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Consulting Engineers Limited

The CSWDC Waste to Energy Plant

CSWDC

BREF Derogation

ENGINEERING CONSULTING

Document approval

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Non-technical Summary

The Coventry and Solihull Waste Disposal Company (CSWDC) operates the Coventry Energy from Waste Facility (the Facility). The Facility comprises three waste incineration lines which release flue gas to atmosphere via a common stack.

The most recent Variation to the EP, granted by the EA on 5 October 2022, implements the requirements of the Waste Incineration BREF (WI BREF). The EP requires the Facility to comply with the relevant BAT-AELs within the WI BREF by 3 December 2023.

Having undertaken trials to determine whether the Facility is able to emission limits within the EP, CSWDC has identified that whilst the Facility is able to comply with most of the emission, it is currently not able to consistently operate in accordance with the emissions limits for NOx and ammonia imposed in the EP. CSWDC has identified further improvements that can be made to the design and operation of the NOx and ammonia abatement systems, and is in the process of implementing a programme of works. However, at this stage, CSWDC does not have certainty that the proposed improvements will enable the Facility to consistently operate in accordance with the emission limits.

Taking this into consideration, following consultation with the EA, CSWDC is applying for a derogation from the emission limits for ammonia and NOx stated within the EP whilst it implements and commissions the proposed improvements to minimise emissions of NOx and ammonia. CSWDC is requesting that the derogation is granted for up to two years following implementation of the BREF, i.e. up to 3 December 2025. Following successful implementation of the modifications to the Facility, and demonstration of compliance with the BAT-AELs, CSWDC would propose that the application of the Derogation is removed.

As set out within this application, CSWDC has considered a number of alternatives for compliance with the BAT-AELs. However, the following options are considered to be feasible alternatives to achieve long-term compliance with the BAT-AELs for NOx and ammonia:

1. optimise the existing SNCR system based on CFD modelling;
2. retrofit an advanced SNCR system;
3. retrofit an SCR system; and
4. construct a new EfW facility.

CSWDC is currently going through a process of optimisation of the SNCR system. In the event that the optimisation of the SNCR system is not able to demonstrate long-term compliance with the proposed ELV's, CSWDC acknowledges that it will need to consider the installation of the other options.

In accordance with the EA's Guidance, a Cost Benefit Analysis has been undertaken to consider the options. The CBA has shown that there is an environmental benefit to be gained from implementing an Advanced SNCR system; however, due to the financial costs associated with implementing this option, compared to optimising the existing SNCR system, the overall benefit is marginal.

As demonstrated within this application, the environmental impact of operating under the proposed Derogation will be the same as operating in accordance with the BAT-AELs. Therefore, this derogation will not result in a significant environmental impact, and will provide the same level of environmental protection as operating in accordance with the BAT-AELs.

In the event that the optimisation of the existing SNCR system is not sufficient, and additional improvements are required, CSWDC would propose to consider the alternative options. CSWDC would propose that the deadline for responding to Improvement Condition 1 is extended to 30 June 2024, and revised to include for the following:

- reporting on implementation of the Proposed Derogation; and
- in the event that the proposed improvements do not result in the Facility being able to consistently perform in accordance with the BAT-AEL's, proposing a timeline for the consideration and implementation of additional measures to ensure compliance.

Contents

1 Introduction

The Coventry and Solihull Waste Disposal Company (CSWDC) operates the Coventry Energy from Waste Facility (the Facility). The Facility comprises three waste incineration lines which release flue gas to atmosphere via a common stack.

The Facility was granted an Environmental Permit (EP) by the Environment Agency (EA) on 20 December 2005. Since the EP was granted, there have been nine variations to the EP granted by the EA. The variations have been granted for a number of changes/modifications, including the following:

1. Changes to periodic ELVs - particulates, HCl, SO_2 and NOx;
2. Incorporation of a Selective Non-Catalytic Reduction (SNCR) system for the abatement of NOx;
3. Modifications to the primary and secondary air systems;
4. Changes to the EWC does which can be processed at the Facility; and
5. Change the reporting requirements for Carbon Monoxide.

The most recent Variation to the EP, granted by the EA on 5 October 2022, implements the requirements of the Waste Incineration BREF (WI BREF). The EP requires the Facility to comply with the relevant BAT-AELs within the WI BREF by 3 December 2023.

Having undertaken trials to determine whether the Facility is able to emission limits within the EP, CSWDC has identified that whilst the Facility is able to comply with most of the emission limits, it is currently not able to consistently operate in accordance with the emissions limits for NOx and ammonia imposed in the EP. CSWDC has identified further improvements that can be made to the design and operation of the NOx and ammonia abatement systems, and is in the process of implementing a programme of works. However, at this stage, CSWDC does not have certainty that the proposed improvements will enable the Facility to consistently operate in accordance with the emission limits.

Taking this into consideration, following consultation with the EA, CSWDC is applying for a derogation from the emission limits for ammonia and NOx stated within the EP whilst it implements and commissions the proposed improvements to minimise emissions of NOx and ammonia. Following successful implementation of the modifications to the Facility, and demonstration of compliance with the BAT-AELs, CSWDC would propose that the application of the Derogation is removed.

2 Legislative Context

For the purposes of applying for the derogation to the BAT-AELs, the relevant legislation is:

- Industrial Emissions Directive; and
- Waste Incineration BREF.

2.1 Industrial Emissions Directive

The Industrial Emissions Directive 2010/75/EU (IED), which was adopted on 7th January 2013, is the key European Directive which covers almost all regulation of industrial processes in the EU. Within the IED, the requirements of the relevant sector BREF become binding as BAT guidance, as follows.

1. Article 15 (2) requires that emission limit values are based on best available techniques, referred to as BAT.
2. Article 13 requires that 'the Commission' develops BAT guidance documents (referred to as BREF's).
3. Article 21 (3) requires that when updated BAT conclusions are published, the Competent Authority has up to four years to revise permits for facilities covered by that activity to comply with the requirements of the sector specific BREF.

