

BIOMASS BOILER PART B PERMIT APPLICATION SUPPORTING INFORMATION

Ash Heat and Power Limited

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Waste, Planning & Environmental Consultants



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1 Introduction

1.1 Overview

1.1.1 This document contains supporting information which accompanies the Environmental Permit application being submitted by Ash Heat and Power Limited for the proposed operation of two biomass boilers at Redwither Road, Wrexham Industrial Estate, Wrexham. This application has been completed on behalf of Ash Heat and Power Limited by Oaktree Environmental Ltd.

1.1.2 The application is for the operation of a biomass boiler installation, to include two boilers. The boilers will be fuelled by Grade A waste wood, and each have an operational capacity of 425kg.hour⁻¹, generating up to 1000KW of renewable heating for use on site. As the capacity of each of the biomass boiler exceeds 50kg.hour⁻¹, an Environmental Permit is required. The process will be regulated under Part 2, Chapter 5, Section 5.1 Part B(a)(v) of the Environmental Permitting (England and Wales) Regulations 2010 (as amended) (“the regulations”), which is defined as follows:

“(a) The incineration in a small waste incineration plant with an aggregate capacity of 50 kilogrammes or more per hour of the following waste –

(v) wood waste with the exception of wood waste which may contain halogenated organic compounds or heavy metals as a result of treatment with wood preservatives or coatings”

1.1.3 Reference should be made to Appendix I for the proposed site infrastructure plan and proposed permit boundary plan.

1.2 Details of Site Operator

1.2.1 This permit is being applied for by ASH Heat and Power Limited.

1.3 Documents Consulted

1.3.1 The following guidance documents have been consulted for the purpose of completing this supporting document:

- Process Guidance Note 1/12(13): Statutory Guidance for Combustion of Waste Wood, Department for Environment, Food and Rural Affairs (DEFRA), Revised July 2013.

2 Planning Consents

- 2.1 Although planning consent is required for the proposed use of the land and operations, planning consent is not required to be in place for the permit to be issued. A planning application has been submitted to Wrexham County Borough Council for the biomass boilers. A copy of the planning consent will be included within Appendix II for reference upon issue.

3 Description of Process

3.1 Overview

- 3.1.1 Reference should be made to the drawings within Appendix I for site location and layout drawings. The location of the two boilers and adjacent fuel store is shown on the infrastructure plan (drawing no. 1622B023 - SL). The area which is the subject of this Environmental Permit application is outlined in red on drawing No. 3557/426/02. The Environmental Permit is required for the operation of a biomass boiler fuelled by Grade A waste wood.
- 3.1.2 Reference should be made to the infrastructure plan in Appendix I for the layout of operations. Reference should be made to document ref: 3557/426-A for a copy of the Environmental Management System (EMS) which details procedures to minimise risk of air pollution to assist with compliance with the permit.

3.2 Site Operations

- 3.2.1 Reference should be made to Appendix I for a site infrastructure plan. The site will contain the following infrastructure:
- 1000KW biomass boiler x2;
 - Walking floor loader/fuel storage area; and,
 - Elevated flues.

3.3 Boiler Feedstock

- 3.3.1 In addition to virgin wood/biomass, the wood to be used in the boilers includes Grade A waste wood, which is essentially clean, uncontaminated waste wood. Grade A waste wood was described in a previous WRAP report¹ as 'clean recycled wood', typically used as a fuel in non Waste Incineration Directive (WID) (now IED)

¹ The Business Case for Wood Waste Collection Hubs, WRAP, 2012

installations. Typical non-wood content prior to processing is described as nails and some fixings and minor amounts of paint and surface coatings.

3.4 Wood Sources

- 3.4.1 The Grade A waste wood will be sourced from a combination of source segregated waste streams and mixed waste collections. The site will visually inspect incoming loads to ensure that only appropriate wood fuel will be used in the boilers.

3.5 Wood Fuel Storage

- 3.5.1 The wood will be transferred and unloaded to the buffer wood storage area adjacent to the boilers.

3.6 Boiler Operation

- 3.6.1 The boilers to be used are 1000KW Binder RRK1000 Boilers. Drawings of the boiler configuration are contained within Appendix III. Wood is to be transferred to a walking floor fuel feed system by rubber wheeled shovel. Wood is loaded via continuous feed to each boiler at a rate of 425kg.hour⁻¹, generating up to 2000KW (total) of renewable heat for use on-site. Exhaust emissions from the boilers are to be released via elevated flues. The flue height has been demonstrated to be acceptable, as indicated by the completed DEFRA biomass calculator tool included in Appendix IV.

