

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 SGP¹ 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 03.08.21².

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 NO₂, 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 application³).

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 O₂ 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 response¹). These ELVs are discussed further below in Section 6.

Table 3: Emission Limit Values (ELVs) for Proposed New Combustion Unit¹ (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 O₂ 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 agreed⁴.

Further to our previous provision of additional information¹ 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 03.08.21¹

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 O₂ 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

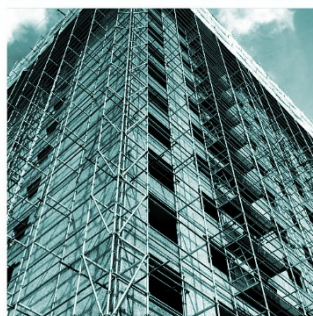
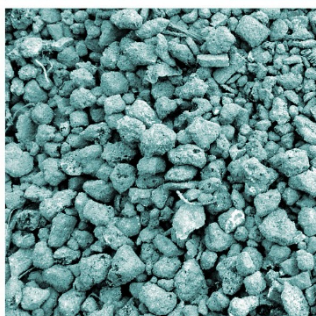
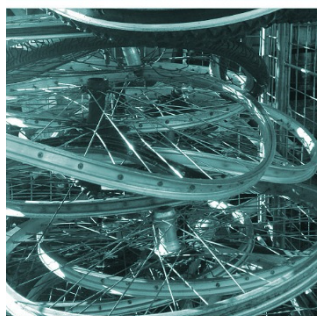
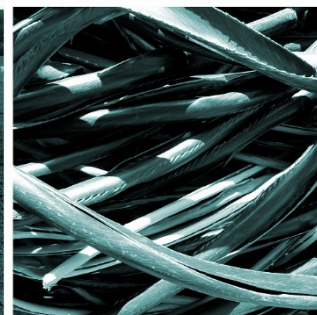
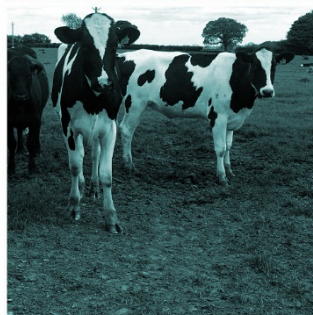
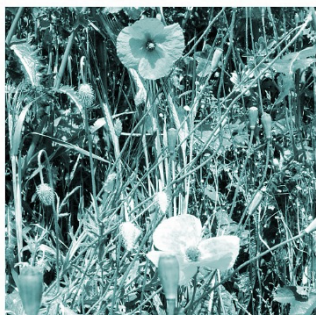
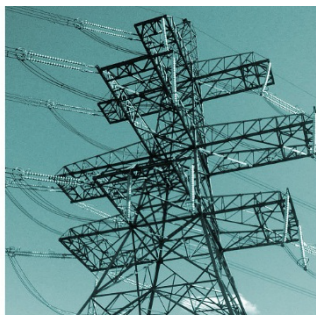
APPENDIX A

BAT Assessment

NEWBRIDGE ENERGY LIMITED PERMIT VARIATION

Measures to Demonstrate BAT

August 2021



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

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

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This report has been prepared by H&C Consultancy Ltd with all reasonable skill, care and diligence. It has been prepared in accordance with instructions from the Client and within the terms and conditions agreed with the Client. The report is based on information provided by the Client and our professional judgment at the time this report was prepared.

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Appendices

Appendix 1 - NBEP028 Feedstock Acceptance Procedures and Pre-Acceptance Procedures

Appendix 2 - SOP006 SOP for Fuel Blending and Application – NB1 (waste and non-waste)

Appendix 3 - SOP006a SOP for Fuel Blending and Application – NB4 (non-waste only)

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*

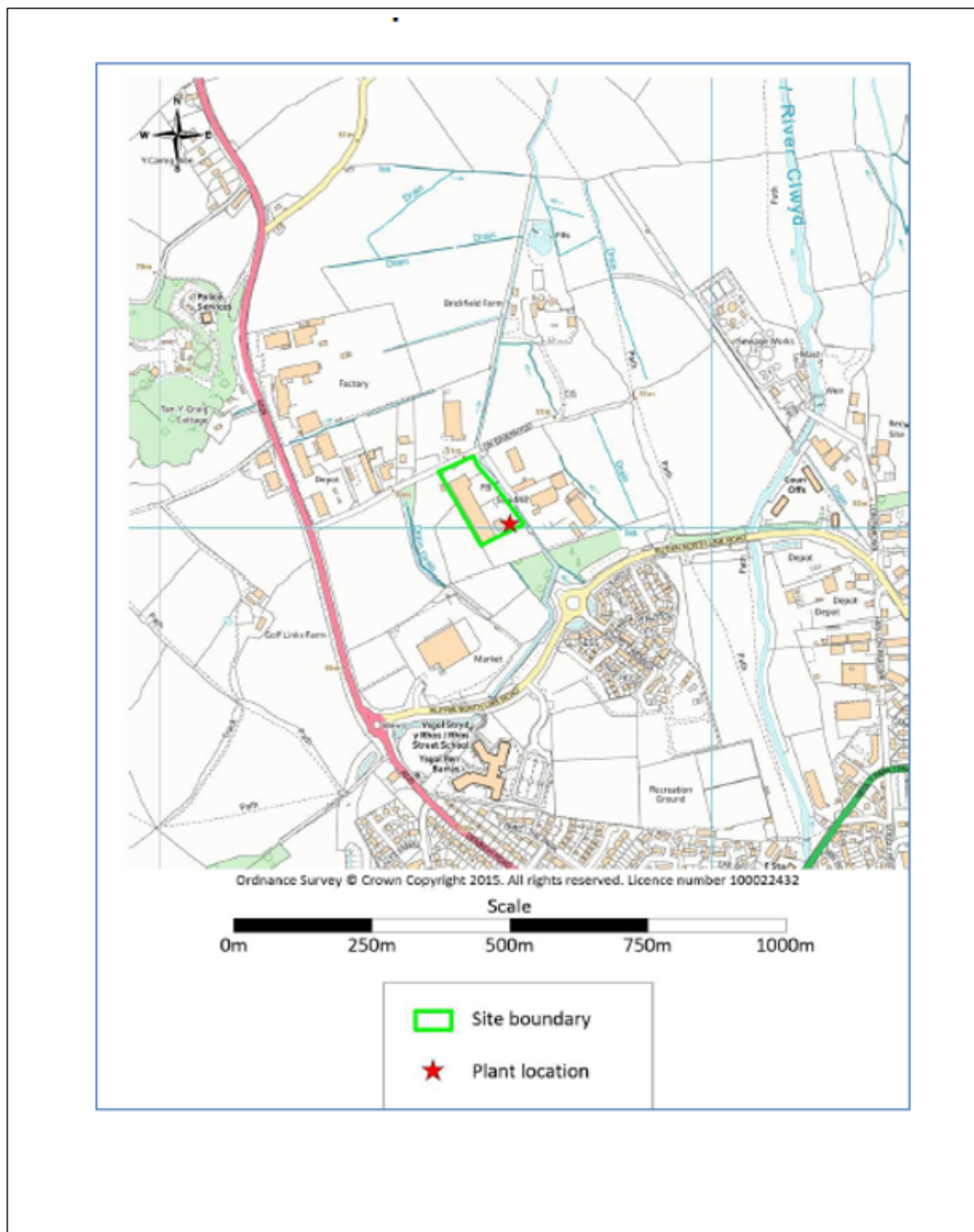
- 1.1.12. H&C Consultancy have been commissioned by the operator to provide a Best Available Techniques (BAT) assessment that will incorporate the data requested in the bullet points above, to be submitted by Smith Grant LLP on behalf of the operator in response to the formal request for additional information.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