In addition, Article 15 (3) states:

> *The competent authority shall set emission limit values that ensure that, under normal operating conditions, emissions do not exceed the emission levels associated with the best available techniques as laid down in the decisions on BAT conclusions referred to in Article 13(5) through either of the following:*
>
> *a) setting emission limit values that do not exceed the emission levels associated with the best available techniques. Those emission limit values shall be expressed for the same or shorter periods of time and under the same reference conditions as those emission levels associated with the best available techniques; or*
> *b) setting different emission limit values than those referred to under point (a) in terms of values, periods of time and reference conditions.*
>
> *Where point (b) is applied, the competent authority shall, at least annually, assess the results of emission monitoring in order to ensure that emissions under normal operating conditions have not exceeded the emission levels associated with the best available techniques.*

Whilst the IED requires the competent authority to impose the emission limits which in accordance with the requirements of the relevant BAT conclusion, Article 15 (4) allows for derogations to be granted to these emission limits. Article 15 (4) states:

> *By way of derogation from paragraph 3, and without prejudice to Article 18, the competent authority may, in specific cases, set less strict emission limit values. Such a derogation may apply only where an assessment shows that the achievement of emission levels associated with the best available techniques as described in BAT conclusions would lead to disproportionately higher costs compared to the environmental benefits due to:*
>
> *a) the geographical location or the local environmental conditions of the installation concerned; or*
> *b) the technical characteristics of the installation concerned.*

The competent authority shall document in an annex to the permit conditions the reasons for the application of the first subparagraph including the result of the assessment and the justification for the conditions imposed.

The emission limit values set in accordance with the first subparagraph shall, however, not exceed the emission limit values set out in the Annexes to this Directive, where applicable.

The competent authority shall in any case ensure that no significant pollution is caused and that a high level of protection of the environment as a whole is achieved.

Therefore, whilst the IED requires the implementation of the BAT-AELs it also allows for derogations to the BAT-AELs in certain scenarios.

The Environment Agency has developed an IED derogation cost-benefit analysis tool to support Operators that are proposing to develop applications for derogations from the BAT-AELs.

2.2 Waste Incineration BREF

The WI BREF was published by the European Integrated Pollution Prevention and Control (IPPC) Bureau on 3 December 2019. Therefore, in accordance with Article 21 (3), the regulatory authority (the EA) is required to review and implement conditions within all permits which require operators to comply with the requirements set out in the BREF within 4 years of it being published (i.e. by 3 December 2023).

The BREF identifies different requirements for 'existing' and 'new' plants. These are classified as follows.

1. 'Existing' plants are those plants which have been granted a permit before the Final BREF is published.
2. 'New' plants are plants which are not existing plants, i.e. those which have not been granted a permit before the Final BREF is published.

As the Facility was operational was when the WI BREF was published it is understood that the Facility is being regulated as an 'Existing' plant by the EA. Taking this into consideration, the relevant emission limits (referred to as BAT-AELs within the WI BREF) for an 'Existing' facility are presented in Table 1.

Table 1: 'Existing Plant' emission limits from the WI BREF

Pollutant	**BAT-AEL from BREF (mg/Nm^3) – Daily average, unless stated**
Nitrogen dioxide	180
Carbon monoxide	50
Sulphur Dioxide	40
Hydrogen Chloride	8
Total Organic Carbon	10
Ammonia	15
Particulates	5
Cadmium & Thallium	0.02 (2)
Group 3 Metals	0.3 (2)
Hydrogen Fluoride	1
Dioxins & Furans	0.06 ng I-TEQ/Nm^3 (2)

Pollutant	BAT-AEL from BREF (mg/Nm^3) – Daily average, unless stated
Dioxin like PCBs	0.08 ng WHO-TEQ/Nm^3 (2)
Mercury	0.025 (2)
(1) Emission limits expressed at 11% oxygen, standard temperature and pressure. (2) Average over the sampling period.	

3 Current permitting constraints

3.1 Environmental Permit

Table S3.1 of the EP sets out the ELVs which will be applied to the Facility. These are replicated in Table 2.

Table 2: Existing ELVs

Parameter	Units	Half Hour Average	Daily Average	Periodic Limit
Emission Point A1, A2 & A3				
Particulate matter	mg/Nm^3	30	10	-
VOCs as Total Organic Carbon (TOC)	mg/Nm^3	20	10	-
Hydrogen chloride	mg/Nm^3	60	10	-
Carbon monoxide	mg/Nm^3	150[(2)]	50	-
Sulphur dioxide	mg/Nm^3	200	50	-
Oxides of nitrogen (NO and NO_2 expressed as NO_2)	mg/Nm^3	400	200	-
Hydrogen fluoride	mg/Nm^3	4	1	
Ammonia	mg/Nm^3	-	No limit set	-
Cadmium & thallium and their compounds (total)	mg/Nm^3	-	-	0.05
Mercury and its compounds	mg/Nm^3	0.05	0.05	-
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V and their compounds (total)	mg/Nm^3	-	-	0.5
Dioxins & furans ITEQ	ng/Nm^3	-	-	0.1

[(1)] Emission limits expressed at 11% oxygen, standard temperature and pressure.

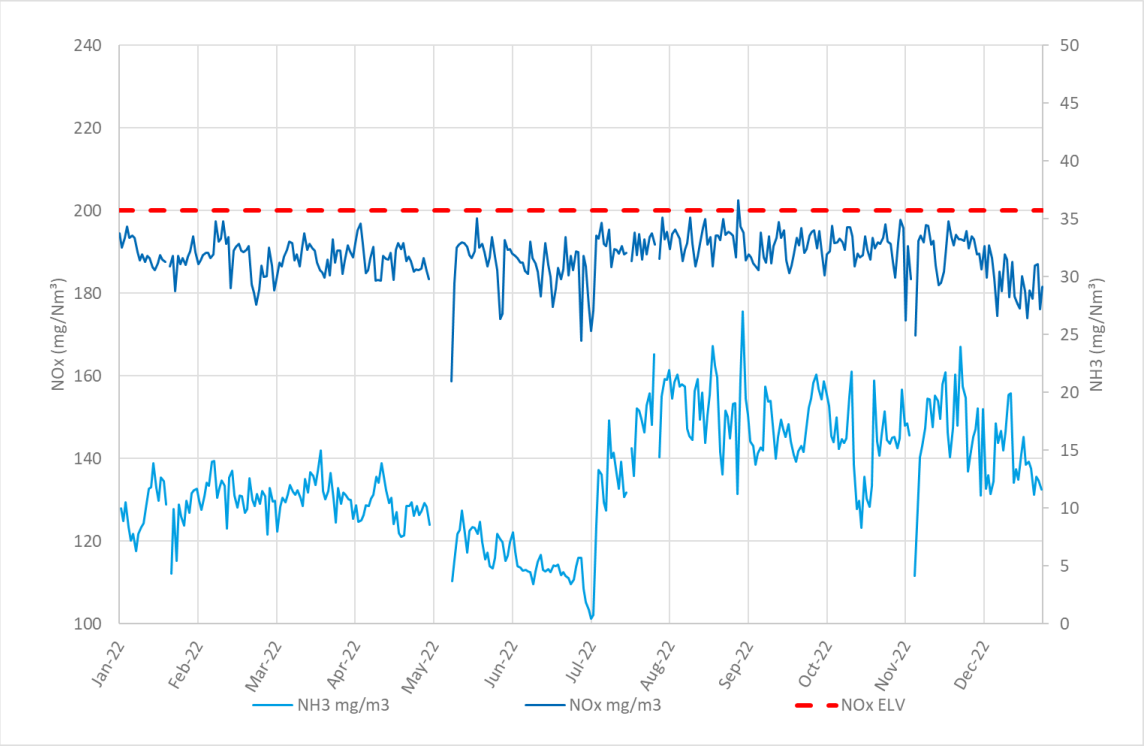
[(2)] Expressed as a 10-minute average.

