reagent consumption and shows evidence that this succeeded. This approach is different to most other operators who have focussed the trial on NO_x reduction.
- Alterations in the use of the “spray scrubber” are noted to allow *“...the overfire gas recirculation system (OFG) could be put into AUTO control and ramped upto full working capacity, this had a positive effect on the gasifier reducing the thermal NO_x within the system allowing the UREA system to reduce.”* - it is likely that the spray scrubber is assisting with temperature control, which then delivers the thermal NO_x reduction.
- No information supplied about N₂O emissions (this can be an issue with plants with lower Oxygen levels such as gasifiers, so needs assessing).
- Some issues with scrubber spray operations are noted, that may present constraints on its use. The operator is assessing this further.



A.48.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- Overall, the trial approach does not appear to have followed the IC protocol and the report provided does not provide sufficient data to assess whether lower NO_x emission can be achieved.
- Clarify which AEL applies (i.e. 270/22.5 or 180/15) – operator may need to repeat trials to demonstrate lower compliance level?
- Request more detailed trial results, including NO_x and NH₃.
- Consider N₂O emissions.
- Follow up on scrubber spray engineering report – the operation of this appears to offer potential for NO_x emissions reduction at the same reagent dose rates (costs) as well as the current 250 mg/Nm³ set point and lower usage / costs.



A.49 Gren – Widmerpool

A.49.1 Basic Data

The table below summarises basic installation data.

Table A-192: Basic installation data

Subject Area	Data
Name	• Widmerpool Biomass Power Plant
Operator	• Gren CHP (Nottingham) Limited
Location / Address	• Fosse way, Widmerpool, biomass NG12 5PS
Location Character (Industrial/ Urban/Rural/ Mixed)	• Rural
Capacity tonnes / annum total	• 70,000 waste wood • 6.7MWe (5.7 MWe export & heat option to 4.5MWth)
Number of lines	• 1 – moving grate 37 m stack
First operation date	• 2017
Main supplier / OEM (grate/boiler/furnace lead)	• Pensotti Fabrica Caldaie Legano S.P.A
Main supplier SNCR/ FGT	• Pensotti Fabrica Caldaie Legano S.P.A

A.49.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.49.2.1 Techniques Deployed

Table A-193: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	Y	Y	• The reference oxygen content for biomass is 6%. The plant is controlled to ensure the oxygen content remains as close to this reference as possible whilst still maintaining stable conditions in the furnace. This helps to minimise excess oxygen which in turn will serve to reduce NO _x emissions provided a stable furnace temperature is maintained.
	Oxygen set point (% excess)	Y	Y	
	Feed rate control	?	?	
	FGR	N ?	N ?	• Not noted in report.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Secondary	SNCR	Y	Y	Urea.
	SCR	N ?	N ?	Not noted in report.
	Catalytic filter bags	N ?	N ?	Not noted in report.
	Wet scrubber (NH ₃ polish)	N ?	N ?	Not noted in report.

A.49.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-194: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea	Urea	30m³ silo.
Concentration etc	35%	35%	35% Urea with ...water. - Deionised H₂O is supplied for dilution at the flow rate required for reagent dilution, at the correct pressure.
Dose rate l/tW	0.0055 – 0.0098	6 fold increase at 100% SNCR capacity	2020 = 295.23 litres = 0.00553 Litres/Tonne of waste incinerated. 2021 = 403.26 litres = 0.00820 Litres/Tonne of waste incinerated. 2022 = 409.63 litres = 0.00834 Litres/Tonne of waste incinerated. 2023 = 511.75 litres = 0.00984 Litres/Tonne of waste incinerated.
Number of injection levels	2	2	Each nozzle has connections for reagent and air for atomisation....and a connection for cooling and blocking air equipped with a regulation valve.
Number of injection points (total)	10	10	- L1 6 (side wall). - L2 4 (boiler roof).
SNCR control system	Y	Y	- Feedback signal from the NO_x analyser in the continuous emissions monitoring system. - Control system diagram provided. - Operator inspection regime to avoid reagent crystallisation blockages plus heated / stirred tanks.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	?	N ?	- Urea is injected into the vapor space directly above the combustion zone where temperatures are controlled within the range of 850 to 1100°C. - Location set during design? Temperature used to control dose rates (with NO_x CEM data), but no description of dynamic flow rate alterations between locations, or consideration of alternative locations.



A.49.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-195: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	270	?	?	?	- Baseline operation: NO_x avg 262 (range 212 to 299). 0% SNCR: NO_x avg 257 (range 223 to 367). 100% SNCR: NO_x avg 207 (range 159 to 239). - Low oxygen: NO_x avg 205 (range 188 to 223).
NH ₃ (air) mg/Nm ³ daily average	No data	No data	No data	No data	No information.
N ₂ O (air) mg/Nm ³ daily average	No data	No data	No data	No data	No information.
Residue quality	No data	No data	No data	No data	No information.

A.49.3 Key Observations

- Opening of report suggests a new ELV of 180 mg/Nm³, but remainder of the report assesses compliance with 270 mg/Nm³ - the O₂ correction factor is not clarified.
- The operator stated that the trial *“has confirmed the effectiveness of the SNCR dosing system and its ability to ensure compliance with new BAT-AEL's of 270mg/m³ (30-min average) for NO_x.”*
- Trail was run across full span of SNCR operating capacity to test range from 0 to 100% capacity. Also, air was reduced as far as possible to observe reduced oxygen level impact on NO_x (at 100% MCR) – results below (O₂ correction not given, raw uncorrected data?):
 - Baseline operation: NO_x avg 262 (range 212 to 299) mg/Nm³
 - 0% SNCR: NO_x avg 257 (range 223 to 367) mg/Nm³
 - 100% SNCR: NO_x avg 207 (range 159 to 239) mg/Nm³
 - Low oxygen: NO_x avg 205 (range 188 to 223) mg/Nm³
- No information on NH₃ or N₂O emissions (or CO / VOC which may be relevant to low Oxygen test), nor residue quality.
- Instability noted during low oxygen test is not surprising.
- Very low historical reagent use rates per tonne input material. Operator states that consumption was “massively increased” at 100% capacity – 6 fold increase.
- Air reductions lead to increases in NO_x – due to temperature increases when temperature control air was reduced. This approach does not really assess better low Oxygen combustion control (which would also target operation in appropriate temperature ranges & control conditions).



- Injection location appears to have been set during design. Temperature data used to control dose rates (with NO_x CEM data), but no description of dynamic flow rate alterations between locations, or consideration of alternative locations.
- Urea dosing blockages are highlighted as requiring attention.
- Constraints on the 100% SNCR application are not described.
- Plant is small and located in a rural area.
- Overall, the way the trial was conducted (extremes) does not currently permit identification of an optimum NO_x level (as per IC requirement), although the operator does then say: *“The work on the NO_x optimisation will continue and further trials will be held over longer intervals to see the long-term effects.”*

A.49.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- The further trials proposed to identify the optimum should be carried out so they are aligned to IC requirements. These trials should include consideration of a full range of approaches and emissions, consumptions and cross media impacts (as per trial protocol), to complete the picture.
- The current trial results and conclusions have limited validity in respect of the NO_x optimisation objective of the IC return e.g. while a combination of reduced oxygen (primary) combustion control and some degree of SNCR application is likely to identify the optimal approach, the present trial approach to oxygen reduction also reduced air supply measures that control temperature (which then resulted in NO_x increase).
- Need to confirm the Oxygen correction factor so that the trial results and compliance conclusions can be assessed (expected 270 at 6% O₂?).



A.50 EPR Glanford

A.50.1 Basic Data

The table below summarises basic installation data.

Table A-196: Basic installation data

Subject Area	Data
Name	Glanford Power Station
Operator	EPR Glanford Limited
Location / Address	Flixborough Industrial Estate, Eighth Ave, Scunthorpe DN15 8SB
Location Character (Industrial/ Urban/Rural/ Mixed)	Rural/ industrial
Capacity tonnes / annum total	110,000 meat & bone meal (MBM) 13.5 MWe generation
Number of lines	1
First operation date	1993
Main supplier / OEM (grate/boiler/furnace lead)	Aalborg Energie Technik
Main supplier SNCR/ FGT	SNCR system designed in house

A.50.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and doses rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.50.2.1 Techniques Deployed

Table A-197: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control			- To simultaneously meet the CO and NO_x ELVs, plant operators had balanced emissions of those species through use of the following Primary Control Techniques: - Low excess air ratio - Staged combustion (fuel and air staging) - Advanced control system
	Oxygen set point (% excess)			
	Feed rate control			



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
				Additionally, Tertiary Air was used as needed to enhance mixing of combustion air and lower combustion air temperature to reduce thermal NO_x.
	FGR	N	N	Not noted in report.
Secondary	SNCR	N	N	Installed SNCR as a precaution, but proposed not for routine use.
	SCR	N	N	Not noted in report.
	Catalytic filter bags	N	N	Not noted in report.
	Wet scrubber (NH ₃ polish)	N	N	Not noted in report.