3.7 Plant and Machinery

- 3.7.1 In addition to the boilers and walking floor loader, the following plant and machinery will be used:
- Loading shovel;
 - Hook Loader Heavy Goods Vehicles (HGVs).
- 3.7.2 Processed Grade A wood will be transferred from the wood storage and processing yard to the biomass boiler fuel store via Hook Loader HGVs.

4 Potential Atmospheric Emissions and Control

4.1 Emission Sources

4.1.1 The main potential sources of air emissions have been identified as follows:

- Residual emissions from flues serving the two boilers; and,
- Fugitive dust from handling and storage of wood.

4.1.2 The two flue locations (A1 and A2) are shown on the site infrastructure plan in Appendix I.

4.2 Flue Emissions

4.2.1 Table 1 below contains an outline of the emission limits that will apply to each boiler, which are based upon the relevant sector guidance.²

Table 1 Boiler Emission Limits

Pollutant	Emission Limits (mg.m ⁻³) Expressed at Reference Conditions of 11% O ₂ , 273K, no correction for moisture
Carbon Monoxide (CO)	150
Total Particulate Matter (TPM)	60
Nitrogen Oxides (NO _x)	400
Organic Compounds	20

4.2.2 The following abatement methods will be used to control emissions from the biomass boilers:

- **Exhaust Cyclone (ZA)** - this device acts as a centrifuge, and is used to clean the exhaust gases before leaving the boiler. The exhaust gas is forced downwards past a series of swirl vanes which results in the gases rotating and changing velocity. This action causes suspended particles in the exhaust gases to fall from the air stream and be deposited in the container below the cyclone. The

² Process Guidance Note 1/12(13): Statutory Guidance for Combustion of Waste Wood, Department for Environment, Food and Rural Affairs (DEFRA), Revised.

clean exhaust gases then exit the boiler upwards through the centre of the cyclone;

- **High Velocity Air Cleaning (HVA)** - during regular automated cleaning cycles, exhaust gases from the boiler are re-circulated at high velocity through the boiler heat exchanger. This displaces any fly ash which may have built up on the heat exchanger tubes, and deposits these into the ash collection vessel. This will avoid these deposits becoming airborne during normal boiler operation. The boiler can continue firing under normal operation during a HVA cycle;
- **Exhaust Gas Recirculation (EGR)** The combustion chamber temperature is monitored, and where necessary exhaust gas recirculation is invoked to prevent the combustion chamber exceeding a temperature threshold. During EGR operation, exhaust gas containing depleted levels of O₂ is reintroduced into the boiler fresh air intake. The mixture of fresh air and exhaust air is modulated by the boiler to maintain an appropriate mixture. These gases contain less available oxygen, and therefore promote a less fierce combustion. Additionally due to the low O₂, a greater quantity of combustion air can be passed through the boiler providing a cooling effect. This has the net effect that the boiler can continue to provide normal output at a reduced combustion chamber temperature. By maintaining the combustion chamber at a reduced temperature, there is less thermal NO_x produced by the boiler. Thermal NO_x is the result of nitrogen naturally present in the air reacting to form nitrous oxides (NO_x) This process is greatly increased under high temperatures; and,
- **O₂ trim** - the boilers have continuous residual oxygen monitoring. The boilers will automatically adjust the fuel feeding and air throughputs in order to provide the optimum air-to-fuel ratio (AFR). This ensures a clean burn with highest efficiency and low carbon monoxide production.

4.2.3 In addition to the physical abatement methods used, regular servicing and preventative maintenance will be undertaken on the boilers to maintain efficient boiler operation. The boiler will be serviced every 2400 hours of full load operation with interim services every 800 hours

4.3 Fugitive Dust Emission

4.3.1 There is potential for dust emission to arise as a result of the proposed activities, as follows:

- Fugitive dust emission from HGVs/machinery transferring processed Grade A wood to the biomass boiler wood store; and,
- Fugitive dust from wood storage area.

4.3.2 A series of dust mitigation measures will be implemented on site to ensure dust emissions are controlled as far as is practically possible. The measures include:

- Sheeting of vehicles delivering materials to the site (if necessary);
- sheeting of vehicles transporting potentially dusty loads off site;
- Cleaning of any spillages using wet cleaning methods; and,
- Drop heights minimised to prevent dust emissions.