For the purposes of applying for this derogation, the only ELVs which are applicable to this application are the daily ELVs for NOx and ammonia. In addition, it should be noted that the EP does not include an EV for ammonia and it is only required to undertake continuous monitoring of emission of ammonia.

3.2 Existing Plant performance

Utilising the reported emissions for NOx and ammonia for 2022 (1 January 2022 to 31 December 2022), the performance of each line against the existing ELVs within the EP are provided in Figure 1 to Figure 3. As stated previously, the EP does not currently impose an ELV for ammonia, therefore emissions of ammonia have not been compared with the ELV.

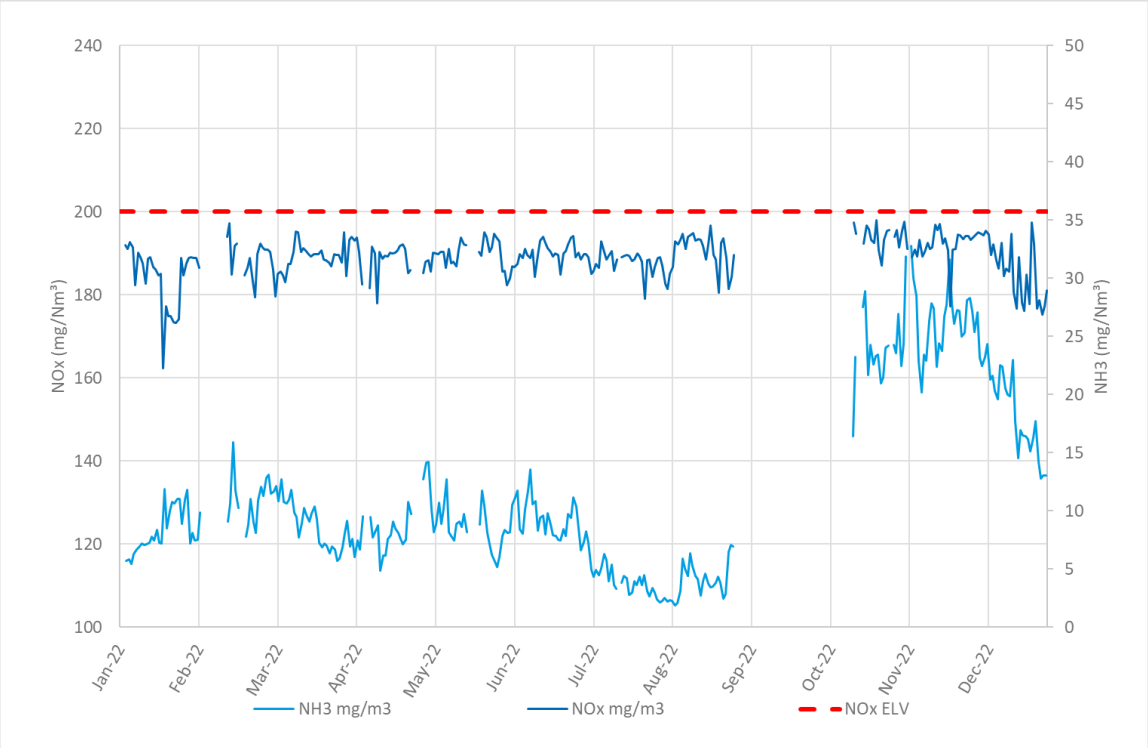
Figure 1 - Line 1: Reported NOx and Ammonia emissions



As shown in Figure 1, Line 1 consistently operates with a NOx concentration of between 180 and 200 mg/Nm^3. The reported daily average NOx concentration for Line 1 was 189.4 mg/Nm^3. There was a single exceedance of the NOx ELV during this period.

Ammonia emissions fluctuated, with emissions between 5 and 25 mg/Nm^3. The reported daily average ammonia concentration for Line 1 was 12.7 mg/Nm^3, and the maximum reported daily average was 26.99 mg/Nm^3.

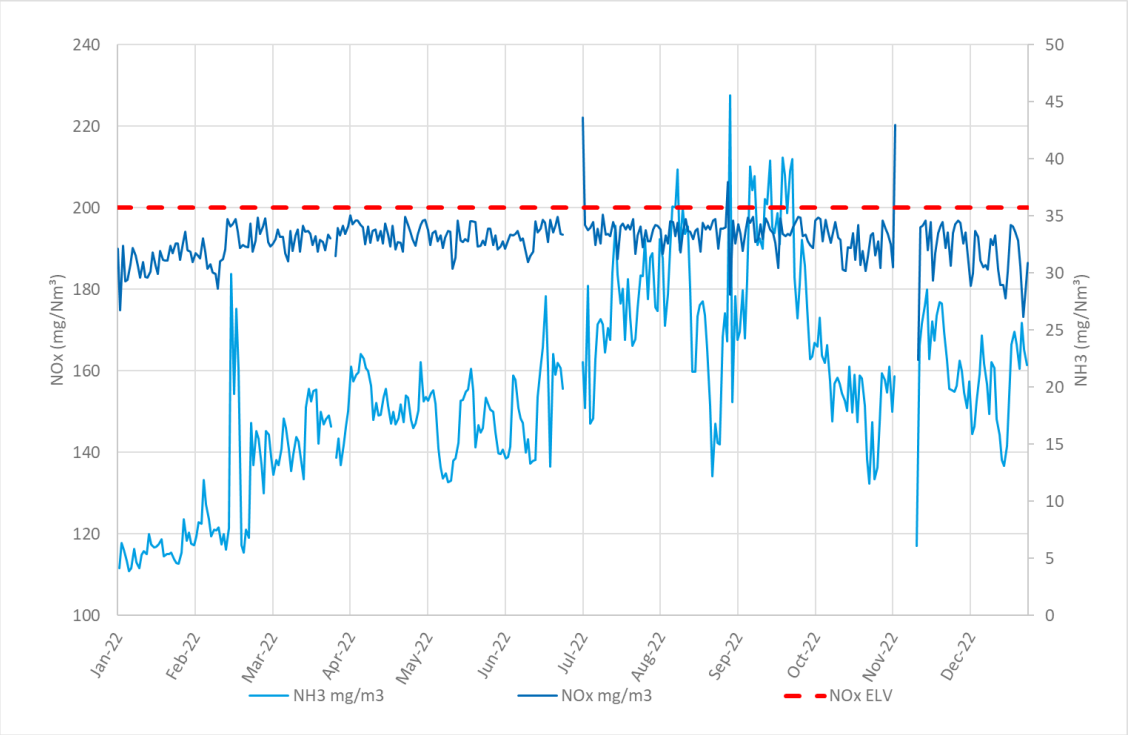
Figure 2 - Line 2: Reported NOx and Ammonia emissions