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).



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NBEP038 Issue 1.0	Feedstock Acceptance, Pre-acceptance, and Rejection Procedure	
19.04.21		

Introduction

This procedure describes the process that will be followed for characterisation and assessments of the suitability of wastes prior to receipt on site. It outlines the measures for ongoing monitoring and maintenance of any pre-acceptance standards agreed.

This procedure also outlines the processes that will be followed during acceptance of pre-assessed wastes at the site, to ensure that they are handled in accordance with permit and legislative requirements, and in a manner which minimises potential negative impacts to the environment and incineration process.

Scope

This procedure applies to all potential wastes and non-waste material received at the Newbridge Energy Limited.

Procedure

Pre-Acceptance Assessment and Audit

Before a feedstock is accepted on site, a visit will be carried out to the site of production. This will allow an evaluation of the incoming material to ensure that the nature of the material is suitable for the biomass and factory production process, and that the process leading to its production and any associated risks are fully understood.

Only waste feedstocks laid out within Table S2.1 of the site permit will be accepted, as follows.

Table S2.1 Permitted waste types and quantities for the incineration of wood in a Sch1 Pt2 5.1 Part B

Maximum quantity	The total quantity of waste accepted at the site for the above activity shall be less than 26,280 tonnes a year.
Waste code	Description
02	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing
02 01	wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing
02 01 03	Plant tissue waste only
02 01 07	Waste from forestry, untreated wood only

If feedstocks are accepted that are not deemed to be wastes, the status of the material will be checked and established prior to acceptance at the site to ensure clarity of status.


Before acceptance, the following must also be checked

- Codes in the site permit
- Status of the material, waste, or non-waste
- Planning permission guidance
- RHI status

If the material (waste or non-waste) is found to meet the above criteria, then further analysis will be carried out to evaluate the suitability of the material. The following additional sample analysis will be carried out:

- Dry matter
- Moisture

All suppliers will enter a written agreement to provide material (waste and non-waste) to Newbridge Energy Limited. This agreement will outline the materials that can be taken on site, and the circumstances under which loads will be rejected.

NBEP038 Issue 1.0	Feedstock Acceptance, Pre-acceptance, and Rejection Procedure	
19.04.21		

It will outline the actions that will be taken should a load be rejected. The agreement will also specify any specific waste characteristic ranges which the feedstock must comply with such as fuel dimensions, contaminants, humidity range and density. Supply agreements will be reviewed on an annual basis at the senior management audit.

Incoming Material Acceptance Procedures

All loads accepted at the site will be checked by a member of staff to ensure that the load meets the agreed requirements, and that suitable paperwork is provided to accompany the load.

The operator is limited to storage of a maximum of 125t of waste wood on site at any one time. Wastes will only be accepted on site if these maximum tonnages will not be exceeded if the load is accepted, and that the waste can be stored in accordance with the standards laid out in this EMS.

A proportion of the loads will be subject to more detailed random waste checks. This will be carried out every 5 loads, or more frequently than this if loads from a given supplier have been found to be non-conforming in recent checks and more regular detailed monitoring is deemed necessary.

Any loads that are found to be contaminated or not in line with the acceptance criteria for the site will either be rejected at source prior to delivery to the plant or quarantined in a separate area at the site before being returned to the supplier.

A dry matter and moisture test is carried out on all material (waste and non-waste) delivered to site.

Contingency Arrangements

If any material cannot be processed through the plant, the supplier is able to divert feedstocks to alternative use/storage or to cancel receipt of loads.

Record Keeping and Reporting

An annual waste transfer note season ticket is issued to document the delivery waste material to the plant operator. This document is kept on file for a minimum of 6 years as required by section 4.1.1 of the permit.


The daily tonnages of waste feedstocks and non-waste material delivered to the site are recorded on the material in and material out sheet. This is saved on each site server file and must be updated daily for all loads in and out (non-waste and waste). Weighbridge tickets and waste transfer notes will be retained on site and stored in date order.

Rejected loads

Any rejected loads are recorded on rejected loads form, saved on the standard forms file on the server.

- Rejected loads will be quarantined in the clamp and segregated from other materials on site.
- The supplier will be contacted with immediate effect to arrange removal of the material
- Material will remain quarantined on site until the supplier attends
- All loads will be weighed out
- The weighbridge ticket will clearly state rejected load
- Both forms – rejected load form and the incident form will be completed
- All paperwork, original paperwork, pictures and outward-bound paperwork will be saved on the server file, environmental incidents.
- A waste transfer note will be completed by the site for the rejected load.

Any preventative and corrective measures identified as a result added to the record to allow any required actions to be tracked at management meetings, these will be reported to the board.

NBEP038 Issue 1.0	Feedstock Acceptance, Pre-acceptance, and Rejection Procedure	
19.04.21		

All incoming and outgoing wastes tonnages will be reported to the Environment Agency on a quarterly basis as required in section 4.2 of the site permit.

Standard Operating Procedure

Fuel Blending

1. Scope

- Taking of goods in.
- Mixing of the burning chip and biomass for fueling of the Uniconfort Biomass burner.
- To be performed by the JCB operators given the requirements of the burner.

2. Prerequisites

- Health and Safety Induction.
- Fire safety.
- Appropriate training on JCB.
- **PPE Required:** Boots, Long sleeves, Ear defenders, High-Vis, Dust Masks.