4.3.3 Any spillages will be cleaned using wet cleaning methods. The boiler room and fuel store is enclosed to minimise risk of fugitive dust emission.

5 Emissions Monitoring

5.1 Boiler Flue Emissions Monitoring

- 5.1.1 Excess air will be continuously monitored and controlled by means of a Lamda probe and control system. Boiler emissions will be monitored using an approved method on an annual basis.
- 5.1.2 Given that the boilers will be fuelled by a consistent type of feedstock (Grade A waste wood), will be continuously loaded with fuel, and have sensors in place to monitor and control excess air, it is argued that continuous monitoring of CO emissions is not required, in accordance with the relevant guidance. CO emissions will be monitored annually, in accordance with the relevant guidance.
- 5.1.3 Particulate matter and organic compounds will be monitored annually, using approved methods.
- 5.1.4 NO_x emissions will be monitored upon commissioning of the boilers and after any subsequent substantial change to the installation.
- 5.1.5 Oxygen will be continuously monitored using a Lambda prob, which feeds information back to the control PLC.
- 5.1.6 Given the nature of the feedstock, which is essentially clean, uncontaminated waste wood, it is not considered that emissions monitoring will be required for any other pollutants.
- 5.1.7 All monitoring will be undertaken in accordance with the methods detailed in DEFRA Process Guidance Note 1/12(13), or by alternative equivalent method agreed with the Local Planning Authority.
- 5.1.8 Reference should be made to the EMS for details of emissions reporting procedures.

5.2 **Visual Monitoring**

Visual Monitoring of Stack Exhaust

- 5.2.1 Emissions from the combustion process should be free from visible smoke. During start up and shut down of the boiler, emissions should not exceed the equivalent of Ringelmann Shade 1 as described in British Standard BS 2742:2009. All emissions from air should be free from droplets and persistent visible emissions. Stack emissions will be visibly monitored on an ongoing basis by site staff.
- 5.2.2 As detailed in the EMS, a complaints procedure will be implemented during the day to day operation to ensure full investigation and remedial action for air emission related issues, such as dust.
- 5.2.3 Reference should be made to the EMS for a detailed outline of visual monitoring.

6 Potential Impacts on Environment

- 6.1 Reference should be made to Appendix IV for a copy of the flue height calculations undertaken using the DEFRA biomass calculator tool, which has verified the proposed stack heights of 15m as acceptable. This is a Local Authority tool which is used to determine if detailed assessment (modelling) is required for biomass boilers. If the emission rate from the boiler is less than the target emission rate in the tool, there is no requirement to proceed to detailed assessment (modelling). The tool focuses on the primary pollutants of concern from biomass boilers, which includes particulate matter and NO_x.
- 6.2 The biomass calculator tool requires information on pollutant emission rates and existing background pollutant concentrations. The Air Quality Limit Values (AQLVs) related to particulate matter are for particulate matter less than 10 micrometers in aerodynamic diameter (PM₁₀) and particulate matter less than 2.5 micrometers in aerodynamic diameter PM_{2.5}. However, ELVs and monitoring data is expressed as TPM. In order to determine PM₁₀ and PM_{2.5} emission rates, the particulate matter emission rate has been factored by 0.8 to determine PM₁₀ emission rates and 0.4 to determine PM_{2.5} emission rates. This is in accordance with government guidance on pollution inventory reporting which advises that it can be assumed that 80% of total particulate matter comprises PM₁₀ and 40% PM_{2.5} from combustion processes using biomass.³
- 6.3 Background annual mean pollutant concentrations used in the tool were obtained from a combination of DEFRA mapped background values for the grid square containing the proposed site and monitoring data from a nearby Local Authority maintained location at Wrexham Isycoed, which is an urban industrial location approximately 1.5km to the East-North-East of the proposed site. PM₁₀ and NO₂ is monitored at this location. The most recent available background pollutant concentrations for PM₁₀ at Isycoed, were obtained from the 2015 Updating and

³ Pollution Inventory Reporting – Combustion Activities Guidance Note, Environmental Permitting (England and Wales) Regulations 2010 Regulation 60(1), Version 4, EA, January 2013.

Screening Assessment for Wrexham County Borough Council. Mapped background and monitored pollution concentrations are presented in the tables below. In order to ensure a worst case assessment, the highest reported background pollutant concentrations for each pollutant have been used in the DEFRA tool.