As shown in Figure 2, Line 2 consistently operates with a NOx concentration of between 180 and 200 mg/Nm^3. The reported daily average NOx concentration for Line 2 was 189.3 mg/Nm^3. There were no exceedance of the NOx ELV during this period.

Ammonia emissions fluctuated, with emissions between 5 and 30 mg/Nm^3. The reported daily average ammonia concentration for Line 2 was 12 mg/Nm^3, and the maximum reported daily average was 32.98 mg/Nm^3.

Figure 3 - Line 3: Reported NOx and Ammonia emissions



As shown in Figure 3, Line 3 consistently operates with a NOx concentration of between 180 and 200 mg/Nm^3. The reported daily average NOx concentration for Line 2 was 189.3 mg/Nm^3. There were three exceedances of the NOx ELV during this period.

Ammonia emissions fluctuated significantly, with emissions between 5 and 40 mg/Nm^3. The reported daily average ammonia concentration for Line 2 was 19.7 mg/Nm^3, and the maximum reported daily average was 40.11 mg/Nm^3.

3.3 Existing NOx abatement measures

NOx is primarily controlled by monitoring and maintaining the flow of primary combustion air (over-fire and under-fire air) within the furnace.

As identified in section 1, a Selective Non-Catalytic Reduction (SNCR) system has been installed at the Facility, an EP Variation to allow for the installation and operation of the SNCR system was granted in March 2009. This is a secondary NOx abatement technique and was installed to enable the Facility to comply with the emissions limits imposed following implementation of the Waste Incineration Directive (subsequently superseded by the IED).

SNCR involves distributing a spray containing an aqueous ammonia solution into the flue gas flow path typically within the boiler. The ammonia reacts with the NOx formed in the combustion process to produce a combination of nitrogen, water and carbon dioxide.

Not dosing the ammonia solution within the optimal location with the boiler or low reaction temperatures can result in some of the ammonia not reacting with the NOx and can result in an ‘ammonia slip’. This leads to the formation of ammonia salts downstream in the flue gas path and discharge to atmosphere of unreacted ammonia.

The efficiency of the SNCR system is controlled through optimisation of the overfire air system and the ammonia dosing rate and the location of the ammonia dosing. The optimal location for dosing the ammonia reagent is within the high temperature region of boiler.

SNCR is widely deployed across waste, biomass and coal power plants in the UK and Europe, and is primary abatement system for the abatement of NOx from nearly all of the operational waste incineration plants within the UK.

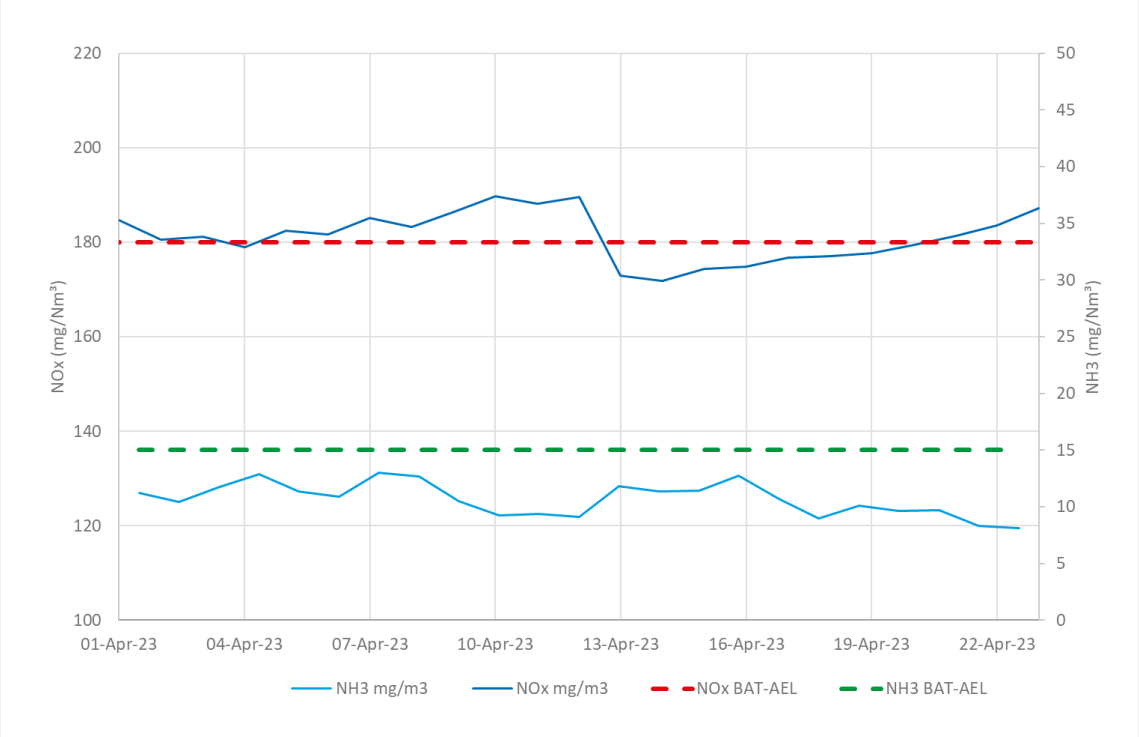
As explained in section 3.2, this has been demonstrated as suitable to ensure compliance with the existing ELVs for NOx.

Based on analysis of the performance of the existing abatement systems, and review of the CFD modelling of the OFA system by the technology provider in 2012/13, the operation of the OFA system produces a biased flue gas flow up the back wall of the furnace. For the current operation, this results in an uneven temperature profile across the dosing range for the SNCR system significantly reducing the efficient operation of the SNCR system. This means that the SNCR system does not operate efficiently meaning that emissions of NOx are not fully abated and resulting in an elevated ammonia slip.

