Permit ref: PAN-0055141/V002

Operator: Newbridge Energy Limited

Site Address: Blazers Fuels, Brick Lane, Denbigh Road, Ruthin, LL15 2TN

Environmental Permit Variation Application: Response to Request for Further Information

An application to vary the above Environmental Permit was submitted to NRW on 26.01.21 by Smith Grant LLP on behalf of Newbridge Energy Ltd.

A note was subsequently prepared by SGP[1] and submitted to NRW in response to an initial request for additional information / clarification received from Rebecca Williams, NRW on 12.05.21.

This following note has been prepared in response to a request for further information / clarification received from Rebecca Williams, NRW on 03.08.21[2].

The individual points raised are dealt with below in turn and supporting information attached as applicable.

1. **NRW comment:** provide us with an accurate National Grid Reference for both the existing and new combustion units

   SGP Response: The National Grid References for the existing and proposed combustion units are confirmed as:

   Table 1: Combustion Unit Stack National Grid References

Combustion Unit	National Grid Reference
Existing MCP / Generator stack (identifier 2766; also referred to as NB1)	311633.7 359010.3[1]
Proposed additional MCP / Generator stack (identifier 2885; also referred to as NB4)	311601.7 359022.2

   1: Typographic error in original application information which incorrectly stated an NGR of SJ 311633 59010

2. **NRW comment:** provide us with a Best Available Techniques (BAT) assessment of the new plant justifying BAT has been applied in line with the following technical guidance note: Environmental Permitting Technical Note 5/1(18).

   SGP Response: A detailed BAT assessment is provided in Appendix A.

3. **NRW Response**: provide us with a summary of proposed monitoring methods and monitoring frequencies in line with the following technical guidance note: Environmental Permitting Technical Note 5/1(18)

[1] Smith Grant LLP, Permit ref: PAN-0055141/V002, Environmental Permit Variation Application, R2298E-N01-v3, 2nd July 2021
[2] Natural Resources Wales, Application ref: PAN-00514/V002, dated 03 August 2021

SGP Response: The existing permit specifies Emissions Limit Values (ELVs) for NO_2, CO, dust, TVOC and dark smoke as summarised below (as detailed in Table 2.1 of the Supporting Information Document to the Environmental Permit Variation application[3]).

Table 2: Existing Environmental Permit ELVs (identifier 2766)

Parameter	Limit[1]	Monitoring frequency
Oxides of nitrogen (NO and NO_2, expressed as NO_2)	475 mg/Nm^3	Annual
Carbon Monoxide	225 mg/Nm^3	Annual
Dust (Particulate Matter)	50 mg/Nm^3	Annual
TVOC	30 mg/Nm^3	Annual
Dark smoke	No visible dark smoke	Daily when in operation

1: Defined at a temperature of 273.15K, a pressure of 101.3 kPa and after correction for the water vapour content of the waste gases at a standardised O_2 content of 6%

The required ELVs for the new plant, as a new MPC and Tranche B Specified Generator, would be as detailed in Table 3 (as detailed in Table 1 of the SGP response[1]). These ELVs are discussed further below in Section 6.

Table 3: Emission Limit Values (ELVs) for Proposed New Combustion Unit[1] (identifier 2885)

Pollutant	Limit[2]	Comments	Monitoring Frequency
SO_2[3]	200 mg/Nm^3	does not apply in the case of plants firing exclusively woody solid biomass	
NO_x	300 mg/Nm^3	Is less than the ELV of 475 mg/m^3 provided for generators (provided as 190 mg/m^3 at 15% O_2)	Annual
Dust (Particulate Matter)[4]	30 mg/Nm^3		Annual
Dark smoke	No visible dark smoke		Daily when in operation

1: As applicable for new medium combustion plants other than engines and gas turbines where using solid biomass
2: Defined at a temperature of 273.15K, a pressure of 101.3 kPa and after correction for the water vapour content of the waste gases at a standardised O_2 content of 6% (for MCP using solid fuels)
3: Does not apply in the case of plants firing exclusively woody solid biomass
4: In the case of plants with a total rated thermal input greater than 5 MW and less than or equal to 20 MW

All monitoring required under the Permit to demonstrate compliance with the ELVs would be undertaken in accordance with the required methodology and recorded and reported to NRW as necessary as outlined in the attached BAT assessment in Appendix A.

4. **NRW Comment**: provide us with information on abatement techniques on the new unit (if any).

SGP Response: full details are provided in the BAT assessment attached in Appendix A.

5. **NRW Comment:** provide us with a copy of your operating techniques detailing how you will ensure only requested fuel virgin wood is used at the new unit.

[3] Smith Grant LLP, Environmental Permit Variation Application Supporting Information Document, Permit PAN-005141, R2298E-R03-v1, January 2021

SGP Response: full details are provided in the BAT assessment attached in Appendix A.

Detailed Air Dispersion Modelling

6. **NRW Comment:** Provide us with requested emission limit values for the new plant and ensure the air emissions risk assessment is completed at requested emission limit values.

SGP Response: The requested ELVs are as detailed above in Table 3.

The air emissions risk assessment is being revised in accordance with these ELVs. This will be provided separately by 17th September 2021 as agreed[4].

Further to our previous provision of additional information[1] investigation and improvement works have been undertaken to the existing plant. Following the implementation of these works further monitoring was undertaken of the existing combustion unit stack on the 3rd August 2021. The results are summarised below and the full data included in Appendix B.

Table 4: Summary of Monitoring Data for Existing Plant (identifier 2885) for 03.08.21[1]

Parameter	Measured Emission Concentration (mg/Nm^3)[2]	ELV (mg/Nm^3)[2,3]	Comment
NO_2	288	300	Below required ELV
Total Particulate Matter	20.9	30	Below required ELV

1: Element, ref: EMT-01425, laboratory report dated 10th August 2021
2: Where reference conditions are defined at a temperature of 273.15K, a pressure of 101.3 kPa and after correction for the water vapour content of the waste gases at a standardised O_2 content of 6% (for MCP using solid fuels)
3: ELVs for the proposed new plant

The measured emission concentrations were found to be within the required ELVs.

7. **Additional NRW Comments**:

SGP Response: The revised air emissions assessment that is to be provided under separate cover will also provide the additional information requested.

Prepared on behalf of Smith Grant LLP by:

Name:	**Signature:**	**Date:**
K. Hawkins, Partner		
BSc MSc MIAQM MEnvSci CEnv		16.08.21

[4] E-mail from Rebecca Williams, Natural Resources Wales, to Katrina Hawkins, Smith Grant LLP, on 10th August 2021

APPENDIX A

BAT Assessment

NEWBRIDGE ENERGY LIMITED
PERMIT VARIATION

Measures to Demonstrate BAT

August 2021

iona capital

Client: Newbridge Energy Limited

Document Reference: HC1688-01

REPORT SCHEDULE

Client: Newbridge Energy Limited

Project Title: Newbridge Energy Limited - Environmental Permit Variation Application ref R2298E-R03

Document Title: Measures to Demonstrate BAT

Document Reference: HC1688-01

Report Status: Final 1.0

Project Director: Joanna Holland

Project Manager: Jo Chapman

AUTHOR	DATE
Jo Chapman	12th August 2021
REVIEWER	DATE
Rebecca Taylor	12th August 2021
APPROVED	DATE
Joanna Holland	15th August 2021

REVISION HISTORY	DATE	COMMENTS	APPROVED
Draft V 1	12th August 2021	Draft for Client Review	Rebecca Taylor
Final V 1	15th August 2021	Final for Project Team Review	Joanna Holland
Final V 1.1	17th August 2021	Final for Submission to NRW	Rebecca Taylor

CONTENTS

Appendices

1. INTRODUCTION

1.1. Introduction

1.1.1. Newbridge Energy Limited operate a permitted facility at Blazer Fuels, Brickfield Lane, Denbigh Road, Ruthin, Denbighshire, LL15 2TN.

1.1.2. The site currently operates a small waste incineration plant that is also a Tranche B Specified Generator aggregated to <50MWth according to a permit issued by National Resources Wales (NRW) permit number PAN-005141.

1.1.3. The current permit allows Newbridge Energy Limited to operate one 5.2 MWth CHP Biomass Boiler Plant, which is used for the purposes of electricity and heat generation. This plant is also a Specified Generator and Schedule 25B of the EP Regulations apply. When brought under permitting, the plant was assessed to be an 'Existing' medium combustion plant (MCP) on the basis that it was operational before 20 December 2018, with the final operation of the facility commencing in mid-2018; as such it has been permitted as a Tranche B Specified Generator.

1.1.4. In January 2021 an application to vary the site permit was submitted to NRW. The application was prepared by Smith Grant Limited Liability Partnership (LLP) on behalf of the operator.

1.1.5. The variation application was submitted with the intention of Newbridge Energy Limited operating a second 5.2MWth CHP Biomass Boiler Plant at the Ruthin site. The additional plant to be installed at the site is the same make and model as the plant that is currently under operation.

1.1.6. The reference for the variation application as given by NRW is PAN-005141/V002, and that given by Smith Grant LLP is R2298E-R03.

1.1.7. The intended additional plant will be considered 'New Plant' as it is to be brought into operation after 19th December 2018 and as such will need to comply with the emission limit values (ELV's) specified for 'New' MCP.

1.1.8. The existing plant at the site operates on a mixture of non-waste and waste wood fuels and given the inclusion of the waste fuel element, is regarded as a small waste incineration plant and subject to the necessary regulatory controls associated with this type of plant.

1.1.9. The operator does not intend to operate the second additional plant that is subject of the recent variation application using waste fuels. Only non-waste fuels will be utilised in the second unit and as such it does not fall under the regulatory controls for a small waste incineration plant.

1.1.10. On 3rd August 2021 NRW made a formal request for additional information to be supplied to support the assessment of the permit variation application to achieve duly made status.

1.1.11. The following additional information was requested.

- *provide us with an accurate National Grid Reference for both the existing and new combustion units*

• provide us with a Best Available Techniques (BAT) assessment of the new plant justifying BAT has been applied in line with the following technical guidance note: Environmental Permitting Technical Note 5/1(18)

• provide us with a summary of proposed monitoring methods and monitoring frequencies in line with the following technical guidance note: Environmental Permitting Technical Note 5/1(18)

• provide us with information on abatement techniques on the new unit (if any)

• provide us with a copy of your operating techniques detailing how you will ensure only requested fuel virgin wood is used in the new unit

1.1.12. H&C Consultancy have been commissioned by the operator to provide a Best Available Techniques (BAT) assessment that will incorporate the data requested in the bullet points above, to be submitted by Smith Grant LLP on behalf of the operator in response to the formal request for additional information.

1.1.13. This document is intended to present the information requested, other than the accurate National Grid References which are to be included in the separate information provided by Smith Grant LLP .

1.1.14. A further data request was made by NRW on 3rd August for data relating to emissions and emissions impact modelling assessments. A separate response will be provided for this part of the data request following preparation by Smith Grant LLP.

1.1.15. The applicant commits to ensure that all relevant and required aspects of the following reference documents are met (or where appropriate justify deviations from specific measures) thus ensuring that the facility will be fully BAT compliant and operable without adverse impact under the conditions of an Environmental Permit (EP).