A.50.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-198: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	None		Liquid urea 30% concentration mixed with demineralised water.
Concentration etc	N/A		Liquid urea 30% concentration mixed with demineralised water.
Dose rate kg/tMSW	N/A		1.49 - 1.57 litres / tonne MBM fired.
Number of injection levels	0	1	
Number of injection points (total)	0	3	
SNCR control system			Various means to control design described, but not how this is linked to NO_x levels / monitoring signal etc.
Injection location optimisation applied. Y/N (e.g. for temperature zones)			Consideration of temperature zones made for installation.

A.50.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-199: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180		170 (qtrly average of daily means)	From the time of the ELV reductions on 3rd December 2023 to the end of February 2024 there have been no breaches of the NO_x, CO or NH₃ Daily Average ELVs.



Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NH ₃ (air) mg/Nm ³ daily average					Ammonia slip as a daily average did not exceed 16% of the ELV, the mean of daily averages for NH₃ was 2.0 mg/Nm³.
N ₂ O (air) mg/Nm ³ daily average					N₂O highest daily average was 1.4 mg/Nm³, the mean of daily averages was 0.4 mg/Nm³.
Residue quality					Analysis showed that there is no apparent alteration to final chemical balance

A.50.3 Key Observations

- Operator anticipates a quarterly mean of daily average NO_x level of 170 mg/Nm³ with primary measures (and tertiary air), reserving the SNCR for essential use, noting certain SNCR disadvantages.
- “It is thought that with selective use of the Tertiary Air or SNCR system that a target of 170 mg/Nm³ as a mean of daily averages is achievable.”*
- The primary aim of the trial, to control NO_x emissions to between 162 and 171 mg/Nm³ with SNCR was achieved, the mean of daily average NO_x result was 164.7 mg/Nm³.
- In house SNCR approach noted as basic by operator.
- Tertiary air use is also noted as having detrimental impacts on the plant operations, including energy demand and material carry over which contaminates boiler surfaces, requiring additional cleaning.
- Ammonia slip as a daily average did not exceed 16% of the ELV, the mean of daily averages for NH₃ was 2.0 mg/Nm³.
- N₂O highest daily average was 1.4 mg/Nm³, the mean of daily averages was 0.4 mg/Nm³.
- Subsequent to the trial the plant was shut down for a cleaning outage and the flue gas path surfaces inspected. It was found that the surfaces of the economisers had a previously unseen covering of a darker shade contaminant. The site then made the subsequent decision to limit NO_x reduction testing to 160mg/Nm³ this will aim to prevent a negative impact of plant availability.
- No impact noted on residue quality.
- Commercial impacts and plant reliability risks are noted as a reason for not targeting further reduced NO_x emissions through more regular use of SNCR and tertiary air.

A.50.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- The 170 mg/Nm³ target is compliant and would appear optimal at present noting the age of the plant and issues noted.
- However, further investigation of commercially supplied SNCR systems (current in-house system is noted as basic) may reveal options for enhanced NO_x performance without the issues noted – noting that the use of SNCR is commonplace in the sector EA may consider requesting a BAT / costed pre-feasibility study.



- The priority for whether this is required may be assessed by considering the plant's ongoing ability to achieve compliance & longer term average emissions performance.



A.51 Holbrook

A.51.1 Basic Data

The table below summarises basic installation data.

Table A-200: Basic installation data

Subject Area	Data
Name	• Holbrook Community Renewable Energy Centre
Operator	• px Ltd.
Location / Address	• Rother Valley Way, Holbrook Industrial Estate, Sheffield, S20 3RW, UK
Location Character (Industrial/ Urban/Rural/ Mixed)	• Urban / industrial
Capacity tonnes / annum total	• 55,300 tpa waste wood • 6.7 MWe (Organic Rankine Cycle) • 30MWth option
Number of lines	• 2
First operation date	• 2017
Main supplier / OEM (grate/boiler/furnace lead)	• Kantor Energy EPC
Main supplier SNCR/ FGT	• No information

A.51.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.51.2.1 Techniques Deployed

Table A-201: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control			• Issues with O₂ measurement noted in report and combustion. • <i>Material is being thrown off the grate and travelling through the SCC which suggests the underfired grate airflow is too high. This is likely the cause of the temperature rise through the SCC. Poor combustion control was observed which can result in high slagging.</i>
	Oxygen set point (% excess)			
	Feed rate control			



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Secondary				• Other issues also reported.
	FGR	Y	Y	
	SNCR	Y	Y	
	SCR	N	N	
	Catalytic filter bags	N	N	
	Wet scrubber (NH ₃ polish)	N	N	

A.51.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-202: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea (aq)	Urea (aq)	• 20,000 l tank store.
Concentration etc	No info	No info	
Dose rate kg/tMSW	See right	See right	• Trial day1/2 gave 890 and 801 litres/day. • <i>The current control philosophy runs on an on-off basis with a set flowrate, which results in high ammonia slip and urea usage. The development of a more sophisticated control philosophy based on back-end NO_x would dramatically reduce ammonia slip breaches and urea usage.</i>
Number of injection levels	3?	3?	• 3 ports (ref page 13/14).
Number of injection points (total)	3?	3?	• System description not clear in report. Possible indication that only one injection port is used and that is placed inappropriately – see note below.
SNCR control system	Not optimised	Not optimised	• <i>The current control philosophy runs on an on-off basis with a set flowrate, which results in high ammonia slip and urea usage. The development of a more sophisticated control philosophy based on back-end NO_x would dramatically reduce ammonia slip breaches and urea usage.</i> • Trial revealed opportunity to improve control to avoid delays in response to relevant NO_x.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	N	N	• Report notes: <i>The current residence time at the SNCR injection port is ~1.2 seconds which is lower than the required residence time of 2 seconds. This likely results in increased ammonia slip.</i> • <i>And: residence time is okay but slightly on the low side which accounts for the higher-than-expected slip at the temperature the SNCR is operating.</i> • But also that: <i>The temperature at the SNCR injection location is in the correct window.</i>



A.51.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-203: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	300	270			- New BAT AEL 270mg/Nm³ set is daily average (ref 6% O₂?). - Line A&B data (page 10) suggest historical NO_x daily average range reported over several months iro 220-24 mg/Nm³, some peaks to 261 (O₂ correction not given). - Bar chart on page 11 suggests CEMS NO_x iro 180-200 (raw NO_x 400-500).
NH ₃ (air) mg/Nm ³ daily average	Not set	22.5	?	?	- NH₃ graphs (page 11) not possible to understand emissions from data presentation provided. - Table suggests NH₃ 8-13 mg/Nm³ (6% O₂). - Report states: <i>There is higher NH₃ slip than would be expected at the current injection temperature.</i>
N ₂ O (air) mg/Nm ³ daily average					No information.
Residue quality					Ofgem sample reports provided – appear to be fuel rather than residues?

A.51.3 Key Observations

- The IC report is imprecise and consequently difficult to interpret. For example, it is not clear from report which were control and response variables during the trial i.e. what was varied and what were the results.
- Whilst the trials undertaken explore combustion design, operational and control aspects of relevance to NO_x reduction, they do not clearly demonstrate or explain how NO_x optimisation has been targeted, although the recommendations do suggest actions and investigation areas that may lead to this, and some significant actions are among these e.g. control logic, relocation of SNCR injection, change of reagent, use of water cooling, improved O₂ measurement.
- Although the Operator report says: *“Confirmation of compliance with new BAT-AEL's of 270mg/m³ for NO_x and 15mg/m³ for ammonia. Holbrook REC is capable of compliance with the revised BAT-AELs of 180mg/m³ for NO_x and 15mg/m³ for ammonia. Holbrook will look to optimise the system through the new DCS change.”*, the lack of logical and clear connection between the trials undertaken and results, means it is not possible to assess whether this conclusion is reasonable.
- Bar chart on page 11 suggests CEMS NO_x iro 180-200 mg/Nm³ (raw NO_x 400-500), which is positive.
- Small capacity lines & ORC technology are noted and atypical for sector.
- Only one line tested in trials as other was off-line.
- Tests carried out 3 times and measured NO_x (& other) at various plant locations.