3.4 WI BREF Trials

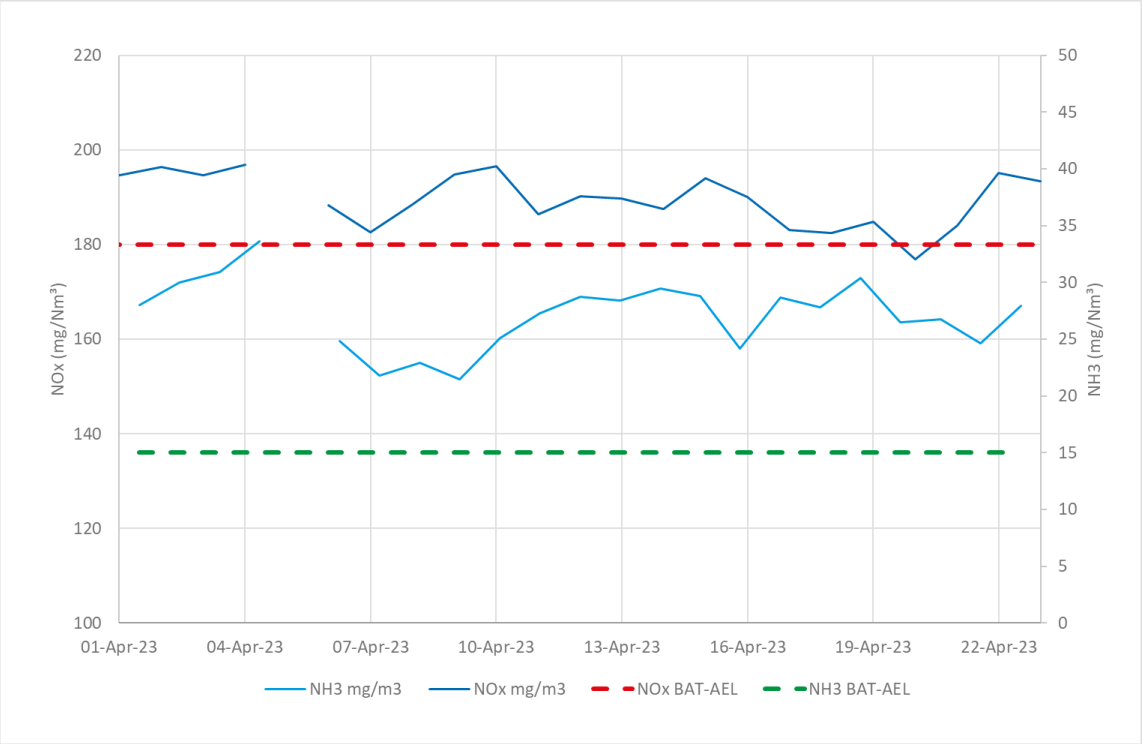
Following the granting of the EP Variation in October 2022, CSWDC undertook a 'BREF trial' to assess the performance of the Facility against the requirements of the proposed ELVs. The BREF trial was undertaken between 1 and 23 April 2023. This involved setting the NOx set point for the SNCR system to 170 mg/Nm³. The performance of all three lines against the proposed ELVs is provided in Figure 4 to Figure 6.

Figure 4 - Line 1: Trial NOx and Ammonia emissions



As shown in Figure 4, at the revised set point, there was a short period (6 days) during the trial whereby Line 1 continuously operated below the BAT-AEL for NOx; however, for more than 50% of the trial period, Line 1 did not comply with the BAT-AEL for NOx. Whilst Line 1 did not operate in accordance with the BAT-AEL for NOx, during the entire trial period, it operated within the BAT-AEL for ammonia.

Figure 5 - Line 2: Trial NOx and Ammonia emissions



As shown in Figure 5, at the revised set point, there was a single day during the trial whereby Line 2 operated below the BAT-AEL for NOx, with NOx concentrations consistently being higher than 180 mg/Nm^3 for the majority of the trial. Furthermore, during the trial emissions of ammonia were higher than 20 mg/Nm^3 for the entire the trial period.

Figure 6 – Line 3: Trial NOx and Ammonia emissions

As shown in Figure 6, at the revised set point, Line 3 only operated continuously for three days below the BAT-AEL for NOx. For more than 50% of the trial period, Line 1 did not comply with the BAT-AEL for NOx. Furthermore, Line 3 exceeded the BAT-AEL for ammonia for more than 50% of the trial period. It is also worthy of note that the exceedances of the BAT-AELs for ammonia and NOx occurred at the same time.

Following the trials, CSWDC does not consider that the existing NOx abatement measures which are installed at the Facility are sufficient to enable all three lines to consistently comply with the BAT-AELs for NOx and ammonia following implementation of the WI BREF. Therefore, a derogation from the BAT-AELs may be required whilst additional measures to reduce emissions of NOx and ammonia are considered.

3.5 Improvement Conditions

Improvement Condition 1 of the EP requires the following:

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 NOx 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 NOx 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 NOx 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 NOx emissions.*
- *The results of trials conducted to further reduce daily average NOx 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 NOx 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 NOx emissions can be optimised on a permanent basis, including justification and an implementation plan where relevant.

The EP requires that this condition is discharged by 30 September 2023. However, due to the results of the WI BREF Trials (section 3.4) and the ongoing optimisation works to the SNCR system (section 4.2), the EA has agreed an extension to the deadline of 31 May 2024 for the submission of the report to demonstrate compliance with the requirements of the BAT-AELs for NOx and ammonia.

4 NOx abatement options

4.1 Available options

As demonstrated in section 3.4, CSWDC does not consider that the existing NOx abatement measures which are installed at the Facility are sufficient to enable all three lines to consistently comply with the BAT-AELs for NOx and ammonia following implementation of the WI BREF.