3. Health, Safety and Environmental

- Risk Assessment

People/Persons at Risk – Numbers at risk							
General				Specific - Vulnerability			
1. Employees/Staff	x	5. Customers	x	9. New & Expectant Mothers		13. Shift/Night Workers	
2. Co-Workers	x	6. Clients		10. Young Persons		14. Temporary/Volunteer Workers	
3. Public		7. Patients		11. Mobile Workers	x	15. Homeworkers	
4. Pupils/Students		8. Service Users/Residents		12. Disabled People		16. Visitors	x
Others:							

HAZARDS/RISKS											
Workplace				Work Equipment		Occupational Health				Specific Activities/Situations	
Structure	Access / Egress	x	Storage	Mechanical	x	Manual handling	x	Vibration		Working Alone	
Services	Housekeeping	x	Glazing	Lifting	x	Noise	x	Violence & Aggression		Working at Height	
Security	Welfare		Temperature	Electrical		Chemicals Agents		Stress		Confined Spaces	
Signage	Transport	x	Lighting	Pressure		Biological Agents		Dusts & Particles	x	Working near or over Water	
External Conditions	Space		Ventilation	Thermal		Radiation		Temp Extremes		Fieldwork	

	Fire & Explosion				Dangerous Substances	x	Animals		Hot Work	
OTHERS – SPECIFY:										

Control Measures

- All visitors and operatives are wearing high-vis clothing
- Visitors & drivers to be made aware of onsite-traffic Hearing protection must be worn where noise levels exceed 85db(A).
- Correct PPE including long-sleeve overalls and grip gloves to be worn
- Awareness of long-term skin exposure to dust and fines to be made aware to employees
- FFP3 dust masks for when dust is present in higher amounts, or entering the trailer
- Full-Face Masks only required when informed by manager
- The JCB windows and Doors must be shut at all times when moving chip.
- Ensure the chip has settled before moving.
- All deliveries to be received via reception or banksman
- Vehicles are fitted with reversing sensor alarms.
- Operators and drivers are required to wear high-vis clothing at all times.
- Trained banksmen to be used for all maneuvers.
- Operators to not approach the rear doors until the driver of the vehicle has stopped the engine.
- The driver is responsible for opening the rear doors of the delivered load.
- Operators should only follow when the driver has opened the door and the vehicle is at a complete stop.
- If chip is on a Curtain Side lorry, then it is the drivers responsibility to safely open the curtain and only once done so , unloading can begin.

Environmental Considerations

- Behind the wall of the Biomass and burning chip bays is a stream that runs alongside the site, please ensure that no biomass is allowed to fall over this wall as it could enter the stream.
- The Process chip bay has a brook that runs along the site that links to stream mentioned previously, no chip should be allowed to enter the brook.
- If any material that enters the site contains excessive levels of contaminants or is not consistent with the description of the load, please inform the on-shift production manager or SHEQ manager as this may need to be rejected.
- Any spills e.g. from the HGV, JCB or other vehicles is reported to the SHEQ manager.

4. Responsibilities







Role	Name	Sign	Date
Author			
Production	Steve Davies		
Health & Safety			

Key Personnel

- Office Assistant

- Banksman
- JCB Driver
- On-shift Production Manager

5. Document key

	Quality check
	Visual check
	Second operator
	Health and safety warning
	Wait time
	Operator maintenance

1. When the HGV approaches site, it will drive onto the weighbridge (Figure 1). The office assistant will weigh the incoming goods once given the tare weight by the driver. The office assistant will also assess the paperwork in accordance with the waste acceptance procedure.



Figure 1 – Weighbridge Location

2. The driver will be guided off the weighbridge by a banksman who will then also direct where the driver is to go to deposit product. The location of where the load is then placed is to be noted and corroborated with the weighbridge paperwork for stock control purposes.

3. The locations of the various bays at which product must be stored are as follows:
- a. Biomass – Front of site (Figure 2) (to be used as fuel for CHP boiler **only**)
 - b. Burning Chip – Front of site (Figure 2) (to be used as fuel for CHP boiler **only**)
 - c. Process Chip – Rear of site (Figure 3)

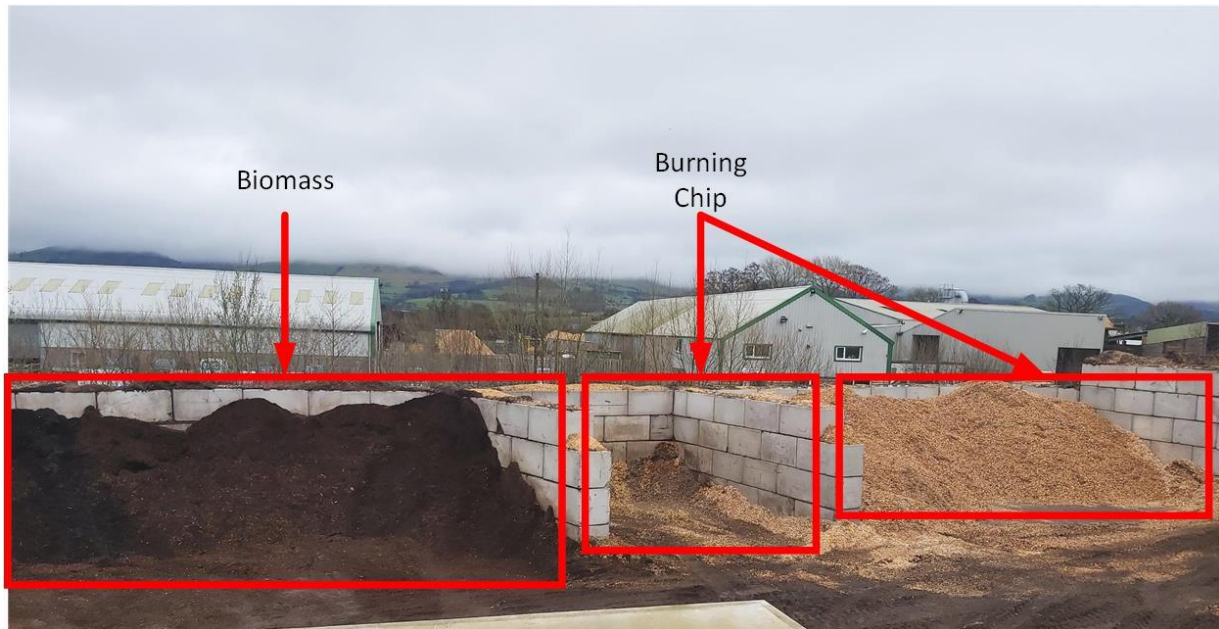


Figure 2 – Biomass and Burning Chip Locations



Figure 3 – Process Chip Location

4. Ensure that after unloading all product is moved into the bays to ensure the road through the site is clear as shown in Figure 2 and Figure 3.