Table 2 Mapped Background Pollutant Concentrations for Grid Square 338500, 349500

Pollutant	2017 Annual Mean Concentration ($\mu\text{g.m}^{-3}$)
Nitrogen dioxide (NO_2)	12.52
PM_{10}	13.81
$\text{PM}_{2.5}$	9.44

Table 3 Monitored Pollutant Concentrations at Wrexham Isycoed

Pollutant	2014 Annual Mean Concentration ($\mu\text{g.m}^{-3}$)
Nitrogen dioxide (NO_2)	12.4
PM_{10}	16

6.4 The table below presents emission rates from the boiler and the target emission rates provided by the biomass calculator tool. Emission rates for the boiler are based upon monitoring data for the same type of boiler installed at another site. Reference should be made to Appendix V for a copy of the emissions data, which has been provided by the boiler manufacturer. As two boilers are being installed, the boiler emission rates have been summed to provide the total emission rate. As is indicated, anticipated boiler emission rates will be less than the target emission rates. As such, it is not likely that AQLVs will be exceeded for NO_2 , PM_{10} or $\text{PM}_{2.5}$. As such, there is no requirement for detailed assessment and it can therefore be concluded that potential impacts will not be significant.

Table 4 Boiler Emission Rates and Target Emission Rates from DEFRA Biomass Tool

Pollutant	Anticipated Emission Rate (g.s^{-1}) ^(a)	Target Emission Rate (from DEFRA Biomass Calculator) (g.s^{-1})
PM_{10}	0.00144 (0.00288 in total)	0.1217
$\text{PM}_{2.5}$	0.00072 (0.00144 in total)	0.3415
NO_x (Annual)	0.105 (0.21 in total)	0.6031
NO_x (Hourly)		0.4787