- Environmental Permitting Technical Note 5/1(18) - Reference document for the incineration/combustion of waste wood.
- JRC Science for Policy Report 'Best Available Techniques (BAT) Reference Document for Waste Treatment' Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control), Pinasseau et al 2018.

2. SITE SETTING, SURROUNDING LAND USE, AND LOCATION OF RECEPTORS

2.1 Site Setting, Surrounding Land Use, and Location of Receptors

2.1.1 The site is located on Brickfield Lane, Ruthin, centered at National Grid reference SJ 11576 59054. The surrounding area is of mixed use, with other business units located immediately adjacent to the site and residential and other amenity sites located from 100-600m from the site. There are open areas of land likely to be in agricultural use to the north of the site.

2.1.2 There are no SSSI's within critical distances of the site. Llwyn SAC is located 8.8km northwest of the site, and Alyn Valley Woods SAC is located 7.5km to the northeast.

2.1.3 The local geology is characterised by superficial deposits of alluvium clay, silt sand and gravel overlaying Kinnerton Sandstone formation at the bedrock level.

2.1.4 There are no groundwater source protection zones or drinking water safeguard zones in the vicinity of the site.

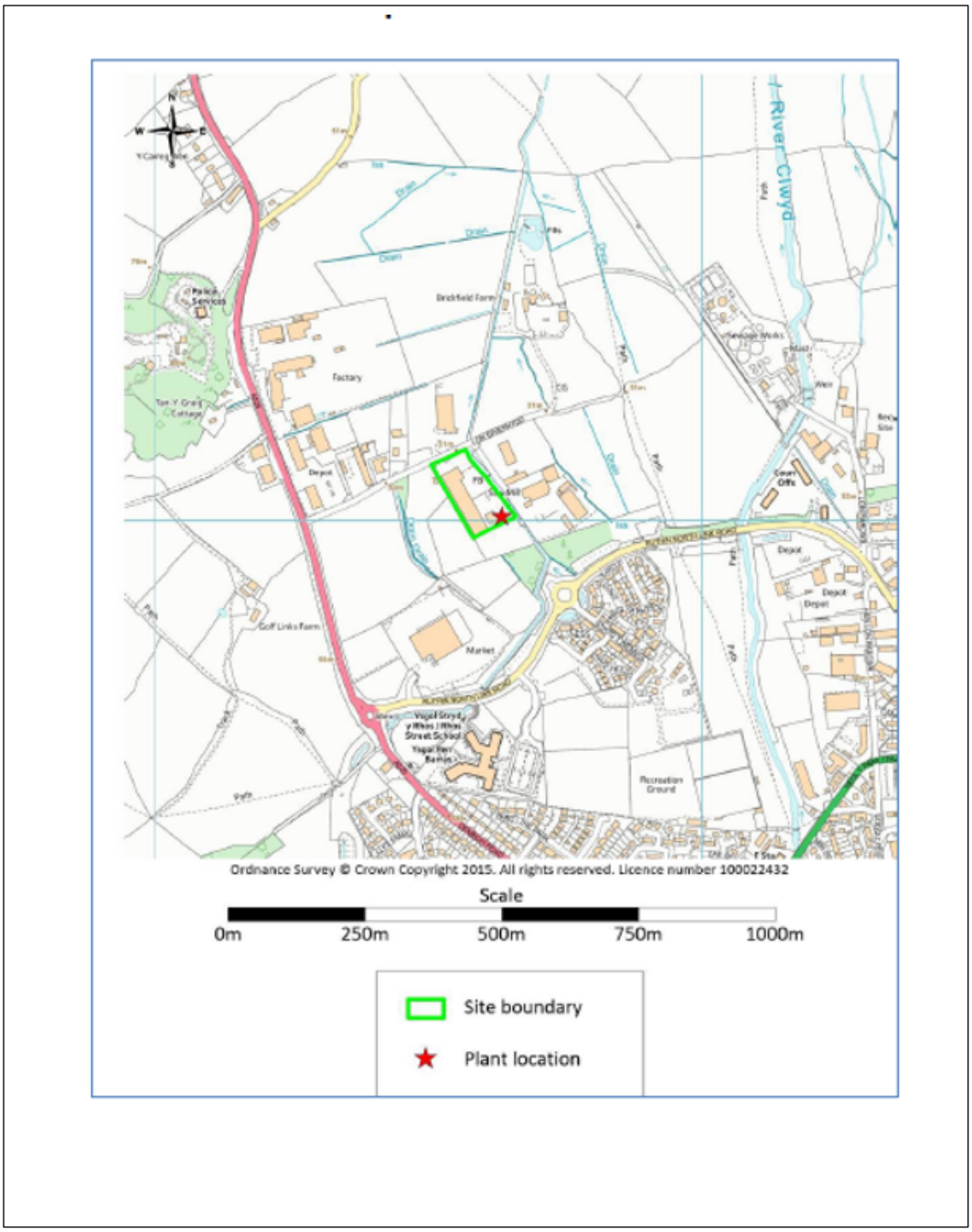
2.1.5 The site is located on a principal aquifer at the bedrock designation and is unproductive at the superficial designation.

2.1.6 The nearest watercourse runs immediately adjacent to the eastern boundary of the site. A second surface water drain runs approximately 100m to the western boundary of the site. The site is located in the River Clwyd surface water catchment.

2.1.7 Local watercourses drain to a confluence with the river Clwyd located approximately 1km northeast of the site. There are no known surface water abstractors downstream of the site or drinking water safeguard zones in the catchment.

2.1.8 The site and it's setting are shown in Figure 1 below.

Figure 1 The Site and it's Setting



3. FEEDSTOCK ACCEPTANCE PROCEDURES (ACCEPTABLE MATERIAL TO BURN)

3.1 Feedstock Pre-Acceptance

3.1.1 In order to ensure compliance with the site permit and optimum plant operations, it is essential that the operator has measures in place to ensure that only clean wood (non waste) as specified in the site permit is accepted at the site.

3.1.2 In order to ensure sourcing of suitable materials prior to acceptance of both waste and non-waste fuels at the site, the operator implements a fuel feedstock pre-acceptance assessment procedure to ensure clear assessment of suitability and understanding of the nature and status of the material before it is brought to the site.

3.1.3 The procedure for pre-acceptance assessment of both wase and non-waste fuel feedstock is laid out in the operator's Environmental Management System (EMS) in document reference **NBEP038 – Feedstock Acceptance Procedures and Pre-Acceptance Procedures.** A copy of this document is provided with this assessment as **appendix 1**.

3.1.4 The waste pre-acceptance assessment procedure is recorded and retained in the operators EMS records on EMS form NBEF021.

3.2 Feedstock Acceptance Procedures

3.2.1 Once a fuel feedstock stream has been assessed as suitable for use at the site, and characterised as a waste or non-waste feedstock, it can be accepted at the site.

3.2.2 A list of approved suppliers is kept on the site EMS and this list includes an assessment of the status of the fuel feedstock as 'waste' or 'non-waste', EMS reference NBEF019.

3.2.3 All loads received at the site are pre-booked and so their arrival and source are anticipated/known. Paperwork accompanying the load is checked at the site weighbridge and following approval, loads are escorted from the weighbridge to the suitable storage bay by a member of site staff.

3.2.4 The weighbridge operator will check the status of the fuel feedstock on the approved supplier list at the point of receipt and will indicate which storage bay the fuel feedstock will be taken to according to the waste/non-waste status of the material.

3.2.5 Waste and non-waste feedstock fuels will be stored in dedicated separate storage bays.

3.2.6 The operator stores no more than 125t of wood wastes onsite at any one time and does so in accordance with RPS213. Wood wastes are stored in accordance with conditions of the RPS as stipulated in EMS document NBEP040 Waste Storage and Handling Standards.

BAT Assessment Statement:

The measures in place at the site to ensure suitability of fuel feedstocks are in accordance with the requirements laid out in Environmental Permitting Technical Note 5/1 (18).

The measures in place at the site for waste characterisation and pre-assessment, for acceptance of wastes, for tracking and segregation of feedstock materials and for storage of wastes are in accordance with BAT 2 and BAT 4 as stated in JRC Science for Policy Report 'Best Available Techniques (BAT) Reference Document for Waste Treatment' Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control), Pinasseau et al 2018.

4. PLANT DESIGN AND OPERATION

4.1 Plant Design and Operation

4.1.1 The boilers burn wood fuel creating temperatures up to 1,000°C. The heated air then passes through a thermal oil heat exchanger. During this process the heat transfers into the thermal oil reducing the air temperature by circa 700°C and warming the oil to circa 300°C.

4.1.2 The air then passes through a cyclone system causing any heavy particulates to drop into a waste collection bin before then passing through a series of bag filters which remove any smaller particulates. After this abatement system the air is then exhausted to atmosphere through the stack at a temperature of circa 200°C.

4.1.3 After heating, the thermal oil transfers through pipework into the electricity generation process. By passing through a series of heat exchangers the oil powers a Turboden Generator which creates up to 1MW of electricity which is used to power the site and to export to the National Grid. During the heat exchanger cycle the thermal oil is also warming a water circuit, heating the water to circa 80°C.

4.1.4 This heated water transfers through pipework into the “Product Manufacture” process providing heat to the onsite Stela dryers.

4.1.5 Management of fuel used in this process with respect to size and moisture content is a key component in ensuring optimum combustion and process control.

4.1.6 The storage facilities at the Newbridge Energy Limited Ruthin site are located outdoors and are uncovered and as such the operator has implemented measures to manage fuel moisture content. Material is delivered on a just in time basis, in accordance with the needs of the site.

4.1.7 All fuel feedstocks received at the site whether waste or non-waste are subject to moisture content testing as stipulated in NBEP038 – Feedstock Acceptance Procedures and Pre-Acceptance Procedures (appendix 1).

4.1.8 Loads are assessed for dry matter, using a dry matter machine and for moisture using a calibrated probe. This information is recorded by supplier and load on the waste in / out sheet.

4.1.9 Fuel blends to be fed into the units are blended based on the results of the dry matter and moisture content testing. The mix to be applied is determined by the shift manager on a day to day basis based on these results.

4.1.10 Trained operators follow standard operating procedures (SOP’s) that is included in the site EMS and lays out how the blending process is to be undertaken. The SOP’s relating to blending of fuel feedstocks are SOP006 and SOP006a. SOP006 relates to blending of feedstock fuels to be used in the existing unit which will burn both waste and non-waste wood feedstocks (this unit is referred to as NB1). SOP006a refers to the blending of feedstock fuels to be used in the new unit

which will only burn non-waste material (this unit is referred to as NB4). **Copies of SOP006 and SOP006a are included with this document as appendices 2 and 3.**

4.1.11 Blended fuel is fed onto a walking floor store where it is called when required, via a series of conveyors and screws, into the Uniconfort boilers. As such the unit is operated via a continuous feed process which is intended to achieve a better combustion than stop-start burning.

4.1.12 Plant start-up and shut-down times are minimised via implementation of continuous operational conditions at the site. 24 hours a day, 7 days a week (24/7) shift pattern has been established at the site to allow for continuous operation to be achieved.