Taking into consideration CSWDC has identified the available options to achieve long-term compliance with the BAT-AELs for NOx and ammonia:

1. **Implement modifications to the existing selective non-catalytic reduction (SNCR) system -** These modifications would be based on computational fluid dynamics (CFD) modelling to optimise the installed system – Modify the over fire air system to provide improved mixing of combustion gases above the bed to provide a more consistent flue gas flow in terms of temperature and gas species concentrations. This should improve the efficiency of the SNCR system; therefore, providing improved NOx control and reduced ammonia concentrations within the emissions released to atmosphere.
2. **Install Flue Gas Recirculation (FGR)** – An FGR system is installed at the Facility but not utilised. Upgrades would need to be made to the pipework/ducting to enable it to be utilised. The operation of the FGR would reduce the unabated NOx emissions generated by the Facility; however, as a single solution it is not expected to reduce NOx formation in the boiler sufficiently to enable the Facility to achieve the BAT-AELs.
3. **Retrofit an acoustic gas temperature measurement (AGAM) system, otherwise referred to as an advanced SNCR system** - The retrofit of an advanced SNCR system would enable the Facility to comply with the BAT-AELs. However, it would require the advanced SNCR system to be designed to integrate into the Facility; planning consent for any plant modifications and infrastructure, which are assumed to be minimal; and installation of the advanced SNCR system with an assumed construction and commissioning period of up to 12 months. Notwithstanding this, the retrofit of an advanced SNCR system is considered to be a feasible alternative.
4. **Retrofit a Selective Catalytic Reduction (SCR) system** – The retrofit of an SCR system would enable the Facility to comply with the BAT-AELs and, in fact, an SCR system would enable the Facility to operate at a lower NOx ELV than the BAT-AEL. However, it would require the SCR system to be designed to integrate into the Facility; planning consent for any plant modifications and infrastructure; and installation of the SCR system with an assumed construction and commissioning period of up to 18 months. Notwithstanding this, the retrofit of an SCR system is considered to be a feasible alternative.
5. **Change all/some of the waste types combusted** – the Facility processes municipal waste which is generated in Coventry, Solihull, Warwickshire and Leicestershire. The types and quantities of waste processed at the Facility has not changed; therefore, changes to the waste processed at the Facility is not considered to be a root-cause of the Facility experiencing elevated concentrations of ammonia and NOx. CSWDC is not able to influence the composition of the waste which is processed at the Facility, and it is not considered to be a feasible alternative.
6. **Shutdown the Facility (total or partial)** – This would require the waste which would otherwise processed at the Facility to be transferred to an alternative waste incineration or disposal facility. CSWDC does not consider that this is a feasible alternative.
7. **Construct a new EfW facility** – It would take up to 5-10 years to secure a site, planning consent and construct a new EfW facility to replace the Facility. Furthermore, the waste currently processed at the Facility would still need to be processed in an alternative waste management

facility during the development and construction period for a new EfW facility. Whilst this would require any derogation to be for an extended period to allow for construction and commissioning of a new EfW facility, it is considered to be a feasible alternative.

Taking the above into consideration, the following options are considered to be feasible alternatives to achieve long-term compliance with the BAT-AELs for NOx and ammonia:

1. optimise the existing SNCR system based on CFD modelling;
2. retrofit an advanced SNCR system;
3. retrofit an SCR system; and
4. construct a new EfW facility.

4.2 CSWDC's Proposed Derogation

It should be noted that CSWDC's Proposed Derogation is to optimise the existing selective non-catalytic reduction (SNCR) system, and is currently being implemented.

CSWDC is working with a recognised specialist contractor that has extensive experience in improving NOx control on a wide range of combustion and waste incineration plants within the UK and Europe to identify opportunities to optimise the efficiency of the SNCR system. The contractor has undertaken CFD modelling of the flue gases within the furnace and boiler. This has identified that the design of the existing over-fire air system is not sufficient to cope with the unstable combustion on the grate.

The contractor has advised that this results in significant fluctuations in the flue gas temperatures in the SNCR injection system within the boiler. As explained previously, this will impact on the efficiency of the SNCR, resulting in ammonia slip caused by overdosing of ammonia or dosing where the flue gases are not at the optimum temperature for the reactions to be efficient. In addition, CFD modelling has also shown a large recirculation zone in the furnace which significantly reduces the residence time for ammonia to react with the NOx within the flue gas.

Taking this into consideration, the Contractor has identified improvements which can be made to the over fire air system, to improve the mixing of the flue gases above the bed to improve mixing of the flue gas within the furnace and ensure a more consistent flue gas flow in terms of temperature and gas species concentrations within the SNCR dosing system. Overall, the modifications are intended to improve the efficiency of the SNCR system resulting in lower ammonia slip and reduced emissions of NOx.

Modifications to the over fire air systems have been planned as follows:

- Line 1 modifications were made in July 2023;
- Line 2 modifications were made in September 2023; and
- Line 3 modifications are due to be progressed in November 2023.

However, whilst the modifications to the over fire air systems will have been made to all three lines before 3 December 2023, the commissioning and optimisation of the system are expected to take approximately 6 months to be fully commissioned and to be able to demonstrate compliance with ELV's.

For the purposes of this application, it is assumed that the existing emissions controls for NOx and ammonia within the existing EP are retained, refer to Table 2, whilst CSWDC considers the available options to comply with the BAT-AELs.

5 Environmental Assessments – Proposed Derogation

5.1 Air quality

Dispersion modelling has been undertaken utilising the modelling software package, ADMS 6 developed by CERC. The modelling was undertaken to consider the difference in environmental impacts between the Proposed Derogation and compliance with the BAT-AELs for NOx and ammonia.

The modelling has been undertaken based on flue gas temperature and volumetric flow rate derived from data from the CEMS covering the period of 1 January 2022 to 21 May 2023.

For the purposes of this assessment, the impacts on both human health and ecology have been considered. The following emission limits have been assumed:

Table 3: Monitored Emissions Concentrations

Pollutant	Emission Concentration (mg/Nm³)	
	Proposed Derogation	BAT-AELs
NOx	200	180
Ammonia		15
Ammonia (Maximum reported)	40	
Ammonia (Average reported)	15	
Notes: The EP does not currently include an ELV for ammonia; therefore, the maximum and average daily average from the 2022 Performance Report have been applied.		

5.1.1 Human receptors

The process contributions (PCs) for the assessment of the impact on human health have been calculated at the point of maximum impact. In accordance with EA guidance, impacts of less than 1% of the relevant long-term ES or less than 10% of the short-term ES can be screened out as 'insignificant'.

The impact on the maximum hourly mean ammonia concentration of operating under the Proposed Derogation has been calculated assuming operation at the maximum reported daily average ammonia concentration as a worst case (refer to Table 3). The impact on the maximum annual mean ammonia concentration has been calculated assuming operation at the average reported ammonia concentration.