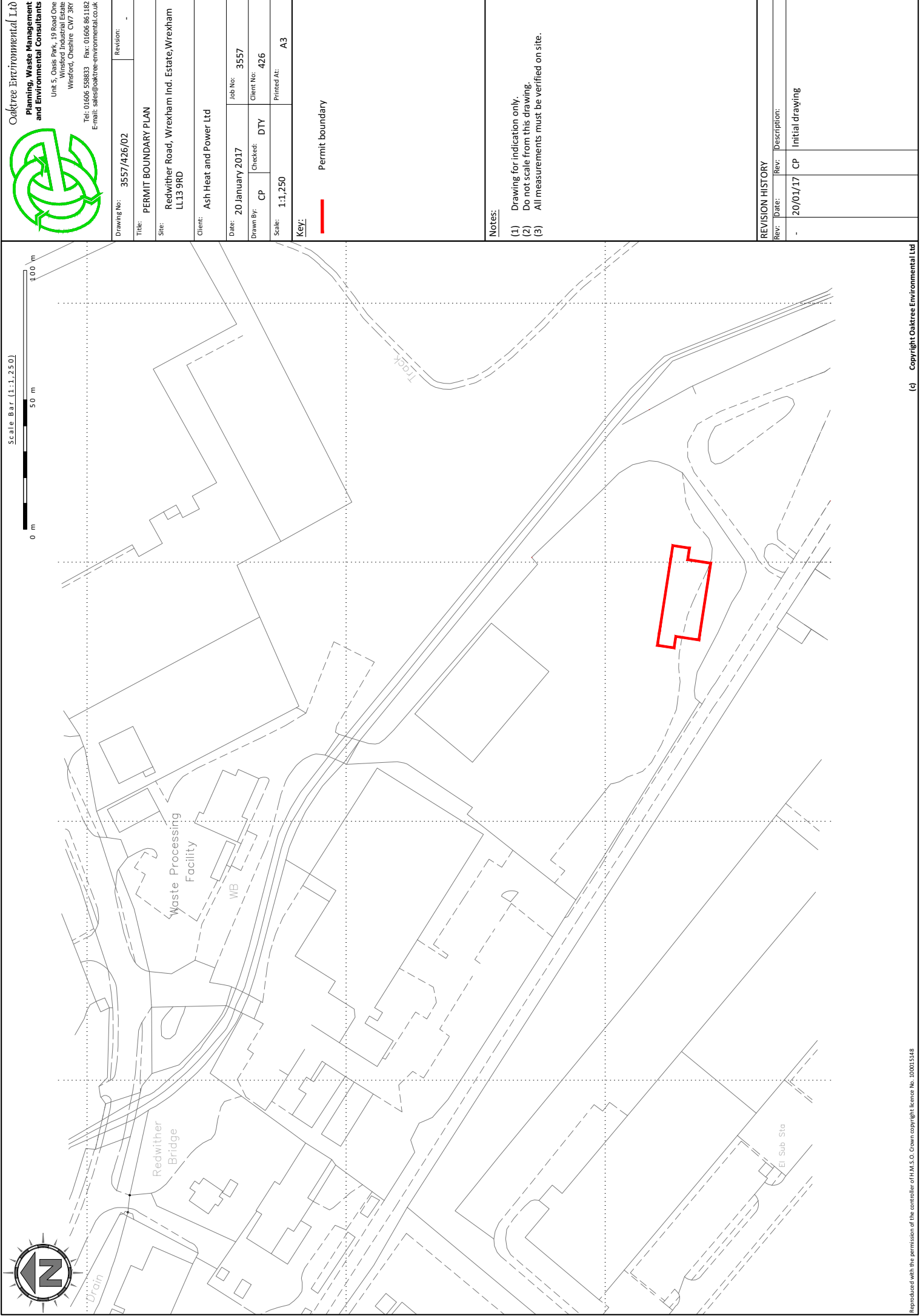
7 Environmental Management System

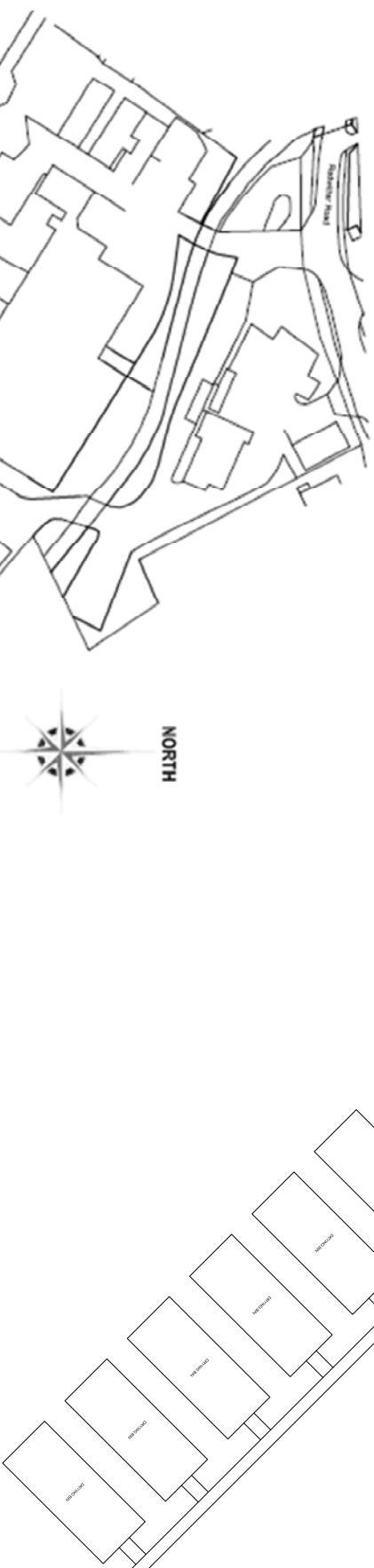
7.1 An Environmental Management System (EMS) will be implemented during the day to day operation of the site to ensure compliance with the Environmental Permit. This outlines the following:

- Site management procedures;
- Training procedures;
- Emissions control procedures;
- Emissions monitoring procedures; and,
- Record keeping procedures.

Supporting Information Document Appendix I

Permit Boundary Plan and Site Layout Plans





LOCATION PLAN (NTS)

[illegible]