5. To start creating the mix remove one full bucket from the burning chip bay or biomass bay as required, shown in in a 3 : 1 ratio of virgin woodchip to arboricultural residue biomass.



Figure 4

6. Drop the contents of the bucket as a uniform layer within the undercover mixing bay.



Figure 5

7. Repeat step 5 depending on the mix required as dictated by the on-shift production manager and lay each bucket's contents on top of the previous in a uniform layer (for a 3:1 Chip to Biomass mix, this indicates 3 buckets of burning chip for every one biomass bucket deposited in the mixing bay).



Figure 6

8. Using the bucket of the JCB, from the bottom of the pile of chip/biomass lift a bucket of the semi-mixed fuel and re-lay in a uniform layer within the mixing bay.



Figure 7

9. Repeat step 8 a minimum of 5 times to ensure full mixing. More repetitions may be required, the JCB driver is to assess the consistency of the mix and repeat as necessary.



Figure 8

10. Arrange within mixing bay as required or deposit on the the correct walking floor as required. The walking floor bunker for NB4 (not currently operational) is the mixing bay. The mixed material awaiting burning will be retained in this bay until the levels of misture are in accordance with the process requirements.



Figure 9

11. Once the daily fuel mix has been correctly blended within the mixing bay, the coning and quartering technique will be used to create a 1kg representative sample. This will be placed in a sealed plastic bag and labelled with the date and taken to Newbridge Energy compliance manager for storage.
12. In the event the boiler is restarted following a period of shut down, only the virgin chip / hacker material will be used to restart the engine. The system will operate on this material until the boiler attains full operating temperature.
13. Once the operating temperature is reached the 3:1 ratio, (3 chip / hacker : 1 biomass) can be fed into the boiler.

Standard Operating Procedure

Fuel Blending – non waste

1. Scope

- Taking of goods in.
- Mixing of the burning chip and biomass for fueling of the Uniconfort Biomass burner.
- To be performed by the JCB operators given the requirements of the burner.

2. Prerequisites

- Health and Safety Induction.
- Fire safety.
- Appropriate training on JCB.
- **PPE Required:** Boots, Long sleeves, Ear defenders, High-Vis, Dust Masks.

3. Health, Safety and Environmental

- Risk Assessment

People/Persons at Risk – Numbers at risk							
General				Specific - Vulnerability			
1. Employees/Staff	x	5. Customers	x	9. New & Expectant Mothers		13. Shift/Night Workers	
2. Co-Workers	x	6. Clients		10. Young Persons		14. Temporary/Volunteer Workers	
3. Public		7. Patients		11. Mobile Workers	x	15. Homeworkers	
4. Pupils/Students		8. Service Users/Residents		12. Disabled People		16. Visitors	x
Others:							

HAZARDS/RISKS											
Workplace				Work Equipment		Occupational Health				Specific Activities/Situations	
Structure	Access / Egress	x	Storage	Mechanical	x	Manual handling	x	Vibration		Working Alone	
Services	Housekeeping	x	Glazing	Lifting	x	Noise	x	Violence & Aggression		Working at Height	
Security	Welfare		Temperature	Electrical		Chemicals Agents		Stress		Confined Spaces	
Signage	Transport	x	Lighting	Pressure		Biological Agents		Dusts & Particles	x	Working near or over Water	
External Conditions	Space		Ventilation	Thermal		Radiation		Temp Extremes		Fieldwork	

	Fire & Explosion				Dangerous Substances	x	Animals		Hot Work	
OTHERS – SPECIFY:										

Control Measures

- All visitors and operatives are wearing high-vis clothing
- Visitors & drivers to be made aware of onsite-traffic Hearing protection must be worn where noise levels exceed 85db(A).
- Correct PPE including long-sleeve overalls and grip gloves to be worn.
- Awareness of long-term skin exposure to dust and fines to be made aware to employees.
- FFP3 dust masks for when dust is present in higher amounts, or entering the trailer.
- Full-Face Masks only required when informed by manager.
- The JCB windows and Doors must be shut at all times when moving chip.
- Ensure the chip has settled before moving.
- All deliveries to be received via reception or banksman.
- Vehicles are fitted with reversing sensor alarms.
- Operators and drivers are required to wear high-vis clothing at all times.
- Trained banksmen to be used for all maneuvers.
- Operators to not approach the rear doors until the driver of the vehicle has stopped the engine.
- The driver is responsible for opening the rear doors of the delivered load.
- Operators should only follow when the driver has opened the door and the vehicle is at a complete stop.
- If chip is on a Curtain Side lorry, then it is the drivers responsibility to safely open the curtain and only once done so , unloading can begin.

Environmental Considerations

- Behind the wall of the Biomass and burning chip bays is a stream that runs alongside the site, please ensure that no biomass is allowed to fall over this wall as it could enter the stream.
- The Process chip bay has a brook that runs along the site that links to stream mentioned previously, no chip should be allowed to enter the brook.
- If any material that enters the site contains excessive levels of contaminants or is not consistent with the description of the load, please inform the on-shift production manager or SHEQ manager as this may need to be rejected.
- Any spills e.g. from the HGV, JCB or other vehicles is reported to the SHEQ manager.

4. Responsibilities







Role	Name	Sign	Date
Author			
Production	Steve Davies		
Health & Safety			

Key Personnel

- Office Assistant

- Banksman
- JCB Driver
- On-shift Production Manager

5. Document key

	Quality check
	Visual check
	Second operator
	Health and safety warning
	Wait time
	Operator maintenance

1. When the HGV approaches site, it will drive onto the weighbridge (Figure 1). The office assistant will weigh the incoming goods once given the tare weight by the driver. The office assistant will also assess the paperwork in accordance with the waste acceptance procedure in terms of waste and non waste status.



Figure 1 – Weighbridge Location

2. The driver will be guided off the weighbridge by a banksman who will then also direct where the driver is to go to the deposit product. The location of where the load is then placed is to be noted and corroborated with the weighbridge paperwork for stock control purposes.