- At iro 10mg/Nm³ NH₃ is relatively high – report notes injection location and control optimisation opportunities.
- Residue results appear to be fuel samples not residues.
- No information on nitrous oxide emissions.
- Overall, the way information is reported, and some data gaps makes it difficult to draw robust conclusions. However, there are indications (e.g. recommendations made) that indicate the plant is presently not optimised for NO_x reduction, nor in relation to other combustion control and optimisation approaches usually considered BAT.
- Assuming the NO_x emission levels in bar chart (page 11) of 180 – 220 mg/Nm³ are correct, then compliance with 180 may be possible if the recommendation made are implemented and successful.

A.51.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- The Operator should be asked to re-submit the report, updated to clarify the ambiguities noted above, including making a logical connection between the trials and NO_x levels.
- Further trials more aligned with the NO_x IC optimisation requirements may be appropriate and would provide the opportunity to include consideration of missing information and improved approaches that are to be investigated.
- Greater reporting clarity and trial information completeness (e.g. missing residue quality data? Nitrous oxide data? Consistent use of units and correction factors) will help assessment of plant performance.
- In so far as it is possible to draw conclusions, the report (recommendations) suggests significant investigations and potential changes may be appropriate. These recommendations include follow up on and addressing:
 - SNCR system response improvement
 - Reagent injection location (for temperature zone targeting)
 - Consideration of reagent change, water cooling
 - Combustion control and optimisations – air supply, monitoring & control



A.52 Enviropower Lancing

A.52.1 Basic Data

The table below summarises basic installation data.

Table A-204: Basic installation data

Subject Area	Data
Name	• Enviropower Lancing
Operator	• Enviropower Ltd
Location / Address	• Chartwell Road, Lancing Business Park, Lancing, West Sussex, United Kingdom, BN15 8TU
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial
Capacity tonnes / annum total	• 75ktpa
Number of lines	• 2
First operation date	• 2011 (?)
Main supplier / OEM (grate/boiler/furnace lead)	• No information
Main supplier SNCR/ FGT	• No information

A.52.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.52.2.1 Techniques Deployed

Table A-205: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	Y	Y	• Primary and Secondary air control, and flue gas recirculation (FGR) has already been optimised through years of operational experience and data, so this will not be adjusted as part of these trials. • Optimised primary and secondary air control, and flue gas recirculation (FGR) noted as used in combination with SNCR. • O₂ set point at boiler exit varied over trial from 9.24 to 10.82%.
	Oxygen set point (% excess)			
	Feed rate control			
	FGR	Y	Y	• Used.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Secondary	SNCR	Y	Y	• Combined with combustion opt and FGR.
	SCR	N	N	
	Catalytic filter bags	N	N	
	Wet scrubber (NH ₃ polish)	N	N	

A.52.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-206: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea	Urea	• Prilled Urea 46N.
Concentration etc	See right	See right	• Prilled Urea 46N Technical Grade is then diluted with water to between 8%-12% solution strength.
Dose rate kg/t fuel	See right	See right	• PPM Inspection and pump alarm system. Daily trial averages: • 150 set point: 1.2 – 1.9 kg/t fuel • 125 set point: 2.1 – 3.6 • 100 set point: 1.9 – 3.9 • 75 set point: 4.1 – 5.3
Number of injection levels	1	1	
Number of injection points (total)	4	4	• 4 urea injection points on each combustion line, situated on one level near the secondary air inlet ring at the outlet of the combustion chamber.
SNCR control system	Y	Y	• urea injection rate is automatically controlled by upstream management of NO _x , the NO _x concentrations being continually monitored by CEMS and urea delivery pump speed automatically adjusted to optimise urea usage.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	?	?	• Location identified but optimisation not discussed.

A.52.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-207: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	150	150	150	150	- The emissions levels / setpoints used during the 3 planned trials 125mg/Nm³, 100mg/Nm³ & 75mg/Nm³. - No-SNCR 4hr baseline trial gave half hour levels from 222 to 326.7 mg/Nm³ with line 2 marginally lower than line 1 (peak 300.5). Daily trial averages: 150 set point: NO_x 131.4 - 148.2 125 set point: NO_x 119.5 – 123 100 set point: NO_x 94.1 – 97.9 75 set point: NO_x approx. 73
NH ₃ (air) mg/Nm ³ daily average		15			Daily trial averages: 150 set point: 0.02 – 0.11 125 set point: 0.02 – 0.11 100 set point: 0.01 – 0.10 75 set point: 0.03-0.17
N ₂ O (air) mg/Nm ³ daily average					No information.
Residue quality					Not impacted in trial.

A.52.3 Key Observations

- Current ELV of 150 mg/Nm³ already below new BREF 180 level & easily compliant with 15 mg/Nm³ NH₃.
- The trials showed a reduction on NO_x concentrations, with little to minor increase in ammonia slip (at 75 set point), but with an increase in reagent and water usage.
- Operator notes waste types may alter results.
- Ammonia slip levels very low, even at highest dose rates.
- Lack of N₂O data.
- Residue testing showed little difference.
- Reagent water dosing equipment capacity limitation reached at lower set point.
- Operational risk & maintenance concerns noted.
- Issue with ammonia supply chain noted as a constraint with limited storage on a tight site.
- Plant is very small for a two-line plant.
- Plant already complies with 150 NO_x ELV and trial appear to show some further reduction to below 120 may be achievable but N₂O needs assessment.
- Injection location optimisation (for temperature zone) may be considered. Likely that mixing already good in such small lines?



A.52.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- The existing ELV of 150 mg/Nm³ and small size of plant may mean the environmental benefit gained from further lowering (already low) NO_x ELV appear likely to be outweighed by the additional costs from reagent dosing and other constraints / risks noted.
- Trial results positive and suggest a target toward 120 mg/Nm³ may be explored, although N₂O data needs assessing, along with Operator comments about other permitted waste codes, reagent storage / supply and dosing system constraints may mean this is not possible and the 150 ELV is already the optimum.
- Trial with more difficult waste types may better demonstrate case for no change in applied ELV, noting it is already low.
- A lower target / ELV for NH₃ may be considered, although small plant size may lower rational for reduction?
- Operator may consider injection (temperature zone) location optimisation, but noting plant scale, options may be limited.



A.53 London Energy Edmonton

A.53.1 Basic Data

The table below summarises basic installation data.

Table A-208: Basic installation data

Subject Area	Data
Name	• Edmonton EfW
Operator	• London Energy Ltd
Location / Address	• Edmonton London N18 3AG
Location Character (Industrial/ Urban/Rural/ Mixed)	• Urban / Industrial
Capacity tonnes / annum total	• Up to 750 tkpa (actual typically iro 500 tkpa)
Number of lines	• 5 grates, 4 FGT, 2 stacks
First operation date	• 1969 (several lifetime upgrades, replacement in construction)
Main supplier / OEM (grate/boiler/furnace lead)	• No information
Main supplier SNCR/ FGT	• No information

A.53.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.53.2.1 Techniques Deployed

Table A-209: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control			• Not noted – focus on SNCR system. • O₂ set point at boiler exit – design >15% and range given as 5.73 – 20.83 %.
	Oxygen set point (% excess)	>15%	?	
	Feed rate control	?	?	
	FGR	?	?	• Not noted.
Secondary	SNCR	Y	Y	
	SCR	N	N	
	Catalytic filter bags	N	N	



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	Wet scrubber (NH ₃ polish)	N	N	

A.53.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-210: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea	Urea	• Carbamin 5722.
Concentration etc	40%	40%	• 40% liquid urea – diluted for use.
Dose rate kg/tMSW			• 0-30 l/hr, diluted with water 100-400 l/hr. • Dose rate showed increasing trend over trial (at 165 mg/Nm ³ set point).
Number of injection levels	4	4	• All 4 lances are located on the same level, sat within the 4 corners of the furnace wall.
Number of injection points (total)	20	20	• 4 lances per boiler.
SNCR control system			• Boiler and stack NO _x levels used to control dose rates with 5 mg/Nm ³ trigger. • NH ₃ slip 10mg/Nm ³ emission value limitation.
Injection location optimisation applied. Y/N (e.g. for temperature zones)			• All 4 lances are located on the same level, sat within the 4 corners of the furnace wall – no discussion re location or temperature zone optimisation.