4.1.13 Downtime wherever possible is planned to ensure that maximum maintenance and cleaning activity opportunity is used when the generator is down as one activity and so avoid a series of shut down periods.

4.1.14 Plant start-up will be carried out using non-waste material only in all instances and waste biomass introduced in the case of NB1 once steady state conditions have been achieved. All start up and shut down procedures are recorded on the site Supervisory Control and Data Acquisition (SCADA) system and on the production, log completed by production managers on a daily/shift basis. These procedures are laid out in EMS document reference NBEP021 Process Description Monitoring and Controls.

4.1.15 Trained operators follow the procedures laid out in the relevant SOP's in the site EMS when overseeing start-up and shut-down of the plant, in emergency and planned situations. These procedures specify how these operations will be carried out to minimise any potential environmental impacts.

4.1.16 Process monitoring parameters, including fuel feed, airflow, temperature and oxygen levels are monitored via in situ sensors which transmit data to the SCADA interface system. Trained staff are able to view this interface to monitor process control parameters and check that they are within desired limits. Corrective actions can be undertaken to the process in response if required.

BAT Assessment Statement:

The plant design and operation parameters are in accordance with the requirements laid out in Environmental Permitting Technical Note 5/1 (18).

5. AIR QUALITY, DISPERSION AND DILUTION

5.1 Air Quality Impact Modelling

5.1.1 Exhaust gases from the combustion process are dispersed to atmosphere via a 20m high exhaust stack.

5.1.2 Air quality impact modelling assessments to support the application have been undertaken by Smith Grant LLP and further modelling and assessment work is currently being undertaken to provide additional data to support the application.

5.1.3 As such, further data will be presented in due course to provide evidence that the new unit (NB4) will meet the requirements laid out in section 4.3 of Environmental Permitting Technical Note 5/1 (18).

5.1.4 Further data will be presented in due course to demonstrate that the new plant (NB4) will achieve the ELV's for 'New Plant' for relevant parameters as specified in table 5.5 in section 5.2 of Environmental Permitting Technical Note 5/1 (18).

5.1.5 With respect to dark smoke and odours that might be detected beyond the site boundary, further details of measures in place for management and monitoring are detailed elsewhere in this document.

BAT Assessment Statement:

The operator anticipates that the modelling assessment work currently being undertaken will confirm that the plant meets BAT requirements with respect to air quality impacts. Data to support this position will be presented when available.

6. ABATEMENT

6.1 Abatement Measures Installed

6.1.1 Both the pre-existing (NB1) and new plant (NB4) incorporate abatement measures for management of emissions of dusts/particulates to air.

6.1.2 Exhaust gases from the combustion process pass through a cyclone system causing any heavy particulates to drop into a waste collection bin before then passing through a series of bag filters which remove any smaller particulates.

6.1.3 Both of these abatement methods are listed as suitable techniques in section 4.4. of Environmental Permitting Technical Note 5/1/(18).

6.1.4 Both the cyclone and the bag filter are managed and monitored via the integrated SCADA system. The SCADA system monitors the pressure differentials and temperature of both bag filter and cyclone.

BAT Assessment Statement:

The abatement measures installed at the site for management of dusts and particulates are in accordance with the requirements laid out in Environmental Permitting Technical Note 5/1 (18).

7. EMISSIONS TESTING

7.1 Emissions Testing

7.1.1 The current site permit specifies that an annual stack emissions monitoring assessment is to be undertaken for the existing plant.

7.1.2 Monitoring points have been established on the current plant/equipment in line with Technical Guidance Note (Monitoring) M1: Sampling requirements for stack monitoring. The new plant to be installed is the same make and model as the current plant and so monitoring points will be established to mirror current arrangements at the site.

7.1.3 Following determination of the variation, the operator will implement any required emissions testing regime as specified in the permit with respect to the new unit (NB4), and any amended regime with respect to the existing unit (NB1).

7.1.4 The operator has previously engaged a suitable third-party contractor with the required MCERTS accreditation to carry out monitoring exercises according to the methodology specified in the permit.

7.1.5 The operator will continue to undertake emissions monitoring exercising in this way once the varied permit is issued.

7.1.6 Emissions testing is carried out when the plant is operating under stable conditions at a representative even load.

7.1.7 The operator will notify NRW sufficiently in advance of any emissions testing exercises undertaken to provide reasonable opportunity for the regulator to attend and witness the test if desired. Test results are submitted to the regulator to NRW within a timescale and format agreed with NRW.

7.1.8 The operator will consider the need to carry out additional or more frequent emissions testing exercises than specified in the permit if there are specific circumstances at the site that mean that this is necessary or of benefit.

BAT Assessment Statement:

The emissions testing undertaken at the site is in accordance with the requirements laid out in Environmental Permitting Technical Note 5/1 (18).

8. MANAGEMENT

8.1 Site EMS

8.1.1 The operations at the site are carried out according to a written management system which is designed to identify and minimise risks of pollution arising from operations, maintenance, accidents, incidents, non-conformances, closure, and those that are identified as a result of complaints.

8.1.2 A copy of the site permit is available for site staff to access at all times.

8.1.3 Written records of activities relating to permit compliance and all items listed in section 4.11 of Environmental Permitting Technical Note 5/1 (18) are kept as specified in the EMS and copies of these records are retained for a minimum of 6 years.

8.1.4 Digital records generated on the SCADA system are also retained for a minimum of 6 years.

8.1.5 All retained data is subject to regular backup of digital files.

8.1.6 The EMS is subject to a regular schedule of review and update including an annual review overseen by senior management.

8.1.7 A summary of the documents contained within the site EMS has been provided to NRW permitting officers in support of the permit application.

8.1.8 The maintenance/cleaning schedule for plant and equipment is included in the EMS suite of documents to ensure that cleaning and maintenance activities are specified, documented and subject to review.

8.1.9 The EMS also includes a list of staff roles and responsibilities, a staff training needs assessment matrix. Written records of staff training are maintained at the site.

8.1.10 Measures in place to ensure suitability of fuel feedstock materials have been described in section 3 of this document.

8.1.11 Ash arising from different stages of plant operations at the site has been assessed and characterised in order to allow the operator to determine suitable storage and disposal arrangements for the various streams of material. The results of this characterisation exercise and measures in place for management, storage and disposal are documented in the EMS in SOP009 Management of Process Derived Wastes.

8.1.12 Ash arising from the new unit will be characterised in the same way once the new plant (NB4) becomes operational and suitable measures for disposal and storage finalised at this stage. In the meantime, a precautionary approach will be taken towards storage and disposal methods until such time that full characterisation can be achieved.

8.1.13 In the event that any non-compliance with any emission limit value or malfunction and breakdown of the plant that leads to abnormal operating conditions or complaints about odour and/or smoke; the operator shall take the measures necessary to ensure that compliance is restored within the shortest possible time. All such incidences and complaints will be managed in accordance with the incident response and reporting procedures specified in the site EMS.

BAT Assessment Statement:

The EMS in place at the site is in accordance with the requirements laid out in Environmental Permitting Technical Note 5/1 (18).

The EMS in place at the site is in accordance with BAT 1 as stated in JRC Science for Policy Report 'Best Available Techniques (BAT) Reference Document for Waste Treatment' Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control), Pinasseau et al 2018.

9. EMISSIONS MONITORINIG

9.1 Emissions Monitoring

9.1.1 The operator carries out annual emissions monitoring/testing exercises as specified in the permit as outlined in section 7 of this document with respect to oxides of nitrogen, carbon monoxide, dust/particulate matter and total volatile organic compounds (TVOC) (as specified in the permit).

9.1.2 In addition to this, the operator carries out daily monitoring for visible dark smoke (as specified in the permit) and for odours, according to the site odour management plan, which is EMS document reference NBEP018. The methodology for dark smoke monitoring is carried out in a manner as agreed with NRW in accordance with Table S1.3 Pre-Operational measures - PO1.

9.1.3 The agreed methodology has been included in the site EMS as document reference SOP008 Dark Smoke Checks Procedure.

9.1.4 Following determination of the permit variation, the first emissions monitoring measurement for the new/additional plant (NB4) will be undertaken within four months of the varied permit issue date or the date of start of plant operations, whichever is the latest.

BAT Assessment Statement:

The EMS in place at the site is in accordance with the requirements laid out in Environmental Permitting Technical Note 5/1 (18).

h&c consultancy

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APPENDIX B

Additional Monitoring Data

Element Materials Technology, Unit C6, Emery Court, The Embankment Business Park, Heaton Mersey, Stockport, SK4 3GL
Your Element Contact: Scott Pilkington (07825 991 537)
E: scott.pilkington@element.com

Stack Emissions Testing Report Commissioned by
Blazers Fuels Ltd

Installation Name & Address
Newbridge Energy Ltd
Brickfield Lane
Ruthin
Denbighshire
North Wales
LL15 2TN

Stack Reference
Biomass CHP Plant Exhaust

Dates of the Monitoring Campaign
3rd August 2021

Job Reference Number
EMT-01425

Report Written by
Matthew Miller Team Leader MCERTS Level 2 MM 14 1313 TE1 TE2 TE3 TE4

Report Approved by
Richard Carter Senior Team Leader MCERTS Level 2 MM 07 861 TE1 TE2 TE3 TE4

Report Date
10th August 2021

Version
Version 1

Signature of Report Approver


CONTENTS

Opinions and interpretations expressed herein are outside the scope of Element's ISO 17025 accreditation.

MONITORING OBJECTIVES

Newbridge Energy Ltd, Ruthin
Biomass CHP Plant Exhaust
3rd August 2021

Overall Aim of the Monitoring Campaign

Element were commissioned by Blazers Fuels Ltd to carry out stack emissions testing for Newbridge Energy Ltd on the Biomass CHP Plant Exhaust at Ruthin.

The aim of the monitoring campaign was to perform testing, as requested by the customer, for a number of prescribed pollutants. There are no emission limits set for any of the pollutants at this time.

Special Requirements

There were no special requirements.

Target Parameters

Total Particulate Matter, Oxides of Nitrogen (as NO_2)

Executive Summary

MONITORING RESULTS

Newbridge Energy Ltd, Ruthin
Biomass CHP Plant Exhaust
3rd August 2021

where MU = Measurement Uncertainty associated with the Result

	Concentration				Mass Emission			
Parameter	**Units**	**Result**	**MU +/-**	**Limit**	**Units**	**Result**	**MU +/-**	**Limit**
Total Particulate Matter [1]	mg/m³	20.9	2.0	30	g/hr	175	31	-
Oxides of Nitrogen (as NO_2) [1]	mg/m³	288	12.0	300	g/hr	2406	380	-
Oxygen	% v/v	**Dry** 9.9	0.25					
Water Vapour	% v/v	13.1	0.73					
Stack Gas Temperature	°C	202						
Stack Gas Velocity	m/s	10.5	1.5					
Volumetric Flow Rate (ACTUAL)	m³/hr	22574	3441					
Volumetric Flow Rate (REF) [1]	m³/hr	8352	1273					

NOTE: VOLUMETRIC FLOW RATE & VELOCITY DATA TAKEN FROM AN AVERAGE OF ALL OF THE ISOKINETIC RUNS.