Table 4: Dispersion Modelling Results – Point of Maximum Impact

Pollutant	Averaging Period	ES (µg/m³)	PC (% of ES)	
			Proposed Derogation	BAT-AELs
Nitrogen dioxide	Annual mean	40	0.92%	0.83%
	99.79%ile of hourly means	200	2.32%	2.09%
Ammonia	Annual mean	180		0.02%

Pollutant	Averaging Period	ES (µg/m³)	PC (% of ES)	
			Proposed Derogation	BAT-AELs
	Hourly mean	2,500		0.09%
Ammonia (Average)	Annual mean	180	0.02%	
Ammonia (Maximum)	Hourly mean	2,500	0.23%	

As shown, the maximum annual mean PCs are less than 1% of ES and the short-term PCs are less than 10% of the ES in all scenarios. Therefore, all impacts can be screened out as 'insignificant' in all three scenarios.

Whilst the maximum daily average ammonia concentration (taken from the 2022 Annual Performance Report) is 40 mg/Nm³, the average is almost exactly 15 mg/Nm³; therefore the PC calculated using the BAT-AEL and the average monitored concentration is the same.

5.1.2 Ecological receptors

The PCs have also been calculated at all relevant ecological receptors. No European or UK designated sites have been identified within the relevant screening distances from the Facility, so only local nature sites[1] have been included. In accordance with EA guidance, for local nature sites, where an impact is less than 100% of the relevant long- or short-term ES, it can be screened out as 'insignificant'.

For ecological receptors, consideration has been given to the impact of airborne pollutant concentrations as well as nitrogen and acid deposition. The maximum annual mean impact, as a percentage of the applied ES, occurs at an unnamed ancient woodland for which the receptor point was modelled at 436425, 278130. The maximum daily mean impact (relevant to NOx only) occurs at a separate unnamed ancient woodland for which the receptor point was modelled at 436610, 277940. The appropriate deposition Critical Loads have been obtained from APIS for woodland habitats.

For ammonia and nitrogen and acid deposition impacts on ecology, the relevant ESs are over an annual averaging period. Therefore, to calculate the impact on ecology the average reported ammonia emission concentration presented in Table 3 has been used. The maximum impact at any ecological receptor for each scenario is presented in Table 5.

Table 5: Dispersion Modelling Results – Maximum Impacted Ecological Receptor

Pollutant	Averaging Period	Units	ES	PC (% of ES)	
				Proposed Derogation	BAT-AELs
NOx	Annual mean	µg/m³	30	1.35%	1.22%
	Daily mean	µg/m³	75	5.42%	4.88%
Ammonia	Annual mean	µg/m³	1	3.04%	3.04%

[1] National Nature Reserves (NNR), Local Nature Reserves (LNRs), Local Wildlife Sites (LWSs) and ancient woodlands

Pollutant	Averaging Period	Units	ES	PC (% of ES)	
				Proposed Derogation	BAT-AELs
Nitrogen Deposition	Annual	kgN/ha/yr	10	3.19%	3.11%
Acid Deposition	Annual	keq/ha/yr	2.663	2.21%	2.19%
Note: Acid deposition includes sulphur dioxide and hydrogen chloride emissions at BAT-AELs					

The PC for all pollutants and averaging periods is below 100% of the ES so can be screened out as 'insignificant' for both scenarios.

5.2 Emissions to water and sewer

The proposed derogation will not result in any changes to the emissions to water or sewer from the Facility.

5.3 Raw materials

The proposed derogation will not result in any changes to the types or quantities of raw material consumed by the Facility.

5.4 Residues

The proposed derogation will not result in any changes to the types or quantities of residues generated by the Facility.

6 Cost Benefit Analysis

As explained in section 4.1, CSWDC considers the following options to be 'available' to achieve long-term compliance with the BAT-AELs for NOx and ammonia:

1. optimise the existing SNCR system based on CFD modelling;
2. retrofit an advanced SNCR system;
3. retrofit a SCR system; and
4. construct a new EfW facility.

Therefore, in applying for a Derogation from the BAT-AELs for NOx and ammonia, CSWDC has considered each of these options within a Cost Benefit Analysis, as required by Article 15 (4) of the IED. The Cost Benefit Analysis has been undertaken in accordance with the EA's IED derogation cost-benefit analysis tool, refer to Appendix A.

For the purposes of completing the CBA tool, the options have been considered as follows:

- Proposed derogation – optimise the existing SNCR system based on CFD modelling;
- BAT-AEL – retrofit an advanced SNCR system;
- Option 1 – retrofit an SCR system; and
- Option 2 – construct a new EfW facility.

It should be noted that CSDWC has considered two additional options to its Proposed Derogation and the BAT-AELs.

6.1 Assumptions

For the purposes of considering each available a number of assumptions have been applied within the CBA tool. The assumptions applied to each option are provided in sections 6.1.1 to 6.1.4

6.1.1 Optimise the SNCR system

The following assumptions have been applied to the optimisation of the SNCR system:

1. The waste/residues generated, and electricity consumed will be the same as the Business As Usual (BAU) case.
2. There will no changes to the emissions to water/sewer or land associated with this case.
3. Capex costs are based on quotations provided to CSWDC.
4. Opex costs are based on CSWDC's current Opex costs, and will be the same as the BAU case.
5. The operating cost profile is the same as BAU case.
6. Emissions to air have been calculated based on actual emission, taken from the CEMS for 2022.

6.1.2 Retrofit an advanced SNCR system

The following assumptions have been applied to the retrofit of an advanced SNCR system:

1. The waste/residues generated, and electricity consumed will be the same as the BAU case.
2. There will no changes to the emissions to water/sewer or land associated with this case.
3. Capex costs have been estimated from budget quotations provided to CSWDC.
4. The maintenance costs for the BAU case have been applied, with an additional maintenance cost of 2% of the capital investment.

5. Emissions to air have been calculated on the application of the BAT-AELs, namely NOx 180mg/m^3 and ammonia 15 mg/m^3.

6.1.3 Retrofit an SCR

The following assumptions have been applied to the retrofit of an SCR system:

1. The waste/residues generated, and electricity consumed will be the same as the BAU case.
2. There will no changes to the emissions to water/sewer or land associated with this case.
3. Capex cost is estimated from previous projects and internal costing data base.
4. Additional maintenance cost compared to BAU is 2% of the capital investment
5. Emissions to air have been calculated on the lower range of the applicable BAT-AELs for an SCR system, namely NOx 70mg/m^3 and ammonia 10 mg/m^3.