A.53.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-211: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	180				• Trial at target NO _x of 175, 170, 165, 160 mg/Nm ³ .
NH ₃ (air) mg/Nm ³ daily average	15				• Trial results in the range of 8.4 to 11.9, with set points of 170 and 165 mg/Nm ³ NO _x indicate slip constraint.
N ₂ O (air) mg/Nm ³ daily average					• No information.
Residue quality					• Not impacted by trial.



A.53.3 Key Observations

- Original design constraints significant (1969 first operation) and current emission levels have been achieved via a number of significant lifetime upgrades, which have also been constrained by original design.
- NH₃ levels are already at upper end of ELV set, and constrain reduction potential for NO_x, along with other pre-existing design factors.
- 5 lines, 4 FGT & 2 stack mean final emission readings are disassociated from furnace and SNCR system, which will limit optimisation potential.
- The Ammonia daily average was consistently close to 10 mg and challenges in the trial meant that 165 mg/Nm³ was the lowest tested, and for good reason.
- *“The main deviation of the trial was the in-ability to reduce the targeted NO_x set point below 165 mg Nm³ as initially intended in the trial scope. This was due to the in-ability of the system to effectively meet the daily average value without having secondary challenges with operations such as overdosing of reagent and Ammonia slip and the requirement for operator manual intervention.”*
- Various upgrades over plant lifetime and current works of relevance to NO_x control e.g. improved injection automation, to injection lances to improve reagent distribution – plans to roll out to all lines.
- Reagent supply blockages are being addressed by regular tank cleaning and line flushing, and targeted equipment replacements.
- Operator notes that *“These alterations have proven to be effective in supporting the site in meeting its permitted requirements.”*
- Does rate showed an increasing trend, at the lowest set point of 165 mg/Nm³ NO_x, and the NO_x emission did not reduce, indicating further increasing the reagent was not effective in reducing final NO_x emissions.
- Residue quality appears not impacted by trials, but further testing proposed.
- No mention of N₂O emissions or primary measures, but boiler O₂ % seems high and variable, indicating challenges with combustion control.
- No consideration of injection location point optimisation.

A.53.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- Current and proposed actions identified to control NO_x limits are appropriate, but emission levels below compliance with current ELVs (NO_x 180 mg/Nm³ and NH₃ 15) appear unlikely to be achievable with the current configuration.
- Age of plant imparts various design constraints & that the plant is expected to be replaced soon means that the more radical change required to achieve lower emission levels is not viable, especially noting evidence presented of low environmental risk.
- Focus upon maintaining existing systems and exploring the areas identified to continue to achieve consistent compliance with current ELVs is appropriate.
- Some investigation of N₂O emissions and consideration of primary NO_x measures may be appropriate (note O₂ % variability), but less important noting intention to close the plant.



- Check whether there are options to improve reagent injection location optimisation to target temperature zones – although whether actions to relocate is viable is likely to be limited given plant age / expectation to close.
- Valid optimisation measurements only likely to be achieved at the furnace, due to FGT and stack blended gas streams.



A.54 Thames W Beckton

A.54.1 Basic Data

The table below summarises basic installation data.

Table A-212: Basic installation data

Subject Area	Data
Name	Beckton Sewage Treatment Works Sludge Powered Generator
Operator	Thames Water Utilities Limited
Location / Address	Beckton Sewage Treatment Works Jenkins Lane, Barking, IG11 0AD, United Kingdom
Location Character (Industrial/ Urban/Rural/ Mixed)	Urban / industrial
Capacity tonnes / annum total	90,500 – sewage sludge
Number of lines	3 – fluidised beds
First operation date	2014
Main supplier / OEM (grate/boiler/furnace lead)	Doosan Lentjes
Main supplier SNCR/ FGT	Doosan Lentjes

A.54.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.54.2.1 Techniques Deployed

Table A-213: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control			- Outside of the NO_x abatement trials, NO_x emissions are managed at Beckton SPG through manual control of temperature and waste feed. - sludge cake feed to the incinerator is automatically cut if an exceedance of the maximum half-hourly average of NO_x (400 mg/Nm³) is recorded.
	Oxygen set point (% excess)			
	Feed rate control	Y	Y	



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	FGR	N	N	This technique has been discounted in its applicability to Beckton SPG due to the constraints of this technique being implemented in existing plants.
Secondary	SNCR	Y	Y	No urea or ammonia was used for the abatement of NO_x emissions over the period of 2020-2022. This has been explained by Thames Water as NO_x emissions were being adequately managed during normal operations to uphold compliance with daily mean and annual maximum NO_x emission limit values (ELVs).
	SCR	N	N	Not noted in report.
	Catalytic filter bags	N	N	Not used.
	Wet scrubber (NH ₃ polish)	N	N	Not used.

A.54.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-214: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea	Urea	Mix of carbamin 5722 (40% blended urea solution) and water.
Concentration etc	40% aq	40% aq	
Dose rate kg/tMSW	Trial 0.72 to 1.75 kg/hr		- No urea or ammonia was used for the abatement of NO_x emissions over the period of 2020-2022. This has been explained by Thames Water as NO_x emissions were being adequately managed during normal operations to uphold compliance with daily mean and annual maximum NO_x emission limit values (ELVs). - Some suggestion that trial NO_x CEMS daily average results reduced with increased reagent dosing, but not clearly correlated.
Number of injection levels	1?	1?	Not clearly explained in report.
Number of injection points (total)	2 / line?	2 / line?	Two lances that are located either side of the lower end of the post-combustion chamber.
SNCR control system	?	?	- SNCR system control not explained. - General plant control noted as: Continuous operation control is maintained during all hours of operation, where temperature of incineration is reduced manually if it is observed that NO_x emissions are increasing to near the half-hour maximum ELVs. The same process is also carried out if it is observed that NO_x emissions are sustained above the daily mean ELV (180 mg/m³), in order to reduce average emissions.



Criteria	Pre-trial	Post Trial / Proposed	Comments
Injection location optimisation applied. Y/N (e.g. for temperature zones)	?	?	No discussion.

A.54.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-215: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200	180		100-120 ?	- New EAL 180 mg/Nm³. 3 year data shows daily averages all lines in region of 70 – 130 mg/Nm³.
NH ₃ (air) mg/Nm ³ daily average	?	?	?	< 1 mg/Nm ³ ?	NH₃ emissions very low (limits of detection) – highest daily average 0.17 mg/Nm³ across all scenarios and no significant deviations at variant does rates noted.
N ₂ O (air) mg/Nm ³ daily average	No data	No data	No data	No data	No information.
Residue quality	See right	See right	See right	See right	- No indication of impacts from trials. - For fly ash, the concentrations of all chemicals were below the detection limit of 100 mg/kg. - For bag house dust, there was no apparent trend in the content of organic nitrogen and ammoniacal nitrogen. The highest contents of organic and ammoniacal nitrogen were 130 mg/kg and 135 mg/kg respectively.

A.54.3 Key Observations

- 3 year data (2020 – 2022) already shows daily averages all lines in region of 70 – 130 mg/Nm³ and therefore was already operational below the upper limit of the core 50 – 150 range noted in the BREF for existing plant, and the upper level of 180 also noted. In 2022, the annual mean across all streams was 100-120 mg/Nm³.
- No urea or ammonia was used for the abatement of NO_x emissions over the period of 2020-2022. This has been explained by Thames Water as NO_x emissions were being adequately managed during normal operations to uphold compliance with daily mean and annual maximum NO_x emission limit values (ELVs). It was recognised that SNCR needed to be refurbished ahead of regularised use to provide sufficient NO_x headroom accompanying the tightened BAT AELs.
- Trials varying reagent fed rates targeted 10-20 mg steps across the range 140 to 90 mg/Nm³ over several weeks (lines not available all periods).
- Trial CEMS data mostly in range 70-100 mg/Nm³.
- Some suggestion that trial NO_x CEMS daily average results reduced with increased reagent dosing, but not clearly correlated.