[1] Reference Conditions (REF) are: 273K, 101.3kPa, dry gas, 6% oxygen.

Executive Summary

MONITORING DATE(S) & TIMES

Newbridge Energy Ltd, Ruthin
Biomass CHP Plant Exhaust
3rd August 2021

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m³	19.3	g/hr	161	03/08/2021	12:06 - 12:38	32
Total Particulate Matter	R2	mg/m³	19.7	g/hr	164	03/08/2021	12:45 - 13:17	32
Total Particulate Matter	R3	mg/m³	23.8	g/hr	199	03/08/2021	13:25 - 13:57	32
Oxides of Nitrogen (as NO_2)	R1	mg/m³	290	g/hr	2419	03/08/2021	12:06 - 12:38	32
Oxides of Nitrogen (as NO_2)	R2	mg/m³	283	g/hr	2366	03/08/2021	12:45 - 13:17	32
Oxides of Nitrogen (as NO_2)	R3	mg/m³	291	g/hr	2434	03/08/2021	13:25 - 13:57	32
Oxygen	R1	% v/v	9.8			03/08/2021	12:06 - 12:38	32
Oxygen	R2	% v/v	9.8			03/08/2021	12:45 - 13:17	32
Oxygen	R3	% v/v	10.1			03/08/2021	13:25 - 13:57	32
Velocity Traverse	R1					03/08/2021	09:25 - 09:35	

All results are expressed at the respective reference conditions.

PROCESS DETAILS

Newbridge Energy Ltd, Ruthin
Biomass CHP Plant Exhaust
3rd August 2021

Standard Operating Conditions

Parameter	Value
Process Status	Normal Operation
Capacity (of 100%) and Tonnes / Hour	3 Tonnes / Hour
Continuous or Batch Process	Continuous
Feedstock (if applicable)	Wood Chip Pellets
Abatement System	Bag Filter & Cyclone
Abatement System Running Status	On
Fuel	Wood Chips
Plume Appearance	Not visible from the sampling location

Executive Summary

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MONITORING & ANALYTICAL METHODS

Newbridge Energy Ltd, Ruthin
Biomass CHP Plant Exhaust
3rd August 2021

	Monitoring				Analysis					
Parameter	**Standard**	**Technical Procedure**	**Sampling Status**	**Testing Lab**	**Analytical Procedure**	**Analytical Technique**	**Analysis Status**	**Analysis Lab**	**Overall Status**	**LOD (Average)**
Total Particulate Matter	EN 13284-1	CAT-TP-01	MCERTS	EET	CAT-TP-03	Gravimetric	MCERTS	EET	MCERTS	0.48 mg/m³
Water Vapour	EN 14790	CAT-TP-05	MCERTS	EET	CAT-TP-05	Gravimetric	MCERTS	EET	MCERTS	0.10 % v/v
Oxides of Nitrogen (as NO_2)	EN 14792	CAT-TP-39	MCERTS	EET	Chemiluminescence by Horiba PG-350E				MCERTS	0.41 mg/m³
Oxygen	EN 14789	CAT-TP-39	MCERTS	EET	Dry Paramagnetic Cell by Horiba PG-350E				MCERTS	0.1 %
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	CAT-TP-41	MCERTS	EET	Pitot Tube and Thermocouple				MCERTS	1.8 m/s

ANALYSIS LABORATORIES

(with short name reference as appears in the table above)

Element Materials Technology (EET)	ISO 17025 Accreditation Number: 4279

SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
Total Particulate Matter	1, 2, 3	One out of two sampling lines was used due to sampling location restrictions, however the number of sample points used on the available line were increased to the minimum required by the Standard

SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.87
Width	m	-
Area	m^2	0.59
Port Depth	cm	30
Orientation of Duct	-	Vertical
Number of Ports	-	2
Sample Port Size	-	5" Flange

Location of Sampling Platform

General Platform Information	Value
Permanent / Temporary Platform	Permanent
Inside / Outside	Inside

Platform Details

EA Technical Guidance Note M1 / EN 15259 Platform Requirements	Value
Sufficient working area to manipulate probe and operate the measuring instruments	Yes
Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	Yes
Platform has vertical base boards (approx. 0.25m high)	Yes
Platform has chains / self closing gates at top of ladders	Yes
There are no obstructions present which hamper insertion of sampling equipment	Yes
Safe Access Available	Yes
Easy Access Available	Yes

Sampling Location / Platform Improvement Recommendations

The sampling location meets all the requirements specified in EA Guidance Note M1 and EN 15259, and therefore there are no improvement recommendations.

EN 15259 Homogeneity Test Requirements

There is no requirement to perform a EN 15259 Homogeneity Test on this Stack.

Sampling Plane Validation Criteria (from EN 15259)

Criteria in EN 15259	Units	Traverse 1	Required	Compliant
Lowest Differential Pressure	Pa	60.8	> 5 Pa	Yes
Mean Velocity	m/s	10.75	-	-
Lowest Gas Velocity	m/s	10.66	-	-
Highest Gas Velocity	m/s	10.84	-	-
Ratio of Above	: 1	1.02	< 3 : 1	Yes
Maximum Angle of Swirl	°	3.00	< 15°	Yes
No Local Negative Flow	-	Yes	-	Yes

Executive Summary

PLANT PHOTOS

Photo 1

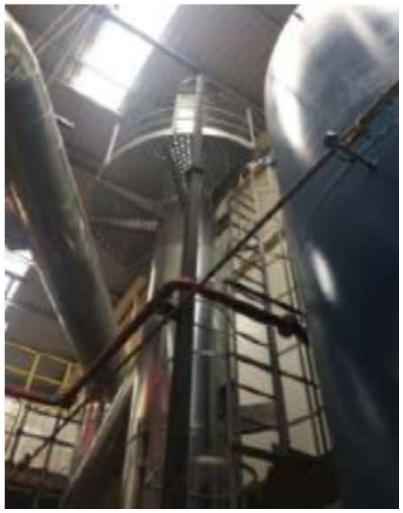
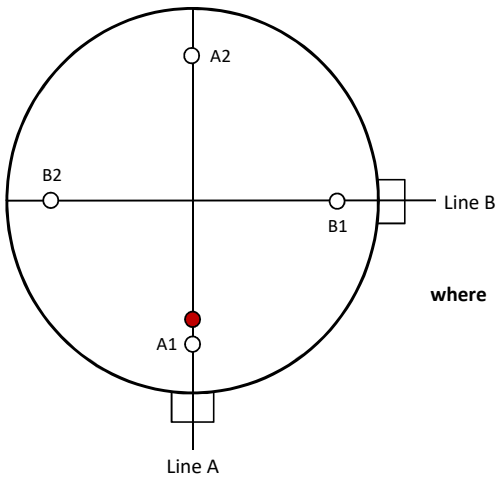


Photo 2

Photo 3

Photo 4

SAMPLE POINTS



where
- ○ = isokinetic point sampled at
- ● = isokinetic point not sampled at
- ● = combustion gases sample point
- ● = non-isokinetic sample point

APPENDIX CONTENTS

STACK EMISSIONS MONITORING PERSONNEL

Position	Name	MCERTS Accreditation	MCERTS Number	Technical Endorsements
Team Leader	Matthew Miller	MCERTS Level 2	MM 14 1313	TE1 TE2 TE3 TE4
Trainee	Afraz Rajah	MCERTS Trainee	MM 21 1621	None

LIST OF EQUIPMENT

Extractive Sampling	
Equipment Type	**Equipment I.D.**
Control Box DGM (1)	CAT 7.5
Control Box DGM (2)	-
Box Thermocouples (1)	CAT 4.96
Box Thermocouples (2)	CAT 4.97
Umbilical (1)	CAT 3.12
Umbilical (2)	-
Oven Box (1)	CAT 12.36
Oven Box (2)	-
Heated Probe (1)	-
Heated Probe (2)	CAT 5.19
Heated Probe (3)	-
S-Pitot (1)	-
S-Pitot (2)	CAT 21P.126
L-Pitot	CAT 21L.29
Site Balance	CAT 17.20
500g / 1Kg Check Weights	CAT 17.20
Last Impinger Arm	-
Callipers	CAT 23.7
Tubes Kit Thermocouple	-

Instrumental Analysers	
Equipment Type	**Equipment I.D.**
Horiba PG-350E	CAT 39.29
Horiba PG-250 SRM	-
Servomex 4900	-
Eco Physics CLD 822Mh	-
ABB AO2020-URAS26	-
Testo 350 XL	-
JCT JCC P1 Cooler	CAT 4.0030
Gasmet DX4000	-
Gasmet Sampling System	-
Bernath 3006 FID	-
M&C PSS	CAT 12.139
Mass Flow Controller (1)	CAT 6.19
Mass Flow Controller (2)	CAT 6.20
Mass View (1)	-
Mass View (2)	-
Hioki 5043 (V)	-
Easylogger EN-EL-12 Bit	-
Bioaerosols Temperature Logger	-
Electronic Refrigerator	-

Miscellaneous Items	
Equipment Type	**Equipment I.D.**
Digital Manometer (1)	CAT 3.124
Digital Manometer (2)	CAT 3.125
Digital Temperature Meter	-
Stopwatch	CAT 14.25
Barometer	CAT 13.29
Stack Thermocouple (1)	-
Stack Thermocouple (2)	-
Stack Thermocouple (3)	CAT 4.00099
1m Heated Line (1)	-
1m Heated Line (2)	-
1m Heated Line (3)	-
5m Heated Line (1)	-
15m Heated Line (1)	-
20m Heated Line (1)	CAT 20.170
20m Heated Line (2)	-
Dual Channel Heater Controller	CAT 3.18
Single Channel Heater Controller	-
Laboratory Balance	CAT 1.18, 1.18a, 1.18b
Tape Measure	CAT 16.26

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	EN 13284-1	CAT-TP-01
Water Vapour	EN 14790	CAT-TP-05
Oxides of Nitrogen (as NO_2)	EN 14792	CAT-TP-39
Oxygen	EN 14789	CAT-TP-39
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	CAT-TP-41

PRELIMINARY STACK SURVEY: CALCULATIONS

General Stack Details

Stack Details (from Traverse)	Units	Value
Stack Diameter / Depth, D	m	0.87
Stack Width, W	m	-
Stack Area, A	m^2	0.59
Average Stack Gas Temperature, T_a	°C	199.5
Average Stack Gas Pressure	mmH_2O	6.3
Average Stack Static Pressure, P_{static}	kPa	0.010
Average Barometric Pressure, P_b	kPa	101.4
Average Pitot Tube Calibration Coefficient, C_p	-	0.83

Stack Gas Composition & Molecular Weights

Component	Conc ppm	Conc Dry % v/v	Conc Wet % v/v	Volume Fraction r	Molar Mass M	Density kg/m³ p	Conc kg/m³ p_i
CO_2 (Estimated)	-	10.00	8.69	0.1000	44.01	1.9635	0.19635
O_2	-	9.91	8.62	0.0991	32.00	1.4277	0.14150
N_2	-	80.09	69.62	0.8009	28.01	1.2498	1.00099
Moisture (H_2O)	-	-	13.07	0.1307	18.02	0.8037	0.10501