3. The locations of the various bays at which product must be stored are as follows:
- Biomass (waste) – Front of site (Figure 2) (to be used as fuel for CHP boiler **only**)
 - Burning Chip (non waste)– Front of site (Figure 2) (to be used as fuel for CHP boiler **only**)
 - Process Chip (non waste) – Rear of site (Figure 3) (boiler and production)

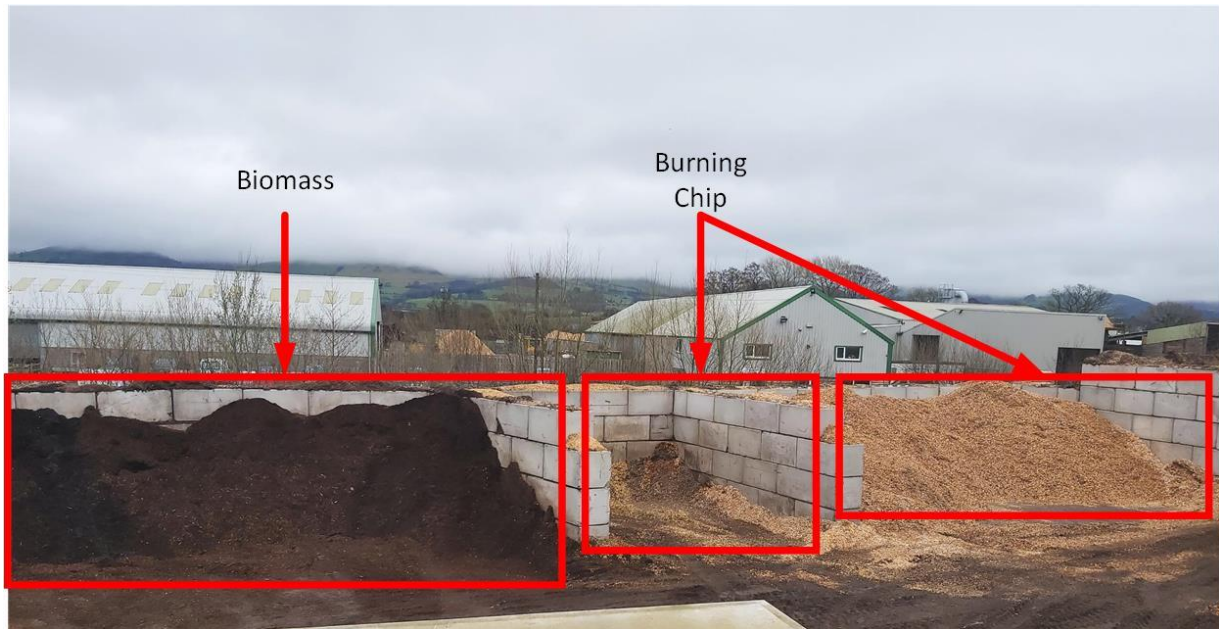


Figure 2 – Biomass and Burning Chip Locations



Figure 3 – Process Chip Location

4. Ensure that after unloading all product is moved into the bays to ensure the road through the site is clear as shown in Figure 2 and Figure 3.
5. To start creating the mix remove only the non waste burning chip and process chip. The material need to be layered and mixed in the feeding hopper area.
6. Repeat step 5 depending on the mix of non waste materail required as dictated by the on-shift production manager and lay each bucket's contents on top of the previous in a uniform layer.



Figure 4

APPENDIX B

Additional Monitoring Data



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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



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APPENDIX 1 - Monitoring Personnel & List of Equipment

APPENDIX 2 - Raw Data, Sampling Equations & Charts

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Executive Summary

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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 NO₂)

Executive Summary

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MONITORING RESULTS

Newbridge Energy Ltd, Ruthin

Biomass CHP Plant Exhaust

3rd August 2021

where MU = Measurement Uncertainty associated with the Result

Parameter	Concentration				Mass Emission			
	Units	Result	MU +/-	Limit	Units	Result	MU +/-	Limit
Total Particulate Matter ¹	mg/m ³	20.9	2.0	30	g/hr	175	31	-
Oxides of Nitrogen (as NO ₂) ¹	mg/m ³	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)	m ³ /hr	22574	3441					
Volumetric Flow Rate (REF) ¹	m ³ /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

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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/m ³	19.3	g/hr	161	03/08/2021	12:06 - 12:38	32
Total Particulate Matter	R2	mg/m ³	19.7	g/hr	164	03/08/2021	12:45 - 13:17	32
Total Particulate Matter	R3	mg/m ³	23.8	g/hr	199	03/08/2021	13:25 - 13:57	32
Oxides of Nitrogen (as NO ₂)	R1	mg/m ³	290	g/hr	2419	03/08/2021	12:06 - 12:38	32
Oxides of Nitrogen (as NO ₂)	R2	mg/m ³	283	g/hr	2366	03/08/2021	12:45 - 13:17	32
Oxides of Nitrogen (as NO ₂)	R3	mg/m ³	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.

Executive Summary

(Page 4 of 7)

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

Parameter	Monitoring				Analysis				Overall Status	LOD (Average)
	Standard	Technical Procedure	Sampling Status	Testing Lab	Analytical Procedure	Analytical Technique	Analysis Status	Analysis Lab		
Total Particulate Matter	EN 13284-1	CAT-TP-01	MCERTS	EET	CAT-TP-03	Gravimetric	MCERTS	EET	MCERTS	0.48 mg/m ³
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/m ³
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

Executive Summary

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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

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PLANT PHOTOS

Photo 1



Photo 2



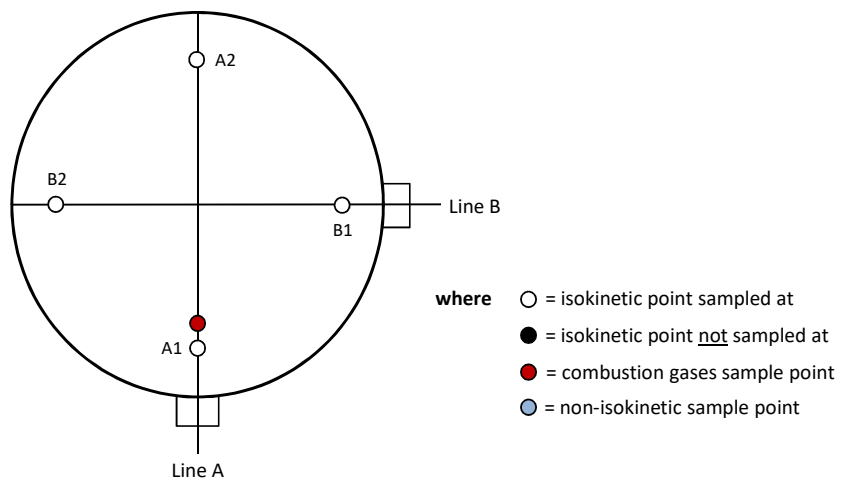
Photo 3



Photo 4



SAMPLE POINTS



APPENDICES

APPENDIX CONTENTS

APPENDIX 1 - Stack Emissions Monitoring Personnel, List of Equipment & Methods and Technical Procedures Used