- NH₃ emissions very low (limits of detection) – highest daily average 0.17 mg/Nm³ across all scenarios and no significant deviations at variant does rates noted. The low levels noted appear inconsistent with the statement that *“Beckton SPG could potentially implement further abatement techniques in addition to SNCR operation in order to mitigate the negative impact on ammonia slip and slag formation.”*
- Slag formation at 90m/Nm³ trial target suggests constraints (although reagent dose related reported of 0.72kg/hr was lower?).
- No significant change in residue contamination.
- No information on Nitrous Oxide emissions – this can be an issue at such plants.
- No information on injection location optimisation, and very limited description of SNCR system design & control features.
- Appendix F provides a list of BAT techniques but does not then explain which are used / not used and why. Section 3.4 cross reference / Section 3.7 assessment appears partial / not specifically considered for the plant or theoretical e.g. higher dose rates “may” lead to increased NH₃, missing assessment of optimisation and control approaches, etc.

A.54.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- Plant already achieves low NO_x emissions (In 2022, the annual mean across all streams was 100-120 mg/Nm³.)
- Moderate reagent application can deliver levels below 100mg/Nm³, although some indications of operational issues (slagging) suggest constraints.
- An annual average target in the region of 100mg/Nm³ may be achievable, subject to checks on nitrous oxide emissions. Long term impacts of lower targets also need consideration.
- Very low NH₃ suggests a target or revised EAL iro 1 mg/Nm³ (daily average) might easily be complied with.
- Some further NO_x reduction may be achievable if reagent injection location optimisation is further assessed, along with greater consideration of SNCR system design and control features (e.g. those noted in IC report appendix F but not then considered in relation to the plant).



A.55 Suez Severnside

A.55.1 Basic Data

The table below summarises basic installation data.

Table A-216: Basic installation data

Subject Area	Data
Name	• Severnside Energy Recovery Centre (SERC)
Operator	• SUEZ
Location / Address	• Severn Road, Hallen, Bristol, BS10 7GB
Location Character (Industrial/ Urban/Rural/ Mixed)	• Industrial
Capacity tonnes / annum total	• 467,082 • 40MWe gross
Number of lines	• 2
First operation date	• 2016
Main supplier / OEM (grate/boiler/furnace lead)	• HZI
Main supplier SNCR/ FGT	• HZI

A.55.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.55.2.1 Techniques Deployed

Table A-217: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control			• Combustion control approaches and interaction with de-NO _x system well explained and implemented.
	Oxygen set point (% excess)	4.61 4.89		
	Feed rate control	?	?	
	FGR	Y	Y	• Suggestion to investigate further optimisation.
Secondary	SNCR	Y	Y	• Detailed system explanation with focus on integration and control / optimisation.
	SCR	N	N	• Not noted in report.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	Catalytic filter bags	N	N	Not noted in report.
	Wet scrubber (NH ₃ polish)	N	N	Not noted in report.

A.55.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-218: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Ammonia	Ammonia	40m³ storage on site.
Concentration etc	24.5%	24.5%	Further diluted.
Dose rate kg/tMSW	0.21	0.31	- Increasing from 0.21 to 0.31 across both lines. <i>A significant increase was observed with the NH₄OH consumption... the system was seen to reach near its maximum flow capacity for long periods of time, highlighting this as a potential bottleneck for further reductions beyond 120 mg/Nm³.</i>
Number of injection levels	4	4	<i>Additional 5th injection level installed on both lines in the 2nd pass of the boiler by HZI in April 2023. Existing 1st level de-commissioned to ensure compatibility with existing system.</i>
Number of injection points (total)	32	32	8 each level.
SNCR control system	Y	Y	<i>DyNOR system at SERC is broken down into 4 independent sectors per line, each controlled by independent distribution modules.</i> <i>Each sector is additionally split into two further nozzles, one being installed at 10° and the other at 30°, enhancing the mixing between the reagent and flue gas. The optimum injection level is individually designated for each sector, based on readings from infrared pyrometers that are installed between levels 3 & 4.</i> - Further description provided indicating comprehensive control systems.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	Y	Y	- Control system responds dynamically to plant conditions and NO_x levels. - Comprehensive PPM described.

A.55.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-219: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200		135 (monthly mean)	130?	135 mg/Nm³ set point used since commissioning to target 150 monthly mean. <i>Historically the DyNOR system at SERC has operated well and always maintained its setpoint of 135 mg/Nm³, dry, 11% O₂, hence already performing well under the lower BREF daily ELV threshold of 180 mg/Nm³, dry, 11% O₂.</i>
NH ₃ (air) mg/Nm ³ daily average	10		<1	<1 ?	<i>An increase in the NH₃ slip was seen on both lines with the reduction in the NO_x setpoint.</i>
N ₂ O (air) mg/Nm ³ daily average				<1 ?	Below 1 mg/Nm³ line 2, close to zero line 1.
Residue quality					<i>Whilst there was no discernible trend highlighted through the IBA analysis, a general increase was seen in the ammoniacal nitrogen content within the APCR at the lower NO_x setpoints and a significant difference was observed between both lines</i>

A.55.3 Key Observations

- Plant already achieving NO_x iro 135mg/Nm³ to target monthly average of 150 mg/Nm³ and deploying various appropriate (modern) design and operational approaches, including primary and abatement system optimisations. Low NH₃ iro 1mg/Nm³ & N₂O (below 1 mg/Nm³ line 2, close to zero line 1).
- Trials showed NO_x reduction from 135 to 120 mg/Nm³ set points delivered NO_x emission levels close to set points, with NH₃ rising towards 2 mg/Nm³, and reagent consumption (kg/tMSW) increasing from 0.21 to 0.31 (across both lines).
- Some detailed difference between the two lines e.g. L1 high slip, but marginal and still relatively low.
- Recent plant MCR upgrade included adjustment so the SNCR system, including new injection levels which have been successful in improving SNCR efficiency (stoichiometric ratio).
- No discernible trend highlighted through the IBA analysis, a general increase was seen in the ammoniacal nitrogen content within the APCR at the lower NO_x setpoints and a significant difference was observed between both lines.*
- Ongoing optimisation work, including to assess temperature control measurement locations, DyNOR control module parameters, tuning of the feedback NO_x control loop.
- Further work could also be carried out to assess the combustion air flows and amount of re-circulated flue gas to help reduce the amount of thermal and prompt NO_x formation, however care would need to be taken not to adversely affect... various.*



A.55.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- Plant already achieving relatively low emission levels. Some evidence to suggest that a marginally lower set point (130 mg/Nm³ rather than 135) can be achieved with minimal impacts, but evidence that going beyond that leads to some negative impacts.
- Recent upgrades have delivered good results, including for NO_x control.
- Low NH₃ indicates possibility to reduce ELV / set low target.
- Operator suggestion to further investigate FGR role / use should be followed up on, as this may be beneficial (but noting also the risks noted).



A.56 Thetford Power Station

A.56.1 Basic Data

The table below summarises basic installation data.

Table A-220: Basic installation data

Subject Area	Data
Name	• Thetford Power Station
Operator	• EPR Thetford Ltd
Location / Address	• Mundford Road, Thetford IP24 1LX
Location Character (Industrial/ Urban/Rural/ Mixed)	• Rural
Capacity tonnes / annum total	• 550 ktpa biomass (poultry litter, wood) • 38.4 MWe
Number of lines	• 1
First operation date	• 1999
Main supplier / OEM (grate/boiler/furnace lead)	• AMEC Foster Wheeler (fluidised bed?)
Main supplier SNCR/ FGT	• Yara – SNCR system

A.56.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and doses rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.56.2.1 Techniques Deployed

Table A-221: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	Y	Y	<i>Prior to the NO_x ELV reduction set by Permit Variation V007 and applied on 3rd December 2023, plant operators used the following Primary Control Techniques to balance emissions of CO and NO_x to simultaneously meet both ELVs:</i> • Low excess air ratio. • Staged combustion (fuel and air staging). • An advanced control system, the plants Distributed Control System (DCS).
	Oxygen set point (% excess)	Y	Y	
	Feed rate control	Y	Y	



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
				<i>Additionally, water sprays were available to lower combustion temperature and reduce thermal NO_x.</i> <i>Those sprays had the potential to adversely impact some process conditions which limited their use.</i>
	FGR	N	N	Not noted in report.
Secondary	SNCR	N	Y	New system installed 2023/24 having concluded primary measures alone would not comply with new ELVs.
	SCR			Not noted in report.
	Catalytic filter bags			Not noted in report.
	Wet scrubber (NH ₃ polish)			Not noted in report.