Where: p = M / 22.41

p_i = r x p

Calculation of Stack Gas Densities

Determinand	Units	Result
Dry Density (STP), P_{STD}	kg/m³	1.339
Wet Density (STP), P_{STW}	kg/m³	1.269
Dry Density (Actual), P_{Actual}	kg/m³	0.774
Average Wet Density (Actual), $P_{ActualW}$	kg/m³	0.734

Where: P_{STD} = sum of component concentrations, kg/m³ (not including water vapour)

P_{STW} = sum of all wet concentrations / 100 x density, kg/m³ (including water vapour)

$P_{Actual} = P_{STD} \times (T_{STP} / (P_{STP})) \times ((P_{static} + P_b) / T_a)$

$P_{ActualW}$ (at each sampling point) $= P_{STW} \times (T_s / P_s) \times (P_a / T_a)$

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF [1]
Temperature	°C	199.5	0.0
Total Pressure	kPa	101.4	101.3
Moisture	%	13.07	0.00
Oxygen (Dry)	%	9.9	6.0

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m³/hr	23004
Gas Volumetric Flowrate (STP, Wet)	m³/hr	13305
Gas Volumetric Flowrate (STP, Dry)	m³/hr	11567
Gas Volumetric Flowrate REF [1]	m³/hr	8551

PRELIMINARY STACK SURVEY: VELOCITY TRAVERSE TO EN 16911-1 (MID)

(1 of 1)

Parameter	Units	Value
Date of Survey	-	03/08/2021
Time of Survey	-	09:25 - 09:35
Atmospheric Pressure	kPa	101.4
Average Stack Static Pressure	Pa	10
Result of Pitot Stagnation Test	-	Pass
Are Water Droplets Present?	-	No
Device Used	S-Type Pitot with Liquid Incline Manometer	

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C_p	-	0.83
Number of Lines Available	-	2
Number of Lines Used	-	2

		Sampling Line A					Sampling Line B				
Traverse Point	**Depth m**	**ΔP mmH_2O**	**Temp °C**	**Wet Density kg/m^3**	**Velocity m/s**	**Swirl °**	**ΔP mmH_2O**	**Temp °C**	**Wet Density kg/m^3**	**Velocity m/s**	**Swirl °**
STATIC (Units: Pa)		*10.0*					*10.0*				
Mean		**6.2**	**199.5**	**0.734**	**10.66**		**6.4**	**199.5**	**0.734**	**10.83**	
1	0.13	6.2	199.0	0.735	10.66	2.0	6.4	199.0	0.735	10.83	2.0
2	0.74	6.2	200.0	0.733	10.67	3.0	6.4	200.0	0.733	10.84	3.0

PRELIMINARY STACK SURVEY: VELOCITY TRAVERSE TO EN 16911-1 (MID) - MEASUREMENT UNCERTAINTY

(1 of 1)

Performance characteristics (Uncertainty Components)	Uncertainty	Value	Units
Standard Uncertainty on the coefficient of the Pitot Tube	u(k)	0.005	-
Standard Uncertainty associated with the mean local dynamic pressures	u(Δpi)	1.864	Pa
- Resolution	u(res)	0.52154	
- Calibration	u(cal)	0.397	
- Drift	u(drift)	1.096	
- Lack of Fit	u(fit)	0.460	
- Overall corrections to dynamic measurements	u(Cf)	2.475	
Standard uncertainty associated with the molar mass of the gas	u(M)	0.00008	-
- $\varphi O_2,w$	-	8.616	
- $\varphi CO_2,w$	-	8.693	
- Oxygen, dry	u(ϕO_2,d)	0.303	
- Carbon Dioxide, dry	u(ϕCO_2,d)	0.306	
- Water Vapour	u(ϕH_2O)	0.667	
- Oxygen, wet	u(ϕO_2,w)	0.272	
- Carbon Dioxide, wet	u(ϕCO_2,w)	0.274	
Standard uncertainty associated with the stack temperature	u(Tc)	2.411	K
Standard uncertainty associated with the absolute pressure in the duct	u(pc)	175.697	Pa
- Atmospheric Pressure	u(patm)	175.692	
- Static Pressure	u(pstat)	1.318	
Standard uncertainty associated with the density in the duct	u(ρ)	0.00395	-
Standard uncertainty associated with the local velocities	u(vi)	1.592	Pa
Standard uncertainty associated with the mean velocity	u(v)	0.798	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	Uc(v)	1.564	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	Uc,rel(v)	14.56	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	Uc(qV,w)	3506.6	m^3/hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV,w)/q^2V,w$	-	0.00605	
- $u^2(qV,w)$	-	3200890	
- $u(qV,w)$	-	1789.1	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	Uc,rel(qV,w)	15.24	%

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

Newbridge Energy Ltd, Ruthin
Biomass CHP Plant Exhaust

Sample Runs

Parameter	Units	Run 1	Run 2	Run 3		Mean
Concentration	mg/m³	19.3	19.7	23.8		20.9
Uncertainty	±mg/m³	1.8	1.9	2.2		2.0
Mass Emission	g/hr	161	164	199		175
Uncertainty	±g/hr	29	30	36		31

Parameter	Units	Run 1	Run 2	Run 3		Mean
Water Vapour	% v/v	12.3	13.8	13.1		13.1
Uncertainty	±% v/v	0.7	0.8	0.7		0.7

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m³	0.80		0.80

General Sampling Information

Parameter	Value	
Standard	EN 13284-1	
Technical Procedure	CAT-TP-01	
Probe Material	Titanium	
Filter Housing Material	Titanium	
Positioning of Filter	In Stack	
Filter Size and Material	47mm Glass Fibre	
Number of Sampling Lines Used	2 / 2	FORMAT: Number Used / Number Required
Number of Sampling Points Used	4 / 4	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1, A2, B1 & B2	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 6% oxygen.

TOTAL PARTICULATE MATTER: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	Run 2	Run 3
Absolute pressure of stack gas, P_s				
Barometric pressure, P_b	mmHg	760.6	760.6	760.6
Stack static pressure, P_{static}	mmH_2O	1.0	1.0	1.0
$P_s = (P_b + (P_{static} / 13.6)$	mmHg	760.6	760.6	760.6
Volume of water vapour collected, V_{wstd}				
Total mass collected in impingers (liquid trap)	g	44.5	49.8	47.6
Total mass collected in impingers (silica trap)	g	16.4	14.0	10.4
Total mass of liquid collected, V_{lc}	g	60.9	63.8	58.0
$V_{wstd} = (0.001246)(V_{lc})$	m^3	0.0759	0.0795	0.0723
Volume of gas metered dry, V_{mstd}				
Volume of gas sample through gas meter, V_m	m^3	0.6300	0.5930	0.5730
Gas meter correction factor, Y_d	-	0.9530	0.9530	0.9530
Average dry gas meter temperature, T_m	°C	31.2	38.3	39.7
Average pressure drop across orifice, ΔH	mmH_2O	36.0	32.8	31.0
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m^3	0.5411	0.4975	0.4785
Moisture content, B_{wo} & R_{wv}				
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m^3	0.1230	0.1378	0.1312
B_{wo} as a percentage	% v/v	12.30	13.78	13.12
Reported Water Vapour, checked with Tables in EN 14790, Rwv	% v/v	12.30	13.78	13.12
Volume of gas metered wet, V_{mstw}				
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m^3	0.6170	0.5770	0.5508
Volume of gas metered at Oxygen Reference Conditions, $V_{mstd@X\%O_2}$ & $V_{mstw@X\%O_2}$				
IED & Incinerates Hazardous Material? (Yes = no positive O_2 correction)	-	No	No	No
% wet oxygen measured in gas stream, $ACT\%O_{2w}$	% v/v	8.54	8.54	8.79
% dry oxygen measured in gas stream, $ACT\%O_{2d}$	% v/v	9.82	9.83	10.11
% oxygen reference condition, $REF\%O_2$	% v/v	6.00	6.00	6.00
O_2 Reference Factor wet $(O_{2REFw}) = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$	-	1.20	1.20	1.23
O_2 Reference Factor dry $(O_{2REFd}) = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$	-	1.34	1.34	1.38
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m^3	0.5126	0.4791	0.4485
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m^3	0.4033	0.3705	0.3475
Molecular weight of dry gas stream, M_d				
CO_2 (Estimated)	% v/v	10.00	10.00	10.00
O_2	% v/v	9.82	9.83	10.11
Total	% v/v	19.82	19.83	20.11
N_2	% v/v	80.18	80.17	79.89
$M_d = 0.44(\%CO_2)+0.32(\%O_2)+0.28(\%N_2)$	g/gmol	29.99	29.99	30.00
Molecular weight of stack gas (wet), M_s				
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.52	28.34	28.43
Velocity of stack gas, V_s				
Pitot tube velocity constant, K_p	-	34.97	34.97	34.97
Velocity pressure coefficient, C_p	-	0.83	0.83	0.83
Average of velocity heads, ΔP_{avg}	mmH_2O	6.60	5.90	5.58
Average square root of velocity heads, √ΔP	$\sqrt{mmH_2O}$	2.57	2.43	2.36
Average stack gas temperature, T_s	°C	199.8	201.8	203.3
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(\sqrt{T_s} + 273)) / (\sqrt{(M_s)(P_s)})$	m/s	11.01	10.46	10.17
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO_2}), Dry@O_{2REF} (Q_{stdO_2})				
Area of stack, A_s	m^2	0.59	0.59	0.59
$Q_a = (60)(A_s)(V_s)$	m^3/min	392.7	373.2	362.8
Conversion factor (K/mm.Hg), C_f	-	0.3592	0.3592	0.3592
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m^3/min	227.0	214.8	208.1
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m^3/min	199.0	185.2	180.8
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	m^3/min	188.6	178.4	169.5
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273) / (O_{2REFd})$	m^3/min	148.3	137.9	131.3
Percent isokinetic, %I				
Nozzle diameter, D_n	mm	8.00	8.00	8.00
Nozzle area, A_n	mm^2	50.23	50.23	50.23
Total sampling time, q	min	32	32	32
$\%I = (4.6398E^6)(T_s+273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	100.6	99.4	97.9

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	Run 2	Run 3
Sampling Times	-	12:06 - 12:38	12:45 - 13:17	13:25 - 13:57
Sampling Dates	-	03/08/2021	03/08/2021	03/08/2021
Sampling Device	-	ISO	ISO	ISO
Volume Sampled (REF)	m^3	0.4033	0.3705	0.3475
Filter I.D. Number	-	47-82962	47-82865	47-82869
Start Filter Mass	g	0.14612	0.14541	0.14646
End Filter Mass	g	0.15175	0.15174	0.15450
Total Mass on Filter	g	0.00563	0.00633	0.00804
Probe Rinse I.D. Number	-	PR-47-82962	PR-47-82865	PR-47-82869
Start Probe Rinse Mass	g	3.05673	3.08869	2.89624
End Probe Rinse Mass	g	3.05889	3.08965	2.89647
Total Mass in Probe Rinse	g	0.00216	0.00096	0.00023
Total Mass Collected	mg	7.79	7.29	8.27
Calculated Concentration	mg/m^3	19.32	19.67	23.80
Balance Uncertainty / LOD	mg/m^3	0.45	0.49	0.52