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

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		Instrumental Analysers		Miscellaneous Items	
Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.
Control Box DGM (1)	CAT 7.5	Horiba PG-350E	CAT 39.29	Digital Manometer (1)	CAT 3.124
Control Box DGM (2)	-	Horiba PG-250 SRM	-	Digital Manometer (2)	CAT 3.125
Box Thermocouples (1)	CAT 4.96	Servomex 4900	-	Digital Temperature Meter	-
Box Thermocouples (2)	CAT 4.97	Eco Physics CLD 822Mh	-	Stopwatch	CAT 14.25
Umbilical (1)	CAT 3.12	ABB AO2020-URAS26	-	Barometer	CAT 13.29
Umbilical (2)	-	Testo 350 XL	-	Stack Thermocouple (1)	-
Oven Box (1)	CAT 12.36	JCT JCC P1 Cooler	CAT 4.0030	Stack Thermocouple (2)	-
Oven Box (2)	-	Gasmet DX4000	-	Stack Thermocouple (3)	CAT 4.00099
Heated Probe (1)	-	Gasmet Sampling System	-	1m Heated Line (1)	-
Heated Probe (2)	CAT 5.19	Bernath 3006 FID	-	1m Heated Line (2)	-
Heated Probe (3)	-	M&C PSS	CAT 12.139	1m Heated Line (3)	-
S-Pitot (1)	-	Mass Flow Controller (1)	CAT 6.19	5m Heated Line (1)	-
S-Pitot (2)	CAT 21P.126	Mass Flow Controller (2)	CAT 6.20	15m Heated Line (1)	-
L-Pitot	CAT 21L.29	Mass View (1)	-	20m Heated Line (1)	CAT 20.170
Site Balance	CAT 17.20	Mass View (2)	-	20m Heated Line (2)	-
500g / 1Kg Check Weights	CAT 17.20	Hioki 5043 (V)	-	Dual Channel Heater Controller	CAT 3.18
Last Impinger Arm	-	Easylogger EN-EL-12 Bit	-	Single Channel Heater Controller	-
Callipers	CAT 23.7	Bioaerosols Temperature Logger	-	Laboratory Balance	CAT 1.18, 1.18a, 1.18b
Tubes Kit Thermocouple	-	Electronic Refrigerator	-	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 ₂ O	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/m ³ p	Conc kg/m ³ 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 ₂ O)	-	-	13.07	0.1307	18.02	0.8037	0.10501

Where: $p = M / 22.41$

$p_i = r \times p$

Calculation of Stack Gas Densities

Determinand	Units	Result
Dry Density (STP), P _{STD}	kg/m ³	1.339
Wet Density (STP), P _{STW}	kg/m ³	1.269
Dry Density (Actual), P _{Actual}	kg/m ³	0.774
Average Wet Density (Actual), P _{ActualW}	kg/m ³	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} x (T_s / P_s) x (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)	m ³ /hr	23004
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	13305
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	11567
Gas Volumetric Flowrate REF ¹	m ³ /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 ₂ O	Temp °C	Wet Density kg/m ³	Velocity m/s	Swirl °	ΔP mmH ₂ O	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	$u(\Delta p_i)$	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	$u(C_f)$	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	$u(\phi_{O_2,d})$	0.303	
- Carbon Dioxide, dry	$u(\phi_{CO_2,d})$	0.306	
- Water Vapour	$u(\phi_{H_2O})$	0.667	
- Oxygen, wet	$u(\phi_{O_2,w})$	0.272	
- Carbon Dioxide, wet	$u(\phi_{CO_2,w})$	0.274	
Standard uncertainty associated with the stack temperature	$u(T_c)$	2.411	K
Standard uncertainty associated with the absolute pressure in the duct	$u(p_c)$	175.697	Pa
- Atmospheric Pressure	$u(p_{atm})$	175.692	
- Static Pressure	$u(p_{stat})$	1.318	
Standard uncertainty associated with the density in the duct	$u(\rho)$	0.00395	-
Standard uncertainty associated with the local velocities	$u(v_i)$	1.592	Pa
Standard uncertainty associated with the mean velocity	$u(\bar{v})$	0.798	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	$U_c(v)$	1.564	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	$U_{c,rel}(v)$	14.56	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	$U_c(qV,w)$	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	$U_{c,rel}(qV,w)$	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/m ³	19.3	19.7	23.8	20.9
Uncertainty	±mg/m ³	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/m ³	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 ₂ O	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 ₂ O	36.0	32.8	31.0	
V _{mstd} = ((0.3592)(V _m)(P _b + (ΔH/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, R _{wv}	% 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%O₂} & V_{mstw@X%O₂}					
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 ₂ O	6.60	5.90	5.58	
Average square root of velocity heads, √ΔP	√mmH ₂ O	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)(√ΔP)(T _s + 273)) / (√(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_{stwO₂}), Dry@O_{2REF} (Q_{stdO₂})					
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 _{stwO₂} = ((Q _a)(P _s)(C _f)) / ((T _s + 273) / (O _{2REFw}))	m ³ /min	188.6	178.4	169.5	
Q _{stdO₂} = ((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 ⁹)(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

(PAGE 1 OF 2)

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/m ³	0.89	0.97	1.04	
ELV [Daily ELV for IED]	mg/m ³	30.00	30.00	30.00	
Allowable Weighing Uncertainty	mg/m ³	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

(PAGE 2 OF 2)

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	Run Number			
	1	2	3	
(x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)				
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

Measured Quantities	Value				Standard uncertainty				
	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	p _m	101.4	101.4	101.4	up _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	-	-	-

Measured Quantities	Uncertainty as a Percentage				Requirement of Standard
	Units	Run 1	Run 2	Run 3	
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	%	-	-	-	-

Measured Quantities	Uncertainty in Measurement Units					Sensitivity Coefficient		
	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

Measured Quantities	Uncertainty in Result			
	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

Measured Quantities	Oxygen Correction Part of MU Budget			
	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 NO₂): RESULTS SUMMARY

Newbridge Energy Ltd, Ruthin
Biomass CHP Plant Exhaust

Sample Runs

Parameter	Units	Run 1	Run 2	Run 3	Mean
Concentration	mg/m ³	290	283	291	288
Uncertainty	±mg/m ³	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
Span Gas Uncertainty (%)	2
Zero Gas Type	Nitrogen (5 Grade)
Number of Sampling Lines Used	1 / 1
Number of Sampling Points Used	1 / 1
Sample Point I.D.'s	A1

