GLOBAL WARMING POTENTIAL

Grid Powr (UK) Ltd
Energy Production Facility

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Sol Environment Ltd

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CONTENTS

1 INTRODUCTION

This document has been prepared by Sol Environment Ltd on the behalf of Gird Powr (UK) Ltd (in support of its Environmental Permit Application) for the proposed energy recovery facility on land off the Houghton Main Colliery Roundabout, Park Spring Road, Houghton Main, Barnsley.

The document forms a GWP comparison against the potential flue gas emissions abatement technology options for the energy recovery facility.

This report provides a qualitative and quantitative appraisal of the various flue gas and emissions abatement technologies relating to NOx abatement, acid gas treatment, dioxin/furan and particulate abatement.

2 EFW OPTIONS APPRAISALS

2.1 Introduction

A detailed description and BAT justification for the proposed EfW combustion systems and associated balance of plant has been provided within the application support document.

In summary, the proposed hybrid combustion system incorporates the following pollution abatement technologies:

- NOx abatement using a combination of SNCR, SCR and flue gas recirculation;
- Acid gas abatement using sodium bicarbonate injection and filtration;
- Heavy metal, dioxins, furans and VOC abatement provided through the injection of activated carbon; and
- Particulate abatement through the use of bag filtration.

2.2 Selection of Treatment Technology

A review of the technology is provided within the Application Support Document. Despite the combustion system involving gasification, the process is more akin to moving grate combustion and cannot be compared to conventional fluidised bed, updraft or downdraft gasification processes.

2.3 NOx Abatement Selection

As required by the EA Sector Guidance, the applicant has provided a site-specific appraisal of the selected NOx abatement and control system. NOx reduction can be achieved through one or a combination of the following, each of which has been considered within the assessment:

- Flue Gas Recirculation (FGR):
- Selective Non-Catalytic Reduction (SNCR); and
- Selective Catalytic Reduction (SCR)

The process of FGR in this application is essential for achieving the staged combustion and low oxygen requirements for sub-stoichiometric combustion and gasification and as such is a fundamental part of the combustion system design. The use of FGR reduces the available Nitrogen within the combustion reaction and therefore reduces both the NOx formation and the overall quantity of reagents required for the downstream SNCR / SCR systems.

Unlike conventional inclined grate incineration systems there is no need for additional electrical trace heating within the FGR system for the prevention of duct borne flue gas condensation, so therefore it is included as standard within the design of the plant. A secondary benefit of the FGR system is the fact that it increases the overall energy efficiency of the process.

Although FGR is an effective means of reducing NOx, it cannot provide sufficient reductions in concentration levels to meet the required BAT AEL's. On the basis that further NOx reduction is required and that primary NOx control measures, for example combustion air controls, fuel mixing, grate cooling etc are applied, this assessment evaluates the key environmental impacts of SNCR and SCR.

Although consideration has been given to the environmental impacts of waste production and raw materials usage, as both options are using the same chemical dosing reagents, the accident risks, noise and odour potential are considered similar and have therefore have not been assessed further.

Air Quality Impacts of NOx Emissions

The NOx removal performance of SNCR and SCR differ and therefore achieve different release concentrations when used in identical combustion systems. Estimated long-term emission concentrations for both SNCR and SCR are provided in Table 2.1 and are based on the EA BAT limit for nitrogen dioxide (NO_2), waste incineration BREF level for nitrous oxide (N_2O) and BAT conclusions limit for ammonia[1].

Short-term emissions performance for both options would be compliant with IED BAT limits for NO_2. Whilst emissions performance data for N_2O is provided, N_2O is not an air quality pollutant but does contribute to global warming which is discussed later in this section.

Given the purpose of this assessment is to provide an assessment of the relative performance of the options, the various options have not been modelled further.

1 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019D2010&from=EN

Table 2.1: Summary of Air Quality Performance Associated with NOx abatement		
Option	SNCR	SCR
Achievable emissions concentrations (in mg/Nm^3) long-term(1)		
Nitrogen Dioxide	100	80
Nitrous Oxide	10	0
NH_3	10	<10

In terms of NO_2 performance SCR can achieve lower emission concentrations in the flue gases than SNCR and consequently lower process contributions and predicted environmental concentrations can be achieved, albeit not substantially lower.

For the proposed development, achieving the new plant BREF Emission Limit Values is achieved with the primary control measures of controlled two stage combustion and use of Selective Non Catalytic Reduction (SNCR) technology with injection of ammonia hydroxide into the hot flue gasses.