A.56.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-222: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	None	NH ₃	Selected to suit boiler design / temp etc.
Concentration etc	N/A	24.5%	Aqueous ammonia @ 24.5 vol%.
Dose rate kg/tMSW	N/A		Average ammonia consumption per tonne of waste fired was 0.27 - 0.5 l/tw.
Number of injection levels	N/A	3	
Number of injection points (total)	N/A	21	Injection of the ammonia/demineralised water mix is controlled by 3 Process Units (PUs): - PU 10 – 10 injection points, 5 at furnace level 3 and 5 at furnace level 5 - PU 8 – 8 injection points, furnace level 3 - PU 5 – 5 injection points, furnace level 4
SNCR control system	N/A	Y	- Various components – comprehensive description reported, incl.: <i>designed to automatically respond to changes of furnace temperatures, NO_x emission levels, and other relevant process conditions to adjust the concentration of the ammonia solution, the injection rate, and injection points to maximise the effectiveness of abatement while reducing potentially adverse effects to the plant.</i> <i>In automatic mode the two valves are modulated by the PLC according to the program, based on the measured furnace temperatures and the emissions of CO, NO_x, O₂ and NH₃ measured</i> <i>by the CEM system.</i>



Criteria	Pre-trial	Post Trial / Proposed	Comments
Injection location optimisation applied. Y/N (e.g. for temperature zones)	N/A	Y	Considered during recent SNCR design.

A.56.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-223: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	?	264.5	?	250-260 ?	- Seasonal NO_x variations with fuel quality – lower winter (moisture). - Progressive fouling increases NO_x instability. 233.5 achieved in trial but with high NH₃ and indications long term sustainability issues.
NH ₃ (air) mg/Nm ³ daily average	< 17.2	< 11.9			- Fuel NH₃ increase in winter. With slip approaching ELV, needing to constrain SNCR. - The mean of daily averages for emissions to air in the month of December 2023 before the SNCR was fully commissioned was 17.2 mg/Nm³, while that in November 2024 with the SNCR system in regular use in the automatic mode using all available injection points was 11.9 mg/Nm³ with the highest daily average ~80% of the ELV.
N ₂ O (air) mg/Nm ³ daily average		5 - 8			Within this range in trials.
Residue quality					- Ash from the plant is used in-house to produce fertiliser and inclusion of an ammonia component is beneficial. - It is judged that ammonia fluid injected from SNCR ... will have minimal, if any, impact on bottom ash composition, particularly when compared to the high level of poultry litter in the fuel mix combusted on the grate. - Possible improvement in APCr due to cooling impact of new SNCR system.

A.56.3 Key Observations

- Comprehensive IC report and approach taken to implementation of new SNCR system & trials. 5 trials conducted covering different relevant aspects.
- New permit BAT AEL set at 264.5 mg/Nm³ (at 6 vol% O₂) equiv. to IC value at 11% vol O₂.
- SNCR system installed late 2023 /early 2024, with IC and other trials conducted during 2024.



- *The findings of the trials show that the SNCR system can effectively control NO_x while meeting the ammonia slip limit and enabling adequate control of CO. Further work is needed to determine the most effective and efficient configuration of the system in both manual and automatic modes.*
- Seasonal NO_x variations with fuel quality – lower winter (moisture).
- Progressive fouling increases NO_x instability – various methods in use to control fouling, with short term emission impacts.
- NH₃ slip to air increased (sometimes above ELV) when lower NO_x levels sought of 245 mg/Nm³ (higher NH₃ doserates) – indicative of NH₃ slip limiting factor.
- Nitrous oxide low and stable iro 5- 8 mg/Nm³ in rials.
- IBA minimal impacts with SNCR and low sensitivity due to offtake ash use benefits from any additional NH₃.
- APCr quality improvement possibly due to cooling impacts.

A.56.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- New SNCR system is delivering compliance with the new BAT AELs issued, but is being bedded in and likely to deliver more information to understand optimum over coming year plus.
- Present target level of 250 (6% O₂) appears optimal at present but should be reviewed over time as operational experience is gained.
- NH₃ slip appears a limiting factor, with some complications arising due to fuel NH₃ content and variations – winter moisture helps reduce NO_x – possible that fuel dampening / moisture adjustment may assist?
- Whilst this is a large plant with a consequential higher mass emission flow, fuel issues mean that NO_x emissions are a challenge with the current configuration, although the addition of SNCR is positive and is revealing NO_x control benefits.
- It is unlikely that the current basic design configuration can deliver dramatically lower emissions, although some benefits may be derived over time as the plant is optimised / bedded in.
- The NH₃ slip limiting factor may possibly be overcome by consideration of a tail end wet scrubber, which is noted in the BREF as permitting higher dose SNCR, whilst recirculating scrubber liquor to the boiler the reduce reagent consumption. A BAT / cost / feasibility study is needed to consider this. This would need to take costs and remaining plant lifetime into account as well as relative NO_x / NH₃ damage costs savings – noting the rural location and low likelihood of environmental sensitivity. A tail end SCR unit may also be an option is lower NO_x is sought, but costs (incl energy) and feasibility may be an issue.



A.57 Mercia EnviRecover

A.57.1 Basic Data

The table below summarises basic installation data.

Table A-224: Basic installation data

Subject Area	Data
Name	EnviRecover
Operator	Severn Waste Services
Location / Address	Hartlebury Trading Estate, Hartlebury, Kidderminster, Worcestershire, DY10 4JB, United Kingdom
Location Character (Industrial/ Urban/Rural/ Mixed)	Rural /industrial
Capacity tonnes / annum total	230,000 17.5 MW generation (40/400) - Non-haz MSW and C&I
Number of lines	1
First operation date	2017
Main supplier / OEM (grate/boiler/furnace lead)	HZI
Main supplier SNCR/ FGT	SNCR DyNor system, installed at build by the OEM; Hitachi Zosen Inova (HZI)

A.57.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.57.2.1 Techniques Deployed

Table A-225: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control			In December 2019 EnviRecover started a series of trials to alter the ratio of air distribution into the furnace. Along with a reduction in air temperature we found we could influence the creation of NO_x and have a significant effect on our NO_x emission and consumable rates.
	Oxygen set point (% excess)	4%	4%	
	Feed rate control			



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
				The air flow adjustments made in 2020 have become our normal operating parameters, so these remained in place throughout.
	FGR	Y	Y	FGR installed at build.
Secondary	SNCR	Y	Y	aqueous ammonia.
	SCR	N	N	Not noted in report.
	Catalytic filter bags	N	N	Not noted in report.
	Wet scrubber (NH ₃ polish)	N	N	Not noted in report.

A.57.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-226: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Ammonia	Ammonia	25m³ storage tank.
Concentration etc	24.5%	24.5%	24.5 % NH₄OH Ammonia.
Dose rate kg/tMSW			Since our optimisation parameters were introduced in 2020, we have dosed an average of 1.93t of ammonia per year as opposed to an average of 51.5t per year before trials began, meaning the total decrease in ammonia injection rates averages 96% per annum.
Number of injection levels	3	3	
Number of injection points (total)	21	21	
SNCR control system			The system monitors at the following parameters and adjusts the dosing rates accordingly: NO_x emissions from the CEMs, ammonia tank level, live furnace operating temperature, excess air level.
Injection location optimisation applied. Y/N (e.g. for temperature zones)			- lances are spread evenly across 3 levels of the boiler to ensure ammonia is injected in the most optimal location, dependant on the furnace operating temperature. - Various PPM actions as recommended by OEM.

A.57.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-227: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	200		180	150	- At 180 mg/Nm³ set point NO_x emissions are typically in the region of 150mg/m³ during normal operation, with only small amounts of ammonia being dosed. <i>Trials lowered the Ammonia control valve set point to 162mg/m³.</i> 2022 highest daily mean 168 with average 130 to 150.
NH ₃ (air) mg/Nm ³ daily average	10	5?		1	All results below 1.
N ₂ O (air) mg/Nm ³ daily average	0?	0?	0?	0?	Low results indicated on graph supplied – close to zero all cases.
Residue quality					- levels were elevated for IBA during the NO_x trial, but there was no noticeable effect on the APCr. - Earlier combustion optimisation approach – no issues.