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1
Blank Dates	-	03/08/2021
Average Volume Sampled (REF)	m^3	0.3738
Filter I.D. Number	-	47-82631
Start Filter Mass	g	0.14435
End Filter Mass	g	0.14444
Total Mass on Filter	g	0.00009
Probe Rinse I.D. Number	-	PR-47-82631
Start Probe Rinse Mass	g	2.99162
End Probe Rinse Mass	g	2.99183
Total Mass in Probe Rinse	g	0.00021
Total Mass Collected	mg	0.30
Calculated Concentration	mg/m^3	0.80
Balance Uncertainty / LOD	mg/m^3	0.48

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

Sample Runs

Leak Test Results	Units	Run 1	Run 2	Run 3
Mean Sampling Rate	l/min	18.8	17.7	17.1
Pre-Sampling Leak Rate	l/min	0.15	0.20	0.25
Allowable Leak Rate	l/min	0.40	0.40	0.40
Leak Test Acceptable	-	Yes	Yes	Yes

Water Droplets	Units	Run 1	Run 2	Run 3
Are Water Droplets Present	-	No	No	No

MU (Concurrent Water Vapour)	Units	Run 1	Run 2	Run 3
Measurement Uncertainty (MU)	%	5.4	5.6	5.7
Allowable MU	%	20.0	20.0	20.0
MU Acceptable	%	Yes	Yes	Yes

Silica Gel (Concurrent Water Vapour)	Units	Run 1	Run 2	Run 3
Less than 50% Faded	%	Yes	Yes	Yes

Isokinetic Criterion Compliance	Units	Run 1	Run 2	Run 3
Isokinetic Variation	%	100.6	99.4	97.9
Allowable Isokinetic Range	%	95 - 115	95 - 115	95 - 115
Isokineticity Acceptable	-	Yes	Yes	Yes

Weighing Uncertainty Criteria	Units	Run 1	Run 2	Run 3
Overall Weighing Uncertainty	± mg	0.36	0.36	0.36
Overall Weighing Uncertainty	± mg/m³	0.89	0.97	1.04
ELV [Daily ELV for IED]	mg/m³	30.00	30.00	30.00
Allowable Weighing Uncertainty	mg/m³	1.50	1.50	1.50
Weighing Uncertainty Acceptable	-	Yes	Yes	Yes

Filter Temperatures	Units	Run 1	Run 2	Run 3
Pre-Conditioning Temperature	°C	180	180	180
Post-Conditioning Temperature	°C	160	160	160
Maximum Filter Temperature	°C	202	202	204

Test Conditions	Units	Run 1	Run 2	Run 3
Ambient Temperature Recorded?	-	Yes	Yes	Yes

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

Blank Runs

Leak Test Results	Units	Blank 1
Expected Sampling Rate	l/min	20.0
Pre-Sampling Leak Rate	l/min	0.10
Allowable Leak Rate	l/min	0.40
Leak Test Acceptable	-	Yes

Validity of Blank vs ELV	Units	Blank 1
Allowable Blank	mg/m^3	3.0
Blank Acceptable	-	Yes

Acetone / Water Rinse Blank	Units	Blank
Acetone / Water Rinse Value	mg/l	2.7
Allowable Blank	mg/l	10
Blank Acceptable	-	Yes

Method Deviations

Nature of Deviation (x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)	Run Number 1	2	3	
One out of two sampling lines was used due to sampling location restrictions, however the number of sample points used on the available line were increased to the minimum required by the Standard	wx	wx	wx	

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

	Value				Standard uncertainty				
Measured Quantities	**Symbol**	**Run 1**	**Run 2**	**Run 3**	**Symbol**	**Units**	**Run 1**	**Run 2**	**Run 3**
Sampled Volume (Actual)	V_m	0.6300	0.5930	0.5730	uV_m	m^3	0.0126	0.0119	0.0115
Sampled Gas Temperature	T_m	304.2	311.3	312.7	uT_m	K	2.00	2.00	2.00
Sampled Gas Pressure	ρ_m	101.4	101.4	101.4	$u\rho_m$	kPa	0.50	0.50	0.50
Sampled Gas Humidity	H_m	0.00	0.00	0.00	uH_m	% v/v	1.00	1.00	1.00
Leak	L	0.80	1.13	1.47	uL	%	-	-	-
Mass of Particulate	m	7.79	7.29	8.27	um	mg	0.18	0.18	0.18
Uncollected Mass	UCM	0.30	0.30	0.30	uUCM	mg	-	-	-

	Uncertainty as a Percentage				
Measured Quantities	**Units**	**Run 1**	**Run 2**	**Run 3**	**Requirement of Standard**
Sampled Volume (Actual)	%	2.00	2.00	2.00	≤2%
Sampled Gas Temperature	%	0.66	0.64	0.64	≤1%
Sampled Gas Pressure	%	0.49	0.49	0.49	≤1%
Sampled Gas Humidity	%	1.00	1.00	1.00	≤1%
Leak	%	0.80	1.13	1.47	≤2%
Mass of Particulate	%	1.49	1.62	1.73	<5% of ELV
Uncollected Mass	%	-	-	-	-

	Uncertainty in Measurement Units					Sensitivity Coefficient		
Measured Quantities	**Symbol**	**Units**	**Run 1**	**Run 2**	**Run 3**	**Run 1**	**Run 2**	**Run 3**
Sampled Volume (STP)	V_m	m^3	0.5411	0.4975	0.4785	35.70	39.55	49.73
Leak	L	mg/m^3	0.089	0.129	0.201	1.00	1.00	1.00
Mass of Particulate	L_r	mg	7.790	7.290	8.270	2.48	2.70	2.88
Uncollected Mass	UCM	mg	0.17	0.17	0.17	2.48	2.70	2.88

	Uncertainty in Result			
Measured Quantities	**Units**	**Run 1**	**Run 2**	**Run 3**
Sampled Volume (STP)	mg/m^3	0.515	0.533	0.647
Leak	mg/m^3	0.0892	0.1286	0.2013
Mass of Particulate	mg/m^3	0.4464	0.4858	0.5180
Uncollected Mass	mg/m^3	0.4295	0.4674	0.4984

	Oxygen Correction Part of MU Budget			
Measured Quantities	**Units**	**Run 1**	**Run 2**	**Run 3**
O_2 Correction Factor	-	1.34	1.34	1.38
Stack Gas O_2 Content	% v/v	9.82	9.83	10.11
MU for O_2 Correction	-	0.06	0.06	0.06
Overall MU For O_2 Measurement	%	4.47	4.48	4.59

Parameter	**Units**	**Run 1**	**Run 2**	**Run 3**
Combined uncertainty	mg/m^3	0.81	0.87	0.99
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m^3	1.59	1.70	1.94
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m^3	1.81	1.92	2.22
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m^3	1.81	1.92	2.22
Reported Uncertainty	mg/m^3	1.81	1.92	2.22
Expanded uncertainty (95% confidence), without Oxygen Correction	%	8.2	8.7	8.1
Expanded uncertainty (95% confidence), with Oxygen Correction	%	9.4	9.7	9.3
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	9.4	9.7	9.3
Reported Uncertainty	%	9.4	9.7	9.3

OXIDES OF NITROGEN (as NO_2): RESULTS SUMMARY

Newbridge Energy Ltd, Ruthin
Biomass CHP Plant Exhaust

Sample Runs

Parameter	Units	Run 1	Run 2	Run 3	Mean
Concentration	mg/m³	290	283	291	288
Uncertainty	±mg/m³	12	12	12	12
Mass Emission	g/hr	2419	2366	2434	2406
Uncertainty	±g/hr	382	374	385	380

General Sampling Information

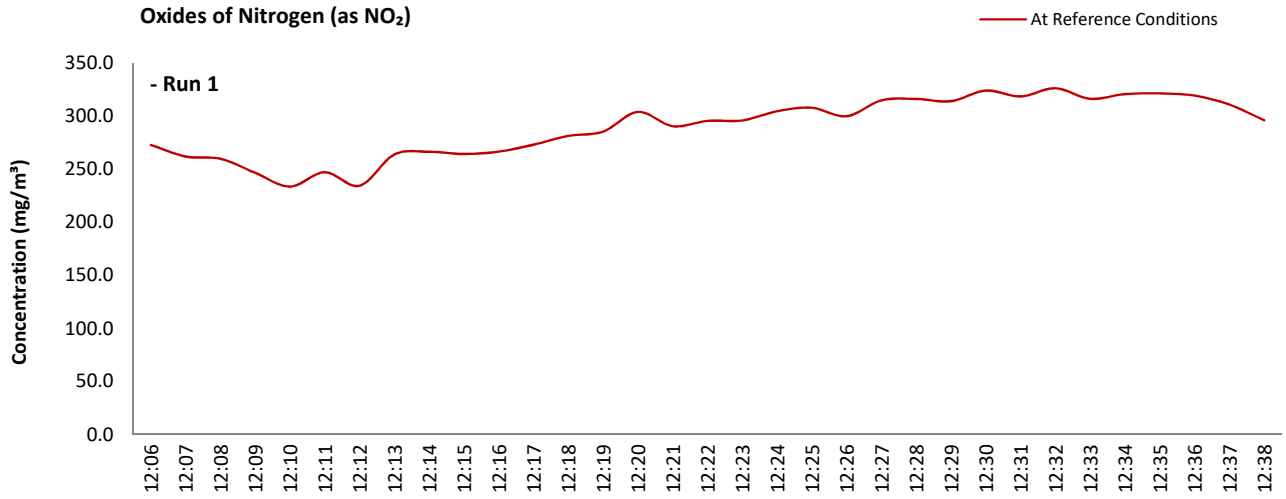
Parameter	Value	
Standard	EN 14792	
Technical Procedure	CAT-TP-39	
Probe Material	Titanium	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Date & Result of Last Converter Check	26/05/2021 - 95.1%	
Span Gas Type	Nitrogen Monoxide	
Span Gas Reference Number	CYL 12.0339	
Span Gas Expiry Date	30/01/2023	
Span Gas Start Pressure (bar)	80	
Gas Cylinder Concentration (ppm)	403.9	NOTE: Dilution performed to achieve correct span value
Span Gas Uncertainty (%)	2	
Zero Gas Type	Nitrogen (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1	