Further NOx control and ammonia slip reduction is achieved using Selective Catalytic Reduction (SCR) technology with injection of ammonia hydroxide into the flue gases after the bag filtration system. Due to having the primary NOx reduction measures of SNCR and FGR, the site requires low reduction via a small SCR system with significantly lower CAPEX and OPEX then a larger SCR system.

Global Warming Potential

The energy requirements to operate an SCR system are considerably higher than those for SNCR due to the need to operate the catalyst within a range of 180 – 400°C. By comparison, SNCR does not require any reheating and therefore minimal energy input is only required to operate associated plant.

Therefore the assessment of the Global Warming Potential (GWP) of the two systems considers a combination of the CO2e releases (nitrous oxides and carbon dioxide) combined with comparison of the relative energy requirements of the two systems.

Raw Materials

SNCR and SCR systems both require the injection of an ammonia containing reducing reagent. In both cases, ammonia hydroxide injection is utilised. Despite the overall annual consumption of ammonia being largely similar, SCR requires a catalyst which periodically needs replacing.

The specific energy consumption and consumables usage of the two options considered is summarised in Table 2.2 below. SCR typically requires more energy to operate that SNCR.

Table 2.2: Summary of GWP Performance		
Option	SNCR	SCR
Energy Requirements	45 – 50	65 – 100

kWh/T waste treated[2]		
Reagent Consumption Kg/T waste treated	1 – 4	1 – 3 (plus catalyst)

Waste

The waste generation of the two competing systems differ. SNCR does not produce any wastes requiring disposal whilst SCR utilises catalysts which in turn require periodic disposal. Spent catalyst typically needs to be replaced approximately every 5 years and is estimated as producing approximately 40 tonnes per annum of waste for disposal.

The spent catalyst is classified as a hazardous waste and will require disposal at a hazardous waste landfill.

Summary of Environmental Performance

A qualitative assessment approach has been used to establish BAT for the proposed NOx abatement system. The comparison of the performance of SNCR and SCR for each of the relevant issues identified in the section above has been provided in Table 2.3 below.

Table 2.3: Summary Ranking

Option	Ranking	
	SNCR	SCR
Performance Ranking		
NOx performance	2	1
Ammonia Performance	1	1
GWP performance	1	2
Raw Material Consumption: Urea and Catalyst (SCR only)	1	2
Waste	1	2
Environmental Performance Total	6	8

From the table above the overall environmental performance of the SNCR option is marginally better than that for SCR. However, both SNCR and SCR will be utilised at the Grid Powr site.

For the proposed development, achieving the new plant BREF Emission Limit Values is achieved with the primary control measures of controlled two stage combustion and use of Selective Non Catalytic Reduction (SNCR) technology with injection of ammonia hydroxide into the hot flue gasses.

Further NOx control and ammonia slip reduction is achieved using Selective Catalytic Reduction (SCR) technology with injection of ammonia hydroxide into the flue gases after the bag filtration system. Due

2 Data sourced from EU Waste Incineration BREF (Tables 4.33 and 4.36 Section 4.5.4.3 and 4.4.5.4 respectively)

to having the primary NOx reduction measures of SNCR and FGR, the site requires low reduction via a small SCR system with significantly lower CAPEX and OPEX then a larger SCR system.

All concentrations from the plant will be in line with the BREF emission limits for new plant except for NOx and NH_3 where more stringent emission limits of 100 mg/Nm^3 and 5 mg/Nm^3 have been adopted, respectively. It is therefore concluded that SNCR and SCR is BAT for the process on the basis that it achieves ELV's well below the IED limits and meets the sector BAT AELs.

2.4 Acid Gas Abatement Selection

In a similar manner to NOx abatement, an options appraisal has been provided for the selected acid gas abatement.

The following options have been considered for the proposed EfW:

- Dry system;
- Semi-dry system; and
- Wet scrubber.

Given that the plant has no process emissions to water and seeks to achieve a level of water neutrality close to zero, the inclusion of a wet scrubbing system would introduce a process discharge to water. This option is undesirable and has been discounted from further consideration.

For both options, it is assumed that the same primary measures for minimising the formation of acid gases are in place.

The options considered for control of acid gases have been assessed on the basis of the following environmental criteria:

- Air quality impacts;
- Global warming potential (GWP);
- Raw material consumption; and
- Waste generation.

The two options considered have similar odour, noise, accident hazard and visible plume potential. No releases to water are generated from the dry and semi dry abatement options and therefore consideration of these environmental effects has therefore been excluded from this assessment.