Supporting Information Document

Appendix II

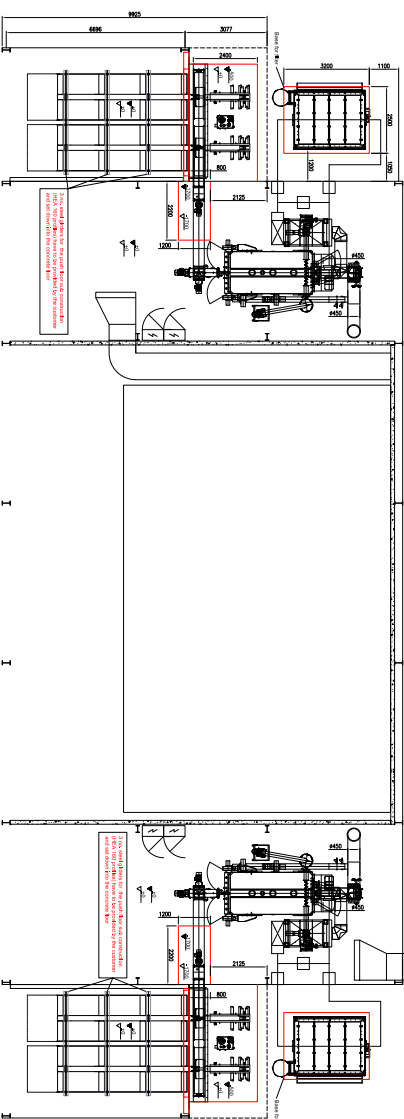
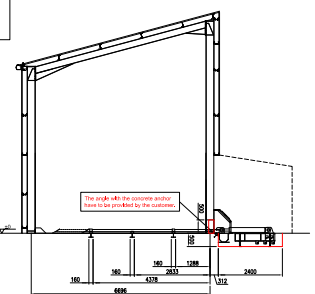
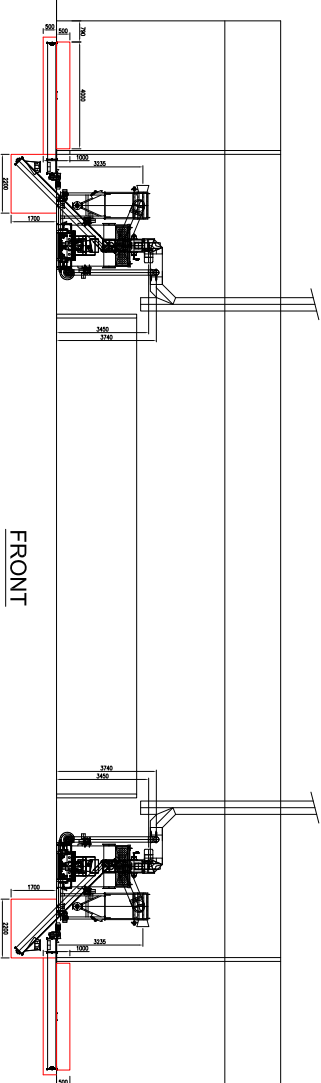
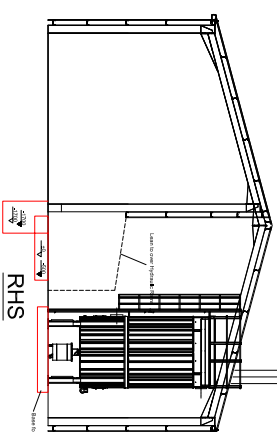
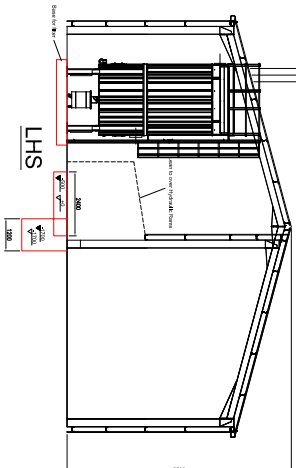
**Copy of Planning Consent (to be added
later)**

Supporting Information Document

Appendix III

Boiler Configuration

- (1) BINER recommends a minimum of 500 psi M40-bolster combustion capacity to be allowed for combustion air ventilation. The customer has to confirm this minimum applicable requirement with local authority.
- (2) All safety equipment must be available according to local regulations.
- (3) The transport of all boiler components into the boiler room may be possible.
- (4) Access for service and maintenance is required for all plant components.
- (5) The auger requires a minimum installation opening of 1000x1000mm (MMH)
- (6) The auger opening needs to be sealed by the client in accordance with local regulations.
- (7) The transport means within the fuel store is a HEA100, as well as the walking floor anchors need to be connected to the base layer and top layer of reinforced concrete.
Hydr. ram fraction ... 40t
Hydr. ram thrust ... 40t
These forces also apply to the fuel store walls.
- (8) An opening of 4000x4000mm (MMH) in front of the walking floor is required.
- (9) The 2nd phase of construction on the fuel store must not start prior to finishing positioning the anchors on the 1st floor (clearance by installing engineer).
- (10) Minimum level difference of fuel store floor is +3,30mm.
- (11) All structural engineering taking in account specified forces by client.



FRONT

PLAN

push floor sub construction

The steel gliders (HEA 160 profiles) have to be flush with the upper edge of the concrete.