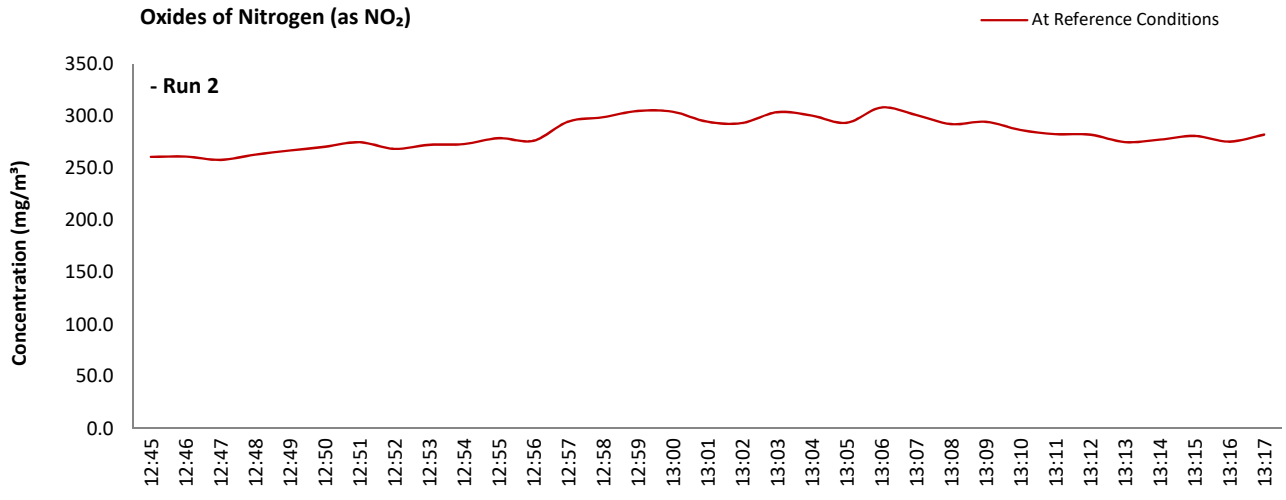
Reference Conditions

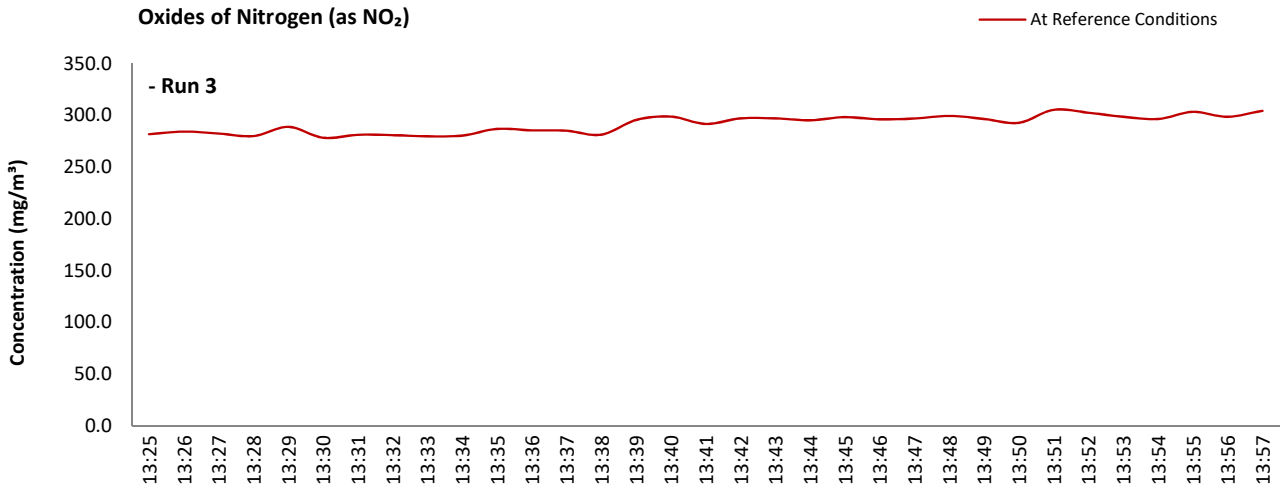
Reference Conditions are: 273K, 101.3kPa, dry gas, 6% oxygen.

OXIDES OF NITROGEN (as NO_2): DATA TREND

Graphical Trend of Data







OXIDES OF NITROGEN (as NO_2): SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1	Run 2	Run 3
Sampling Times	-	12:06 - 12:38	12:45 - 13:17	13:25 - 13:57
Sampling Dates	-	03/08/2021	03/08/2021	03/08/2021
Instrument Range	ppm	500	500	500
Span Gas Value	ppm	146.2	146.2	146.2

Quality Assurance

Conditioning Unit Temperature	Units	Run 1	Run 2	Run 3
Average Temperature	°C	2.5	2.5	2.5
Allowable Temperature	< °C	4.0	4.0	4.0
Temperature Acceptable	-	Yes	Yes	Yes

	Zero Drift	Units	Run 1	Run 2	Run 3
CAL 1	Zero at Analyser (Pre)	ppm	0.00	0.00	0.00
CAL 1	Zero at Analyser (Post)	ppm	0.00	0.00	0.00
CAL 1	Zero Drift	ppm	0.00	0.00	0.00
CAL 1	Zero Drift	%	0.00	0.00	0.00
CAL 1	Drift Correction Applied	2-5%	No	No	No
	Allowable Zero Drift	± %	5.00	5.00	5.00
	Zero Drift Acceptable	-	Yes	Yes	Yes

	Span Drift	Units	Run 1	Run 2	Run 3
CAL 1	Span at Analyser (Pre)	ppm	146.00	146.00	146.00
CAL 1	Span at Analyser (Post)	ppm	143.9	143.90	143.90
CAL 1	Span Drift	ppm	-2.10	-2.10	-2.10
CAL 1	Zero Adj. Span Drift	%	1.44	1.44	1.44
CAL 1	Drift Correction Applied	2-5%	No	No	No
	Allowable Span Drift	± %	5.00	5.00	5.00
	Span Drift Acceptable	-	Yes	Yes	Yes

Test Conditions	Units	Run 1	Run 2	Run 3
Run Ambient Temperature Range	°C	19 - 25	19 - 25	19 - 25

Method Deviations

Nature of Deviation (x = deviation applies to the associated run)	Run Number 1	2	3
There are no deviations associated with the sampling employed.	x	x	x

OXIDES OF NITROGEN (as NO_2): MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1	RUN 2	RUN 3	Units
Limit value	300.0	300.0	300.0	mg/m³ (REF)
Allowable MU	10.0	10.0	10.0	%
Measured concentration	216.40	210.99	211.99	mg/m³ (STP, dry)
Ratio NO / NO_2	5	5	5	%
Range Used	500.0	500.0	500.0	ppm
Range Used [A]	1026.1	1026.1	1026.1	mg/m³
Cal gas conc.	146.2	146.2	146.2	ppm
Conversion	2.05	2.05	2.05	ppm to mg/m³
MCERTS Range [B]	205.0	205.0	205.0	mg/m³
Lower of [A] or [B]	205.0	205.0	205.0	mg/m³
Cal gas conc.	300.0	300.0	300.0	mg/m³

Performance characteristics	RUN 1	RUN 2	RUN 3	Units
Response time	31	31	31	seconds
Number of readings in measurement	32	32	32	-
Repeatability at zero	0.00	0.00	0.00	% full scale
Repeatability at span level	0.10	0.10	0.10	% full scale
Deviation from linearity	0.28	0.28	0.28	% of value
Zero drift	0.00	0.00	0.00	% full scale
Span drift	-1.44	-1.44	-1.44	% full scale
Volume or pressure flow dependence	0.10	0.10	0.10	% of full scale
Atmospheric pressure dependence	0.10	0.10	0.10	% of value/kPa
Ambient temperature dependence	0.04	0.04	0.04	% full scale/10K
Combined interference	0.63	0.63	0.63	% range
Dependence on voltage	-0.23	-0.23	-0.23	% full scale/10V
Converter efficiency	95.1	95.1	95.1	%
Losses in the line (leak)	1.30	1.30	1.30	% of value
Uncertainty of calibration gas blending	1.40	1.40	1.40	% of value
Uncertainty of calibration gas	2.00	2.00	2.00	% of value

Performance characteristic	RUN 1	RUN 2	RUN 3	Units
Standard deviation of repeatability at zero	use rep at span	use rep at span	use rep at span	mg/m³
Standard deviation of repeatability at span level	0.02	0.02	0.02	mg/m³
Lack of fit	0.33	0.33	0.33	mg/m³
Drift	0.00	0.00	0.00	mg/m³
Volume or pressure flow dependence	0.00	0.00	0.00	mg/m³
Atmospheric pressure dependence	0.06	0.06	0.06	mg/m³
Ambient temperature dependence	0.01	0.01	0.01	mg/m³
Combined interference (from MCERTS Certificate)	0.75	0.75	0.75	mg/m³
Dependence on voltage	-0.03	-0.03	-0.03	mg/m³
Converter efficiency	0.31	0.30	0.30	mg/m³
Losses in the line (leak)	1.62	1.58	1.59	mg/m³
Uncertainty of calibration gas blending	1.75	1.71	1.71	mg/m³
Uncertainty of calibration gas	2.50	2.44	2.45	mg/m³

			RUN 1	RUN 2	RUN 3	Units
Measurement uncertainty		**Result**	216.40	210.99	211.99	mg/m³
Combined uncertainty			3.64	3.56	3.57	mg/m³
Expanded uncertainty	k =	1.96	7.14	6.98	7.01	mg/m³
Uncertainty corrected to std conds. (O_2)			9.55	9.37	9.63	mg/m³ (REF)

	RUN 1	RUN 2	RUN 3	Units
Expanded uncertainty (no O_2) - at 95% Confidence	3.30	3.31	3.30	% of Value
Expanded uncertainty (no O_2) - at 95% Confidence	2.38	2.33	2.34	% at ELV
Overall Allowable uncertainty (no O_2) - at 95% Confidence	10.0	10.0	10.0	% at ELV
Result of Compliance with Uncertainty Requirement	**N/A**	**N/A**	**N/A**	-

	RUN 1	RUN 2	RUN 3	Units
Expanded uncertainty (with O_2) - at 95% Confidence	4.17	4.17	4.17	% of Value
Expanded uncertainty (with O_2) - at 95% Confidence	4.08	4.03	4.09	% at ELV
Overall Allowable uncertainty (with O_2) - at 95% Confidence	10.3	10.3	10.32	% at ELV
Result of Compliance with Uncertainty Requirement	**COMPLIANT**	**COMPLIANT**	**COMPLIANT**	-

Requirement for SRM is that Uncertainty should be <10% of the value at the ELV, on a dry gas basis, or if O_2 correction is applied less than 10% + the uncertainty associated with the O_2 correction (using sqrt of sum squares to add uncertainty components).