NOTE: Dilution performed to achieve correct span value

FORMAT: Number Used / Number Required

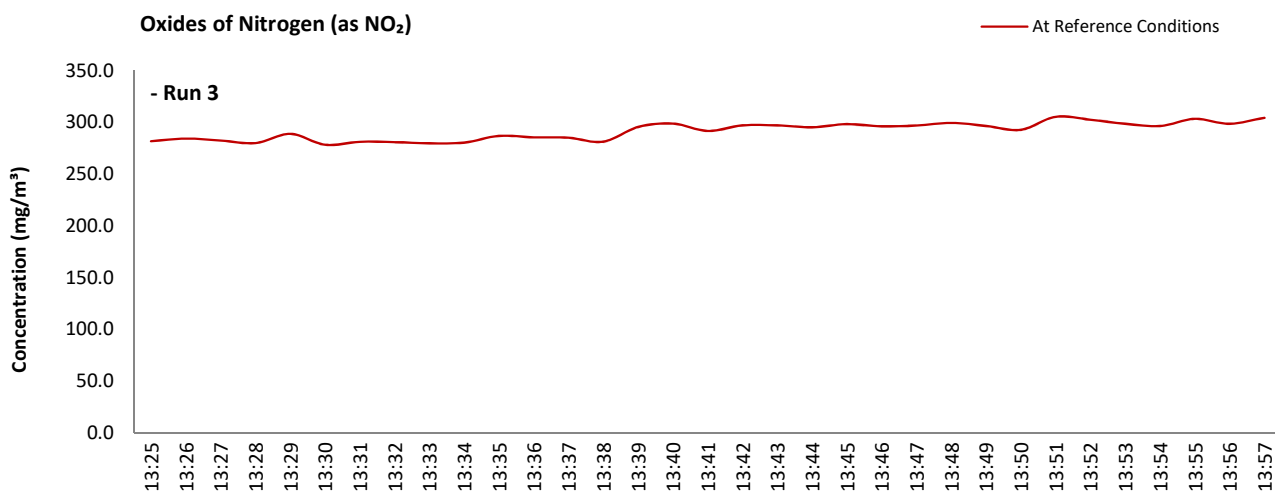
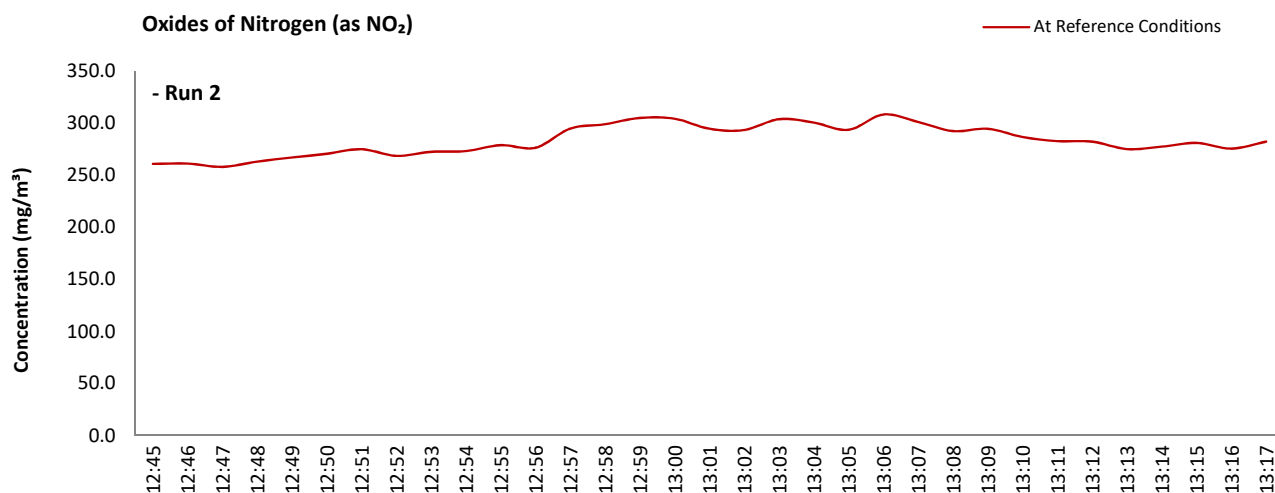
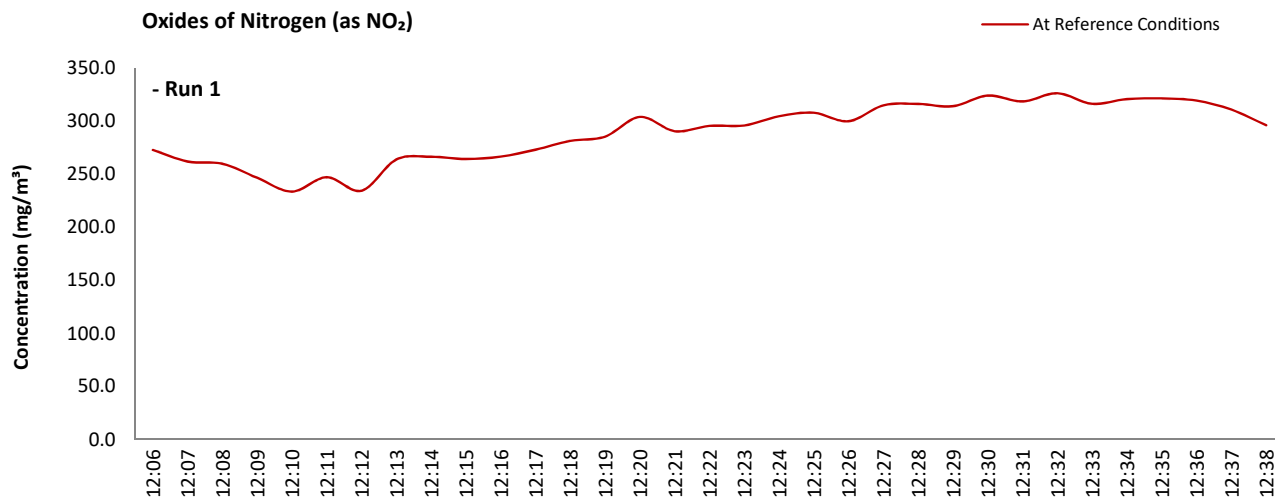
FORMAT: Number Used / Number Required