Detail: see square between fuel storage room and push floor hydraulic room (schematic representation)

A structural calculation considering the specified forces has to be provided by the customer!

The steel girders (HEA 160 profiles) in the fuel store have to be connected with the reinforcement of the concrete bed and the reinforcement of the concrete secondary layer.

Diagram illustrating the layout of a hydraulic room. The room is divided into sections. A section labeled "push floor" is shown. A section labeled "hydraulic room" is shown. A section labeled "fuel storage" is shown. A section labeled "tee square" is shown. A section labeled "L100x100x8 with welded concrete brackets" is shown.

1st construction phase (granular sub-grade) ▼
2nd construction phase = final level ▽
construction phase 1,...., before installation of the pushing floor
construction phase 2,...., after installation of the pushing floor

The concrete foundation where the boiler block is positioned, has to withstand the weight of 16105kg! (The base frame can exceed temperature over 200°C.)

[illegible]

FOR CONSTRUCTION

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Consultants

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Learning Objectives

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Holt, Rinehart & Winston

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Supporting Information Document

Appendix IV

DEFRA Biomass Calculator Tool

Review and Assessment Tool for PM₁₀ from biomass combustion stacks

The maximum emissions of PM₁₀ in g/s from biomass combustion source emissions are calculated for your given stack details. Greater emission rates may result in exceedence of the 24 hour objective for PM₁₀ in England, Wales and Northern Ireland or the annual mean objective in Scotland.

Enter required information in Cream Cells
Resulting Emission in Red Bold

Building height	8.15	m
Stack diameter	0.45	m
Stack height	15	m

Location {Scotland, Rest of UK} Rest of UK

PM₁₀ Annual mean background concentration (include roadside contribution at relevant receptors) 16 $\mu\text{g}/\text{m}^3$

Calculated Effective stack height 11.4 m

Target Emission Rate 0.1217 g/s

If the maximum stack emission rate is less than the target above then it is not likely that the most stringent objective for PM₁₀ will be exceeded

Review and Assessment Tool for PM_{2.5} from biomass combustion stacks

The target emissions of PM_{2.5} in g/s from biomass combustion source emissions are calculated for your given stack details. Greater emission rates may result in exceedence of the cap for PM_{2.5}.

Enter required information in Cream Cells
Resulting Emission in Red Bold

Building height	8.15	m
Stack diameter	0.45	m
Stack height	15	m

Location {Scotland, Rest of UK} Rest of UK

PM_{2.5} Annual mean background concentration (include roadside contribution at relevant receptors) 9.55 $\mu\text{g}/\text{m}^3$

Calculated Effective stack height 11.4 m

Target Emission Rate 0.3391 g/s

If the maximum stack emission rate is less than the target above then it is not likely that the cap for PM_{2.5} will be exceeded

Review and Assessment Tool for oxides of nitrogen emissions from biomass combustion stacks

Hourly mean NO₂ objective

The target emissions of NO_x in g/s from biomass combustion source emissions are calculated for your given stack details. Greater emission rates may result in exceedence of the annual mean objective for NO₂

Enter required information in Cream Cells
Resulting Emission in Red Bold

Building height	8.15	m
Stack diameter	0.45	m
Stack height	15	m

Location {Scotland, Rest of UK}

NO₂ Annual mean background concentration (include roadside contribution at relevant receptors) μg/m³

Calculated Effective stack height m

Target Emission Rate g/s

If the maximum stack emission rate is less than the target above then it is not likely that the hourly mean objective for NO₂ will be exceeded

Review and Assessment Tool for oxides of nitrogen emissions from biomass combustion stacks

Annual mean NO₂ objective

The target emissions of NO_x in g/s from biomass combustion source emissions are calculated for your given stack details. Greater emission rates may result in exceedence of the annual mean objective for NO₂

Enter required information in Cream Cells
Resulting Emission in Red Bold

Building height	8.15	m
Stack diameter	0.45	m
Stack height	15	m

Location {Scotland, Rest of UK} Rest of UK

NO₂ Annual mean background concentration (include roadside contribution at relevant receptors) 12.93 µg/m³

Calculated Effective stack height 11.4 m

Target Emission Rate 0.5941 g/s

If the maximum stack emission rate is less than the target above then it is not likely that the annual mean limit value for NO₂ will be exceeded

Supporting Information Document

Appendix V

Emissions Data for Biomass Boiler

STACK EMISSIONS MONITORING REPORT



Unit 5 Crown Industrial Estate
Kenwood Road
Stockport
SK5 6PH
Tel: 0161 443 0980
Fax: 0161 443 0989