6.1.4 Construct a new EfW facility

The following assumptions have been applied to the construction of a new EfW facility:

1. The waste/residues generated, and electricity consumed will be the same as the BAU case.
2. There will no changes to the emissions to water/sewer or land associated with this case.
3. Capex costs for the construction of a new facility have been derived from a database of reference projects held by Fichtner.
4. Opex for the construction of a new facility have been derived from a database of reference projects held by Fichtner.
5. Capex costs associated with the operation of a new facility have been derived from a database of reference projects held by Fichtner.
6. Emissions to air have been calculated on the applicable BAT-AELs for a new plant using an SNCR system, namely NOx 120 mg/m^3 and ammonia 10 mg/m^3.

6.2 CBA

The available options have been ranked within the CBA tool, taking into consideration the higher costs associated with complying with the BAT-AELs and the environmental benefits which will be gained from complying with the BAT-AELs; compared to the costs and environmental benefits associated with the Proposed Derogation. The Net Present Value for each option is summarised in Table 6.

Table 6: CBA Summary results – Central NPV

	Unit	Proposed Derogation	BAT-AEL – Advanced SNCR system	Option 1 - retrofit a SCR system	Option 2 - Construct a new EfW
Central NPV	£ million	0	1.2	-22.47	-255.87

As shown in Table 6, the additional cost associated with Options 1 and 2 significantly outweigh any environmental benefits to be gained from implementing either of these Options.

As shown in the CBA there is an environmental benefit to be gained from implementing an Advanced SNCR system; however, due to the financial costs associated with implementing this option, compared to optimising the existing SNCR system, the overall benefit is marginal.

Sensitivity analysis has been undertaken within the CBA on the available options and is summarised in Table 7.

Table 7: CBA Summary results – Sensitivity analysis

	Unit	Proposed Derogation	BAT-AEL – Advanced SNCR system	Option 1 - retrofit a SCR system	Option 2 - Construct a new EfW
Lowest NPV – High operating costs	£ million	0	-52.5	-77.08	-328.75
Lowest NPV – Low operating costs	£ million	0	54.9	32.15	-182.98

As shown in Table 7, the cost associated with Option 2 significantly outweighs any environmental benefits to be gained from implementing this Option. As shown in the sensitivity analysis, if the operating costs associated with the BAT-AEL Option and Option 1 were to be higher than currently estimated, then the financial costs associated with the Proposed Derogation would significantly outweigh any environmental benefits gained from complying with the BAT-AELs.

Conversely, as shown in Table 7, if the operating costs associated with the BAT-AEL Option and Option 1 were lower than currently estimated, then the environmental benefits gained would significantly outweigh any financial costs associated with their implementation.

Scenario analysis has been undertaken within the CBA on the available options and is summarised in Table 8.

Table 8: CBA Summary results – Scenario analysis

	Unit	Proposed Derogation	BAT-AEL – Advanced SNCR system	Option 1 - retrofit a SCR system	Option 2 - Construct a new EfW
Lowest NPV – High operating costs and low benefits	£ million	0	-53.41	-87.79	-412.73
Lowest NPV – Low operating costs and high benefits	£ million	0	56.56	56.16	-267.85

As shown in Table 8, the cost associated with Option 2 significantly outweighs any environmental benefits to be gained from implementing this Option. As shown in the scenario analysis, if the operating costs associated with the BAT-AEL Option and Option 1 were to be higher and the environmental benefits were lower than currently estimated, then the financial costs associated with the Proposed Derogation would significantly outweigh any environmental benefits gained from complying with the BAT-AELs.

Conversely, as shown in Table 8, if the operating costs associated with the BAT-AEL Option and Option 1 were to be lower and the environmental benefits were higher than currently estimated, then the environmental benefits associated with the Proposed Derogation would significantly outweigh any financial costs associated with complying with the BAT-AELs.

7 Conclusions

7.1 Current Status

Having undertaken trials to determine whether the Facility is able to emission limits within the EP, CSWDC has identified that whilst the Facility is able to comply with most of the emission, it is currently not able to consistently operate in accordance with the emissions limits for NOx and ammonia imposed in the EP.

CSWDC has identified a number of potential improvements which could be made to the design and operation of the Facility to enable it to comply with the BAT-AELs for NOx and ammonia, and is in the process of implementing a programme of works. However, at this stage, CSWDC does not have certainty that the proposed improvements will enable the Facility to consistently operate in accordance with the emission limits.

Therefore, CSWDC is applying for a derogation from the emission limits for ammonia and NOx stated within the EP whilst it implements and commissions the proposed improvements to minimise emissions of NOx and ammonia. CSWDC is requesting that the derogation is granted for up to two years following implementation of the BREF, i.e. up to 3 December 2025. Following successful implementation of the modifications to the Facility, and demonstration of compliance with the BAT-AELs, CSWDC would propose that the application of the Derogation is removed.

7.2 Future Improvements

The following options are considered to be feasible alternatives to achieve long-term compliance with the BAT-AELs:

1. optimise the existing SNCR system based on CFD modelling;
2. retrofit an advanced SNCR system;
3. retrofit an SCR system; and
4. construct a new EfW facility.

CSWDC's proposed solution is to optimise the existing SNCR system, and modifications to the over fire air systems are being implemented, with works on the final line scheduled for November 2023. CSWDC is in the process of commissioning and optimizing the system, and expects to complete this process for all three lines in the first half of 2024.

A cost benefit analysis has been completed for the three alternatives to the proposed derogation. This has shown that the additional costs associated with retrofitting an SCR system and/or the construction of a new EfW facility significantly outweigh any environmental benefits to be gained from implementing either of these options. Whilst there is an environmental benefit to be gained from implementing an Advanced SNCR system, the financial costs associated with implementing this option, compared to optimising the existing SNCR system, mean that the overall benefit is marginal. Therefore, CSDWC considers that this supports and justifies the proposed derogation whilst it implements the proposed improvements which are expected to achieve long-term compliance with the BAT-AELs.

Finally, as demonstrated, the environmental impact of operating under the proposed Derogation will be the same as operating in accordance with the BAT-AELs. Therefore, this derogation will not result in a significant environmental impact and will provide the same level of environmental protection as operating in accordance with the BAT-AELs.

In the event that the optimisation of the existing SNCR system is not sufficient, and additional improvements are required, CSWDC would propose to develop the alternative options further. CSWDC would propose that Improvement Condition In the event that the optimisation of the existing SNCR system is not sufficient, and additional improvements are required, CSWDC would propose that the deadline for responding to IC1, refer to section 3.5, is extended to 30 June 2024, and revised to include for the following:

- reporting on implementation of the Proposed Derogation; and
- in the event that the proposed improvements do not result in the Facility being able to consistently perform in accordance with the BAT-AEL's, providing a timeline for the consideration and implementation of additional measures to ensure compliance.

Appendices

A Cost Benefit Analysis

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