A.57.3 Key Observations

- As of February 2020, the daily average NO_x has been reduced from 170 mg/m³ down to below 150 mg/m³ solely on-air/temp manipulation. This also has had a significant reduction on the consumption rate of Ammonia injection into the furnace.
- Slagging issues noted during 140 mg/Nm³ set point trial with low NH₃ dosing, eventually caused plant trip, when refractory tiles losses noticed – deemed unviable to trial higher NH₃ dosing due to corrosion risk with (earlier) implemented airflow adjustments.
- Low NH₃ emissions (below 1mg/Nm³) pre-trial, during and post-trial indicate no NH₃ slip constraint. N₂O close to zero in all cases.
- Combustion optimisation approaches introduced in recent years have decreased ammonia consumption by 96% (1.93tpa vs 51.5tpa), whilst also delivering NO_x reductions.
- It is possible that the combination of low O₂ set point, FGR and combustion control approaches create conditions which contribute to the issues noted when lower NO_x set points were also sought, however the performance achieved is already good and the low reagent consumption has broad benefits.

A.57.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- Combustion optimisation and prior design approaches (incl FGR) are already delivering NO_x levels in the range of 130 to 150 mg/Nm³, without N₂O, NH₃ emissions issues or impact on residues. Very large reductions in ammonia reagent use also achieved.



- The adoption of a set point of 162 mg/Nm³ coupled with existing approaches is likely to deliver further reduction in average and mass emissions.
- Trials at lower set point (140 mg/Nm³) have revealed operational issues and IBA contamination also noted.
- Overall, the current operator approach (set point 162 mg/Nm³ and focus on primary approaches with some SNCR) appears justified and while continued investigation of set points towards 150 mg/Nm³ may be worthy of consideration, equally this does not appear urgent noting already delivered good NO_x performance and operational constraints noted.
- An optimal approach specific to this installation appears to have been identified.



A.58 Tradebe Redditch

A.58.1 Basic Data

The table below summarises basic installation data.

Table A-228: Basic installation data

Subject Area	Data
Name	• Redditch Clinical Waste Treatment Facility
Operator	• Tradebe
Location / Address	• Woodrow Drive, Redditch B98 7UB
Location Character (Industrial/ Urban/Rural/ Mixed)	• Urban
Capacity tonnes / annum total	• 10,000 hazardous / clinical waste
Number of lines	• 1
First operation date	• 2019
Main supplier / OEM (grate/boiler/furnace lead)	• No information
Main supplier SNCR/ FGT	• No information

A.58.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and doses rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.58.2.1 Techniques Deployed

Table A-229: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	?	?	• Very limited information provided in report, but low NO _x levels without SNCR provide a suggestion that effective primary measures are in place.
	Oxygen set point (% excess)	?	?	
	Feed rate control	?	?	
	FGR	?	?	• No information in report.
Secondary	SNCR	N	?	• Not originally used. Tested in trials.
	SCR			• No information in report.
	Catalytic filter bags	?	?	• No information in report.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	Wet scrubber (NH ₃ polish)	?	?	Water injection noted, but unlikely to be a scrubber.

A.58.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-230: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	None	tbc	Urea used in trial.
Concentration etc	None	tbc	For the trial 2% urea solution was obtained by decanting 110 litres of commercially purchased AdBlue to 5000 litres of water.
Dose rate kg/tMSW	None	Varied in trials	1.6 to 4 l/min trialled.
Number of injection levels	None	One in trial	Trial installation used.
Number of injection points (total)	None	One in trial	Trial installation used.
SNCR control system	None	tbc	Trial installation used.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	None	One in trial	Trial installation used.

A.58.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-231: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	?	180			137 was achieved pre-trial without SNCR. - Substantial % NO_x reductions were noted leading to emission levels of below 50mg/Nm³ (inlet 132 mg/Nm³) when dose rates of 3-4 l/min were used.
NH ₃ (air) mg/Nm ³ daily average	15	15			Zero reported.
N ₂ O (air) mg/Nm ³ daily average					No information.
Residue quality					No information.



A.58.3 Key Observations

- Without SNCR the installation already reported average NO_x emissions of 137mg/Nm³ and so installation of SNCR was considered “*not appropriate*” by the Operator.
- A temporary installation was made to facilitate the trials, with some pre-engineering assessment to define the approach, along with information from other Tradebe plants.
- Operator undertook injection trials at various rates, and noted that:
 - *The test averages show a substantial reduction in NO_x particularly at 3 - 4L/min urea/water injection rate.*
 - *Although the recommended rate from advance technical work is 1.6 L/minute, the varying nature of the process (burning loads with variable calorific values, etc.) meant that the NO_x levels spiked from time to time when injecting at the recommended rate.*
 - *No such spikes were seen at higher rates which suggests that a slight increase from 1.6 L/minute injection rate is the “optimum” to ensure adequate control of the NO_x at Redditch Incinerator.*
- The combustion cooling effect of water injection is also noted as contributing to NO_x reduction.
- Ammonia slip reported to be zero across all trials.
- No information provided for Nitrous Oxide emissions or residues. CO data does not suggest combustion issues were encountered during the trial.
- No cost information provided e.g. SNCR installation or reagent costs.
- System descriptions and report are very brief, meaning that it is not possible to conclude on whether NO_x optimisation is achieved.

A.58.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- The installation is already compliant without SNCR and a longer-term average iro 150 mg/Nm³ may already be achievable without SNCR.
- Lower still emissions may be achievable with installation of SNCR, although whether required is questionable (noting current good NO_x performance etc) further assessment of overall costs and emissions is advisable, including N₂O.
- Low NH₃ indicated a lower EAL or target may be set, subject to further assessment of as SNCR use may result in NH₃ emissions (air / residues?).
- Further assessment is required to consider residues impacts (in line with IC requirements).
- Noting the small scale of the installation, and type of waste the benefits to be achieved from further NO_x reductions may be limited in relation to costs.



A.59 Baddesley

A.59.1 Basic Data

The table below summarises basic installation data.

Table A-232: Basic installation data

Subject Area	Data
Name	• Baddesley Energy from Waste Plant
Operator	• Gren WTE
Location / Address	• off Merevale Lane Baxterley Near Atherstone Warwickshire CV9 2LA
Location Character (Industrial/ Urban/Rural/ Mixed)	• Rural
Capacity tonnes / annum total	• 100 ktpa RDF
Number of lines	• 1
First operation date	• 2021
Main supplier / OEM (grate/boiler/furnace lead)	• Vyncke
Main supplier SNCR/ FGT	• Luehr Filter GmbH

A.59.2 NOx System Data

The sections below provide information regarding the NOx systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NOx formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NOx abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and does rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.59.2.1 Techniques Deployed

Table A-233: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control			• Combustion is controlled utilising a Primary air fan and Secondary Air fan controlling excess combustion air to a pre-determined set point, which has been reduced to 5.9% from 7.0% to minimise NOx formation.
	Oxygen set point (% excess)	Y	Y	
	Feed rate control	?	?	
	FGR	N	N	• Not noted.
Secondary	SNCR	N	N	



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	SCR	Y	Y	NO_x abatement uses 24%-24.9% w/w Aqueous Ammonia air atomised and lance injected into the flue gas flow and passed over a heated catalyst section with 2 sections of catalyst in series and an empty 3rd section for contingency.
	Catalytic filter bags	N	N	Not noted.
	Wet scrubber (NH ₃ polish)	N	N	Not noted.

A.59.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-234: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Ammonia	Ammonia	NO_x abatement uses 24%-24.9% w/w Aqueous Ammonia.
Concentration etc	24%-24.9% w/w Aq Ammonia	24%-24.9% w/w Aq Ammonia	NO_x abatement uses 24%-24.9% w/w Aqueous Ammonia air atomised and lance injected into the flue gas flow and passed over a heated catalyst section with 2 sections of catalyst in series and an empty 3rd section for contingency.
Dose rate	40 l/hr	40 l/hr	Approximately 40 Litres/hour at 3.9bar.
Number of injection levels	1	1	Both injection points at same level - upstream of catalyst.
Number of injection points (total)	2	2	
De NO _x control system	Y	Y	- The nominal value of flow control for the Ammonia solution is controlled based on measured NO_x concentration in the flue gas prior to inlet of the evaporator cooler (Raw Gas) in connection with volumetric gas flow at the stack. - Regular inspection of FGT system, CEMS etc.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	?	?	Not discussed.

A.59.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.