OXYGEN: RESULTS SUMMARY

Newbridge Energy Ltd, Ruthin
Biomass CHP Plant Exhaust

Sample Runs

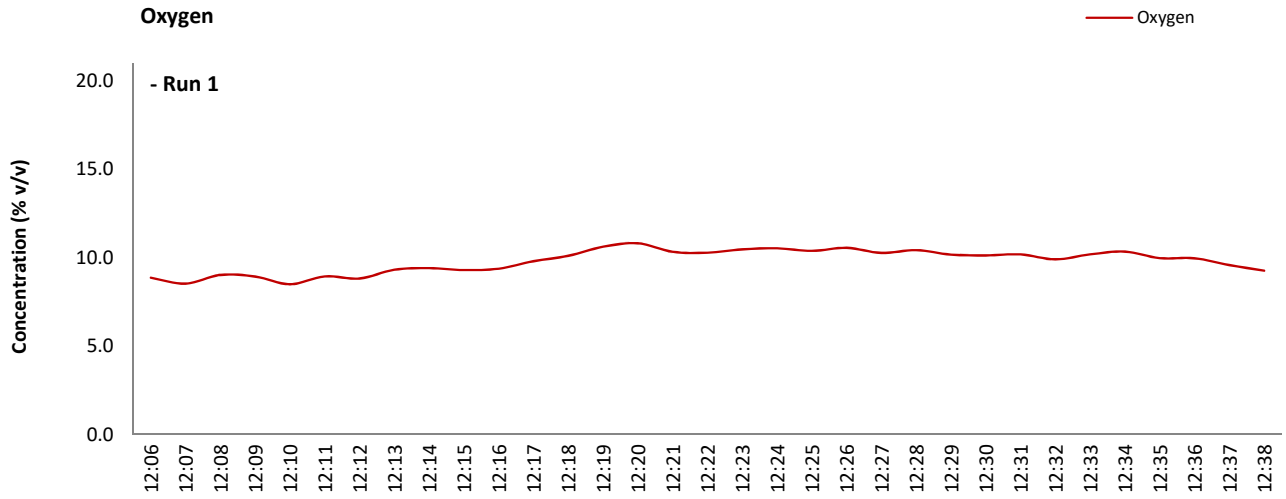
Parameter	Units	Run 1	Run 2	Run 3	Mean
Concentration	% v/v	9.8	9.8	10.1	9.9
Uncertainty	±% v/v	0.2	0.2	0.3	0.3

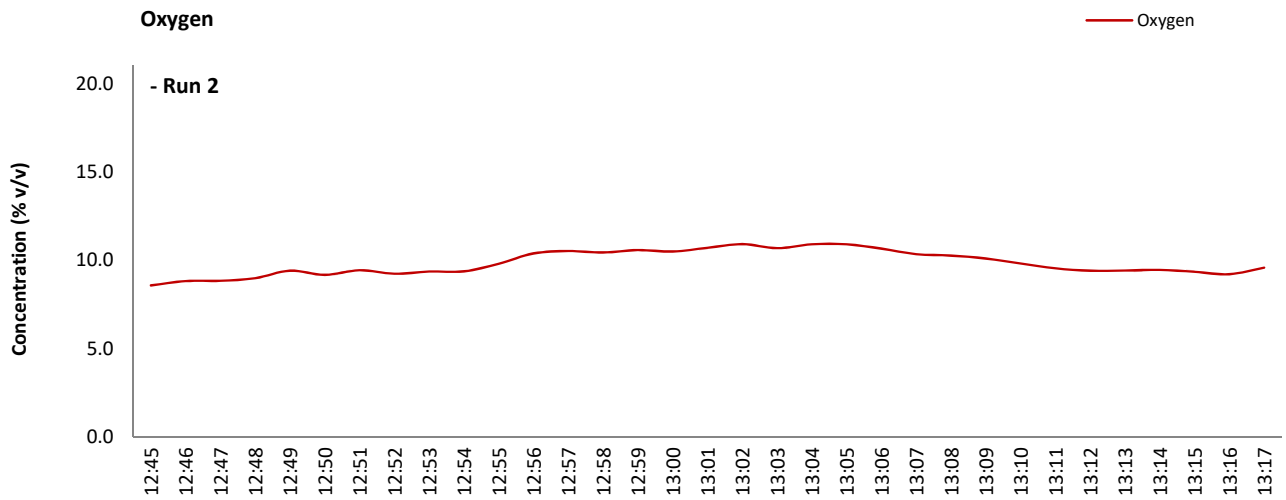
General Sampling Information

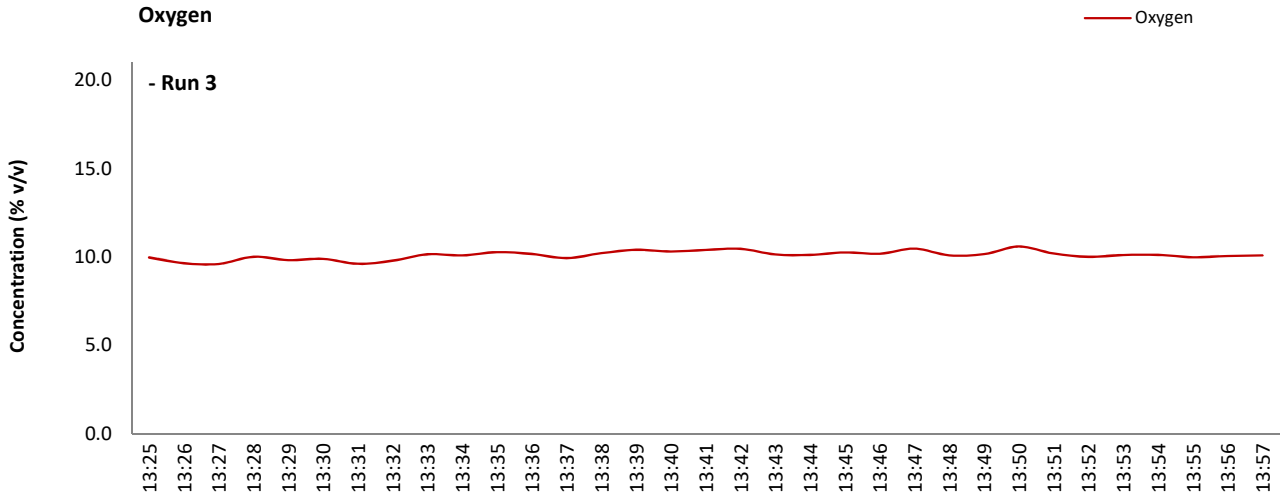
Parameter	Value	
Standard	EN 14789	
Technical Procedure	CAT-TP-39	
Probe Material	Titanium	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Type	Synthetic Air (5 Grade)	
Span Gas Reference Number	CYL 11.0473	
Span Gas Expiry Date	18/05/2026	
Span Gas Start Pressure (bar)	100	
Gas Cylinder Concentration (% v/v)	21.13	NOTE: Dilution performed to achieve correct span value
Span Gas Uncertainty (%)	2	
Zero Gas Type	Nitrogen (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1	

OXYGEN: DATA TREND

Graphical Trend of Data







OXYGEN: SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1	Run 2	Run 3
Sampling Times	-	12:06 - 12:38	12:45 - 13:17	13:25 - 13:57
Sampling Dates	-	03/08/2021	03/08/2021	03/08/2021
Instrument Range	% v/v	25.0	25.0	25.0
Span Gas Value	% v/v	11.0	11.0	11.0

Quality Assurance

Conditioning Unit Temperature	Units	Run 1	Run 2	Run 3
Average Temperature	°C	2.5	2.5	2.5
Allowable Temperature	< °C	4.0	4.0	4.0
Temperature Acceptable	-	Yes	Yes	Yes

	Zero Drift	Units	Run 1	Run 2	Run 3
CAL 1	Zero at Analyser (Pre)	% v/v	0.00	0.00	0.00
CAL 1	Zero at Analyser (Post)	% v/v	0.09	0.09	0.09
CAL 1	Zero Drift	% v/v	0.09	0.09	0.09
CAL 1	Zero Drift	%	0.82	0.82	0.82
CAL 1	Drift Correction Applied	2-5%	No	No	No
	Allowable Zero Drift	± %	5.00	5.00	5.00
	Zero Drift Acceptable	-	Yes	Yes	Yes

	Span Drift	Units	Run 1	Run 2	Run 3
CAL 1	Span at Analyser (Pre)	% v/v	10.99	10.99	10.99
CAL 1	Span at Analyser (Post)	% v/v	11.01	11.01	11.01
CAL 1	Span Drift	% v/v	0.02	0.02	0.02
CAL 1	Zero Adj. Span Drift	%	0.64	0.64	0.64
CAL 1	Drift Correction Applied	2-5%	No	No	No
	Allowable Span Drift	± %	5.00	5.00	5.00
	Span Drift Acceptable	-	Yes	Yes	Yes

Test Conditions	Units	Run 1	Run 2	Run 3
Run Ambient Temperature Range	°C	19 - 25	19 - 25	19 - 25

Method Deviations

Nature of Deviation (x = deviation applies to the associated run)	Run Number 1	2	3
There are no deviations associated with the sampling employed.	x	x	x

OXYGEN: MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1	RUN 2	RUN 3	Units
Limit value	N/A	N/A	N/A	%vol
Allowable MU	6.0	6.0	6.0	%
Measured concentration	9.79	9.83	10.09	%vol
Range Used	25.0	25.0	25.0	%vol
Cal gas conc.	21.1	21.1	21.1	%vol

Performance characteristics	RUN 1	RUN 2	RUN 3	Units
Response time	41	41	41	seconds
Number of readings in measurement	32	32	32	-
Repeatability at zero	0.02	0.02	0.02	% full scale
Repeatability at span level	0.02	0.02	0.02	% full scale
Deviation from linearity	0.07	0.07	0.07	% of value
Zero drift	0.82	0.82	0.82	% full scale
Span drift	-0.64	-0.64	-0.64	% full scale
Volume or pressure flow dependence	0.10	0.10	0.10	% of full scale
Atmospheric pressure dependence	0.19	0.19	0.19	% of value/kPa
Ambient temperature dependence	-0.21	-0.21	-0.21	% full scale/10K
Combined interference	0.00	0.00	0.00	% range
Dependence on voltage	0.02	0.02	0.02	% full scale/10V
Losses in the line (leak)	0.82	0.82	0.82	% of value
Uncertainty of calibration gas	2.00	2.00	2.00	% of value

Performance characteristic	RUN 1	RUN 2	RUN 3	Units
Standard deviation of repeatability at zero	use rep at span	use rep at span	use rep at span	%vol
Standard deviation of repeatability at span level	0.00	0.00	0.00	%vol
Lack of fit	0.01	0.01	0.01	%vol
Drift	0.00	0.00	0.00	%vol
Volume or pressure flow dependence	0.00	0.00	0.00	%vol
Atmospheric pressure dependence	0.01	0.01	0.01	%vol
Ambient temperature dependence	-0.03	-0.03	-0.03	%vol
Combined interference (from MCERTS Certificate)	0.00	0.00	0.00	%vol
Dependence on voltage	0.00	0.00	0.00	%vol
Losses in the line (leak)	0.05	0.05	0.05	%vol
Uncertainty of calibration gas	0.11	0.11	0.12	%vol

			RUN 1	RUN 2	RUN 3	Units
Measurement uncertainty		**Result**	9.79	9.83	10.09	%vol
Combined uncertainty			0.13	0.13	0.13	%vol
Expanded uncertainty	k =	1.96	0.25	0.25	0.26	%vol

	RUN 1	RUN 2	RUN 3	Units
Expanded uncertainty (no O_2) - at 95% Confidence	2.54	2.54	2.54	% of Value
Result of Compliance with Uncertainty Requirement	**COMPLIANT**	**COMPLIANT**	**COMPLIANT**	-

Requirement for SRM is that Uncertainty should be 0.3% vol absolute or 6% relative whichever is the lower, on a dry gas basis. Source, EN 14789.

Version Number	Record of changes made within this version of the document
V1	The original document issued to the client