Air Quality Impacts

The achievable long term emission concentrations for each of these technology options are similar and can be demonstrated to meet the required BAT EALs. On this basis, the emissions performance of each option is considered to be similar and will achieve the same process contribution irrespective of technology used.

Table 2.4: Summary of Air Quality performance Associated with Releases of Acid Gas Emissions		
Option	Dry	Semi-dry
Achievable emissions concentrations (in mg/Nm^3)		
SO_2	30	30
HCl	6	6
HF	1	1

Given the emissions performance is the same for both options the process contributions for both options will be similar. The air quality modelling screens out the emissions impacts of HF, SO_2 and HCl and it therefore can be concluded that the air quality effects from either option would be considered acceptable.

Global Warming Potential

The Waste Incineration BREF does not provide comparative figures for the GWP performance of dry and semi-dry gas abatement systems. Therefore, on this basis a similar energy demand is assumed for both systems.

Raw Materials

Both dry and semi-dry gas abatement systems require the injection of reagent (typically lime or sodium bicarbonate), whilst a semi-dry system also utilises water.

Table 2.5 below summarises the raw material consumption for each of the options.

Table 2.5: Summary of Raw Material Consumption[3]		
Option	Dry	Semi-dry
Lime	10 – 20 kg/t	7 – 10 kg/t
Sodium Bicarbonate	6 – 12 kg/t	Not provided in BREF
Waste	7 – 25 kg/t	25 – 50 kg/t
Water	-	<300

The BREF only details lime as an option for semi-dry systems, however as you will see from the figures provided for dry systems, compared to lime less sodium bicarbonate is required due to its high efficiency. Dry gas scrubbing also tends to consume more reagent than Semi-Dry systems, whilst Semi-Dry systems has an additional water demand and higher levels of waste.

[3] Figures taken from WI BREF Table 4.23 and 4.28. Please note, Table 4.23 for semi-dry only uses quicklime as an reagent option.

Waste

Both options generate waste streams for disposal as a result of excess reagent and reaction products. Residues from both options are considered to be hazardous and therefore subject to the same disposal routes. Given the higher levels of waste associated with semi-dry abatement systems, a dry abatement technology is considered to be BAT for this process.

Summary of Environmental Performance

A qualitative assessment approach has been used to establish BAT for the proposed acid gas abatement system. The comparison of the performance of dry gas and semi-dry gas abatement for each of the relevant issues identified in the section above has been provided in Table 2.6 below.

Table 2.6: Summary Ranking for Acid Gas Options

	Ranking	
	Dry Gas Treatment	Semi-dry Gas Treatment
Emissions to air	1	1
GWP performance	1	1
Raw material usage	1	2
Waste hazard	1	2
Environmental Performance Total	**4**	**6**

It can be seen from the above assessment that dry gas abatement performs largely similar in terms of performance but consumes less waste and raw materials than the alternatives. Whilst dry gas scrubbing performs better that semi-dry gas treatment, the differences in environmental performance are considered marginal.

Summary of Acid Gas Appraisal

The assessment of acid gas abatement has considered the environmental performance of the options.

The plant operators have selected a dry abatement system as their preferred acid gas abatement system and consider this to be BAT for the process. Please refer to the application support document for more information on the selection of sodium bicarbonate for use within the system.

2.5 Dioxin and Furan Abatement Selection

Activated carbon has been selected for control of dioxins and furans and is widely accepted as being the preferred abatement technique for this sector. It is recognised that dioxins and furans can also be controlled by the use of catalytic abatement systems and have the advantage of destroying the dioxins and furans rather than removal and transfer into the APC residues. Activated carbon however has the added benefit of controlling mercury emissions, which is a key consideration for the sector.

Given that activated carbon is effective for the removal of all three pollutants, this is considered to represent BAT and has been selected for the proposed EfW.

2.6 Control of Particulates

There are a range of options available for particulate control including:

- Fabric Filters;
- Ceramic Filters;
- Electro-static Precipitators (ESPs); and
- Wet Scrubbers.

Wet scrubbers and ESPs cannot meet the emission level performance of other techniques therefore do not represent BAT for this sector and are not considered further. Ceramic filters can achieve high removal efficiencies of particulates, but are not applicable in this application due to the relative low temperature of the flue gases. Ceramic filters / candles are also more susceptible to mechanical failures and blinding than fabric filters so are not considered BAT.

Fabric filters provide reliable abatement of particulates and are generally accepted as BAT for particulate control.