Table A-235: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average	120	120		90	- Trial average 63.67 mg/Nm³. - Pre-trial 76.2, post trial 82.1. <i>Initially the trial NO_x set point was reduced to 80mg/Nm³. However, this seen an increase in NH₃ stack level. With plant protection in mind, mainly the SCR catalyst this set point was increased to 90mg/Nm³ from a normal 120mg/Nm³.</i>
NH ₃ (air) mg/Nm ³ daily average	?	5.7 ?			Trial data not supplied.
N ₂ O (air) mg/Nm ³ daily average					- No data supplied. <i>N₂O analysis is currently being set up with QAL2 within the H₂ stack. This element is not yet fully calibrated and is expected to be so Nov/Dec 2023.</i>
Residue quality					<i>As the Ammonia injection is at the rear of the process the additional reagent will not affect the IBA analysis.</i> <i>The APCr analysis through the 4th quarter residue sample will be observed when results are obtained. These would be available on request.</i>

A.59.3 Key Observations

- SCR use rather than SNCR is unusual in UK (although commonplace in Europe for some years).
- Very low NO_x emissions (v UK average) iro 60-85 mg/Nm³.
- 120 mg/Nm³ existing ELV is lower than most UK EFW plants and is complied with.
- Trial initial set point of 80mg/Nm³ was reported to result in increased NH₃ (not quantified in report) and was then increased to 90mg/Nm³, resulting in average emissions of 63.67mg/Nm³.
- Operator concluded that a 10% increase in NH₃ usage has a similar decrease in the total NO_x formation at the stack.
- Concerns noted over Ammonium Sulphide formation impacting on SCR unit performance limiting dose rates are realistic.
- No trial data provided for NH₃ or N₂O emissions, or APCr.
- Lack of trial data for IBA is justifiable on account of the SCR plant position.

A.59.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- Follow up is required to check and consider NH₃, N₂O and APCr results.
- The supplied report was brief and presented conclusions rather than supporting data. However, currently achieved low emission results suggest that a NO_x target value of 80-100 mg/Nm³ may be achievable (but setting a lower AEL than 120mg/Nm³ not required.)



- Lack of information regarding SCR unit optimisation (injection locations, temperature and mixing) may mean some room for further optimisation exists (e.g. to reduce NH₃ slip) but the existing low NO_x performance, plant size and location support lower priority for such optimisation efforts and for further emission reductions (and AEL reduction), also when considering (realistic) limitations arising from SCR operational risks noted if pushed further.



A.60 Allerton

A.60.1 Basic Data

The table below summarises basic installation data.

Table A-236: Basic installation data

Subject Area	Data
Name	• Allerton Waste Recovery Plant
Operator	• Thalia Waste Management
Location / Address	• Knaresborough HG5 0SD
Location Character (Industrial/ Urban/Rural/ Mixed)	• Rural
Capacity tonnes / annum total	• 320 ktpa MSW & C&I • 31.99 MWe
Number of lines	• 2
First operation date	• 2018
Main supplier / OEM (grate/boiler/furnace lead)	• Vinci
Main supplier SNCR/ FGT	• SNCR System supplied by Emissions-Reduzierungs-Konzepte GmbH (ERC)

A.60.2 NO_x System Data

The sections below provide information regarding the NO_x systems used and proposed, as retrieved from the Operator's supplied Improvement Condition return for this installation.

The information presented is that noted in the IC return regarding:

- Technical approaches used to prevent NO_x formation (primary reduction) – based upon those described in the EU BREF as BAT.
- NO_x abatement system used – mainly focussed on certain SNCR system design & operational features, including reagents and doses rates (where quantified data is provided).
- Achieved emission levels.
- Other information & comments e.g. supplied operational or cost comments and data.

A.60.2.1 Techniques Deployed

Table A-237: Techniques deployed

Category	Technique	Pre-trial	Post Trial / Proposed	Comments
Primary	Air control	?	?	• No information on primary measures provided.
	Oxygen set point (% excess)	?	?	
	Feed rate control	?	?	
	FGR	N	N	• Not noted in report.
Secondary	SNCR	Y	Y	
	SCR	N	N	• Not noted in report.



Category	Technique	Pre-trial	Post Trial / Proposed	Comments
	Catalytic filter bags	N	N	• Not noted in report.
	Wet scrubber (NH ₃ polish)	N	N	• Not noted in report.

A.60.2.2 NO_x Abatement / SNCR System Data

The table below present SNCR system design and performance data for this installation.

Table A-238: NO_x abatement system (and SNCR) data

Criteria	Pre-trial	Post Trial / Proposed	Comments
SNCR reagent	Urea	Urea	
Concentration etc	40% diluted	40% diluted	• 40% urea by weight plus water to inject.
Dose rate kg/tMSW	See right	See right	• Line 1 160 NO _x 30 kg/hr & 145 NO _x . • Line 2 165 NO _x 45 kg/hr.
Number of injection levels	5	5	• Lower two levels used.
Number of injection points (total)	8	8	• 4 injection points on each level.
SNCR control system	Y	Y	• Control system implied but not described.
Injection location optimisation applied. Y/N (e.g. for temperature zones)	?	?	• 5 levels provide potential to access optimal zones. • Dosing control link to temperature not explained.

A.60.2.3 Emissions Data

The table below presents emission data reported in the IC return for this installation, including the pre-trial and post-trial optimised / proposed scenarios performance data.

Table A-239: Emissions data

Criteria	EAL		Target / Set-point		Comments / Constraints
	Pre-trial	Post-trial	Pre-trial	Post-trial	
NO _x (air) mg/Nm ³ daily average		180		160	• Trials at 160 and 140 mg/Nm ³ , but 120 abandoned due to observed fluctuations.
NH ₃ (air) mg/Nm ³ daily average	?	?	?	?	• No data provided, but operator states: <i>There were no signs of ammonia slip noted during the process.</i>
N ₂ O (air) mg/Nm ³ daily average	?	?	?	?	• No information supplied.
Residue quality					• <i>Increase to nitrogen levels in the APCR during the second week of the test is of interest and further investigation.</i>



A.60.3 Key Observations

- Operator confirms compliance with 180 mg/Nm³ / 15 BAT AELs is achieved.
- Trial was carried out on Line 2, with Line 1 held as a control – both lines considered identical
- Only lower two installed injection levels used, with 3 additional spare levels available, but not tested.
- *The trial was selected to be conducted at 160mg/Nm³ and 140 mg/Nm³. Initially the aim was to test at 120mg/Nm³ as well however there were concerns that the plant would not be able to manage the dosing levels since there had been some fluctuations observed during normal operations in the pretrial phase.*
- *Line 1 was able to maintain the reduced NO_x emission level even with a single level of lances. Line 2 showed the potential of the system by maintaining both weeks at 120mg/Nm³*
- *No major spike in reagent consumption was observed but the increase to nitrogen levels in the APCR during the second week of the test is of interest and further investigation.*
- No data provided, but operator states: There were no signs of ammonia slip noted during the process.
- *This provides promising indication that with the appropriate levels of refinement to the SNCR system's dosing curve and stable performance, the plant can achieve a reduction to 160mg/Nm³. Longer trials will be required to ascertain the robustness of the system at lower setpoints to maintain continued operations should setpoints be lowered further.*
- *The response from the system was rapid and Line 2 held an average around the 120mg/Nm³ at both 160mg/Nm³ and 140mg/Nm³. Following conversations with the OEM it was ascertained that should the plant need to operate at such levels a detailed tuning will be required of the control curve that regulates the systems dosing levels.*
- No information on nitrous oxide emission or description of primary measures deployed. No cost data presented to rebuff further NO_x reductions.
- IBA not impacted. More NH₃ in APCr was noted.

A.60.4 EA Recommended Actions

Evaluation of the IC return information suggests that:

- The operator has suggested that *“the plant can achieve a reduction to 160mg/Nm³”*. However, there are also indications by them that plant may be capable of achieving lower levels still, although noting that these need longer term assessment (and consideration of missing N₂O data).
- While “observed fluctuations” are given as a reason for not testing 120 mg/Nm³ set point, no further explanation is provided and, **in general the case that constraints / rationale for why lower NO_x emission cannot be achieved is not currently well presented.**
- Further ongoing operational trials and assessment of whether lower NO_x levels should be made noting:
 - Spare injection levels are already available



- No major spike on reagent consumption noted (to date)
- No signs of ammonia slip noted
- Plant (young) age may indicate some further performance enhancement can be accommodated (without significant expenditure?)
- Need to consider nitrous oxide emissions and primary measures
- Plant scale and local environmental sensitivity need consideration, as well as cost and longer-term operational issues.





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