Reference Conditions

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

OXIDES OF NITROGEN (as NO₂): DATA TREND

Graphical Trend of Data



APPENDIX 2

OXIDES OF NITROGEN (as NO₂): 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
Zero at Analyser (Pre)	ppm	0.00	0.00	0.00
Zero at Analyser (Post)	ppm	0.00	0.00	0.00
Zero Drift	ppm	0.00	0.00	0.00
Zero Drift	%	0.00	0.00	0.00
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
Span at Analyser (Pre)	ppm	146.00	146.00	146.00
Span at Analyser (Post)	ppm	143.9	143.90	143.90
Span Drift	ppm	-2.10	-2.10	-2.10
Zero Adj. Span Drift	%	1.44	1.44	1.44
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 NO₂): MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1	RUN 2	RUN 3	Units
Limit value	300.0	300.0	300.0	mg/m ³ (REF)
Allowable MU	10.0	10.0	10.0	%
Measured concentration	216.40	210.99	211.99	mg/m ³ (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/m ³
Cal gas conc.	146.2	146.2	146.2	ppm
Conversion	2.05	2.05	2.05	ppm to mg/m ³
MCERTS Range [B]	205.0	205.0	205.0	mg/m ³
Lower of [A] or [B]	205.0	205.0	205.0	mg/m ³
Cal gas conc.	300.0	300.0	300.0	mg/m ³

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

Measurement uncertainty	Result	RUN 1	RUN 2	RUN 3	Units
Combined uncertainty		216.40	210.99	211.99	mg/m ³
Expanded uncertainty	k = 1.96	3.64	3.56	3.57	mg/m ³
Uncertainty corrected to std conds. (O ₂)		7.14	6.98	7.01	mg/m ³
		9.55	9.37	9.63	mg/m ³ (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 O₂ correction is applied less than 10% + the uncertainty associated with the O₂ correction (using sqrt of sum squares to add uncertainty components).

APPENDIX 2

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
Span Gas Uncertainty (%)	2
Zero Gas Type	Nitrogen (5 Grade)
Number of Sampling Lines Used	1 / 1
Number of Sampling Points Used	1 / 1
Sample Point I.D.'s	A1

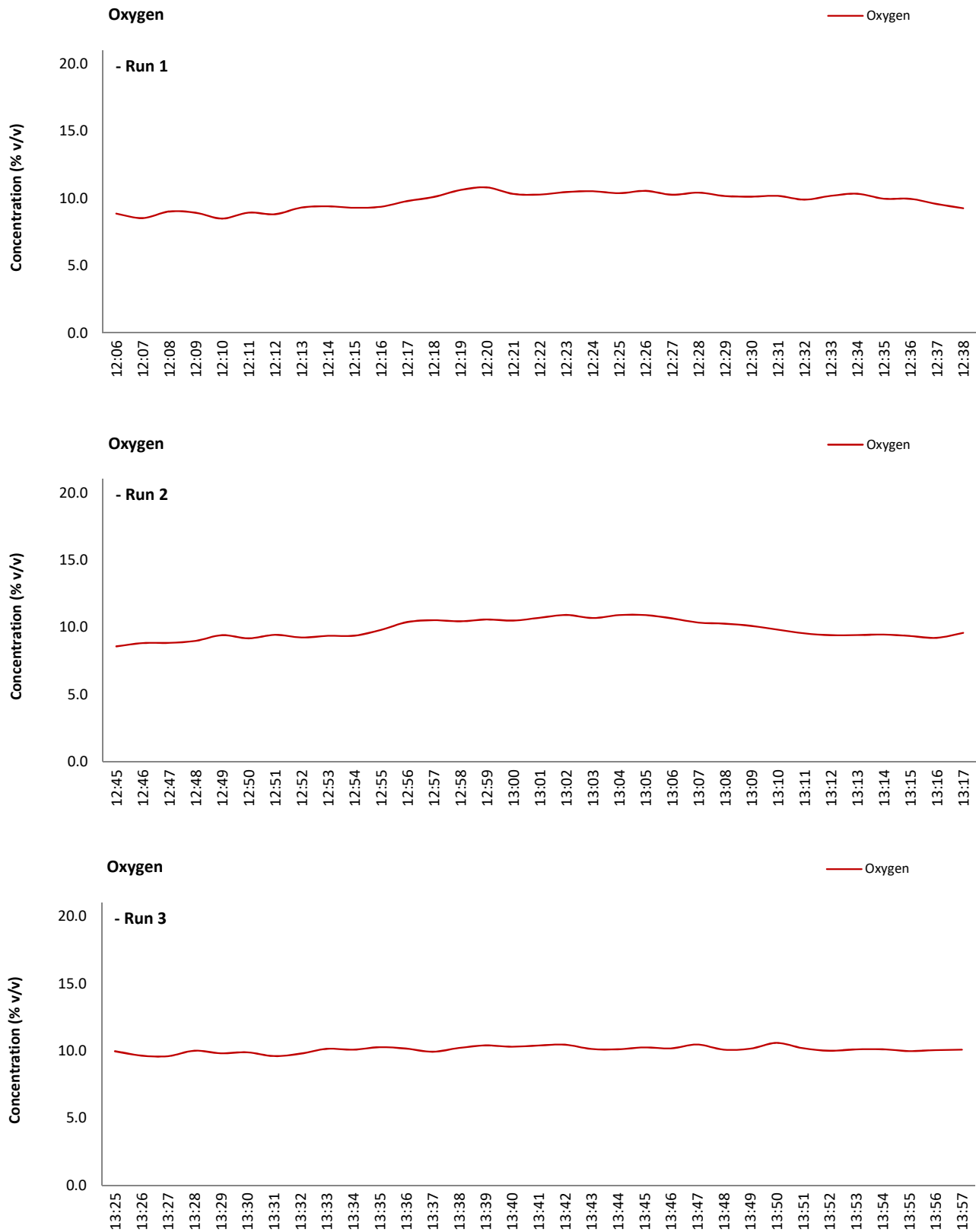
NOTE: Dilution performed to achieve correct span value

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

OXYGEN: DATA TREND

Graphical Trend of Data



APPENDIX 2

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
Zero at Analyser (Pre)	% v/v	0.00	0.00	0.00
Zero at Analyser (Post)	% v/v	0.09	0.09	0.09
Zero Drift	% v/v	0.09	0.09	0.09
Zero Drift	%	0.82	0.82	0.82
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
Span at Analyser (Pre)	% v/v	10.99	10.99	10.99
Span at Analyser (Post)	% v/v	11.01	11.01	11.01
Span Drift	% v/v	0.02	0.02	0.02
Zero Adj. Span Drift	%	0.64	0.64	0.64
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