Your contact at ESG

Mark Woodruff
Business Manager - North
Tel: 0161 443 0982
Email: mark.woodruff@esg.co.uk

Operator & Address:

Colin Myers Timber
Hale Road
Widnes
WA8 8PX

Permit:

EPR Permit: HB/5.1/16/1

Release Point:

Biomass Boiler

Sampling Date(s):

26th July 2016

ESG Job Number:	LNO 13142
Report Date:	15th August 2016
Version:	4
Report By:	Lawrence Mason
MCERTS Number:	MM 07 849
MCERTS Level:	MCERTS Level 2 - Team Leader
Technical Endorsements:	1, 2, 3 & 4
Report Approved By:	Andy Hegarty
MCERTS Number:	MM 03 397
Business Title:	MCERTS Level 2 - Team Leader
Technical Endorsements:	1, 2, 3 & 4
Signature:	



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APPENDIX 4 - Record of Report Amendments

EXECUTIVE SUMMARY

MONITORING OBJECTIVES

Colin Myers Timber operates a biomass boiler process at Widnes which is subject to EPR Permit HB/5.1/16/1, under the Environmental Permitting Regulations 2010.

ESG were commissioned by Wood Energy Ltd to carry out stack emissions monitoring to determine the release of prescribed pollutants from the following Plant during the installation process.

The results of these tests shall be used to demonstrate compliance with a set of emission limit values for prescribed pollutants as specified in the Plant's EPR Permit, HB/5.1/16/1.

Plant

Biomass Boiler

Operator

Colin Myers Timber
Hale Road
Widnes
WA8 8PX

EPR Permit: HB/5.1/16/1

Stack Emissions Monitoring Test House

ESG - Stockport Laboratory
Unit 5 Crown Industrial Estate
Kenwood Road
Stockport
SK5 6PH
UKAS and MCERTS Accreditation Number: 1015

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

MCERTS accredited results will only be claimed where both the sampling and analytical stages are UKAS accredited.

This test report shall not be reproduced, except in full, without written approval of ESG.

This test report replaces and supersedes version - dated -. Please see APPENDIX 4 for the changes made.

EXECUTIVE SUMMARY

EMISSIONS SUMMARY					
Parameter	Units	Result	Calculated Uncertainty +/-	Limit	MCERTS accredited result
Total Particulate Matter	mg/m ³	4.2	0.54	60	✓
Particulate Emission Rate	g/hr	6.6	0.85	-	
Volatile Organic Compounds	mg/m ³	2.1	1.3	20	✓
Volatile Organic Compounds Emission Rate	g/hr	3.6	2.3	-	
Oxides of Nitrogen (as NO ₂)	mg/m ³	223	8.0	400	✓
Oxides of Nitrogen (as NO ₂) Emission Rate	g/hr	378	13	-	
Carbon Monoxide	mg/m ³	172	13	250	✓
Carbon Monoxide Emission Rate	g/hr	292	22	-	
Oxygen	% v/v	11.3	0.3	-	✓
Moisture	%	5.3	0.20	-	✓
Stack Gas Temperature	°C	110	-	-	✓
Stack Gas Velocity	m/s	3.8	0.12	-	
Gas Volumetric Flow Rate (Actual)	m ³ /hr	2606	143	-	
Gas Volumetric Flow Rate (STP, Wet)	m ³ /hr	1845	101	-	
Gas Volumetric Flow Rate (STP, Dry)	m ³ /hr	1747	96	-	
Gas Volumetric Flow Rate at Reference Conditions	m ³ /hr	1692	93	-	

ND = None Detected,

Results at or below the limit of detection are highlighted by bold italic text.

The above volumetric flow rate is calculated using data from the preliminary survey. Mass emissions for non isokinetic tests are calculated using these values. For all isokinetic testing the mass emission is calculated using test specific flow data and not the above values.

Reference conditions are 273K, 101.3kPa, wet gas 11% Oxygen.

EXECUTIVE SUMMARY

MONITORING TIMES			
Parameter	Sampling Date(s)	Sampling Times	Sampling Duration
Total Particulate Matter Run 1	26 July 2016	14:35 - 15:36	60 minutes
Volatile Organic Compounds Run 1	26 July 2016	14:35 - 15:35	60 minutes
Combustion Gases	26 July 2016	14:35 - 15:35	60 minutes
Preliminary Stack Traverse	26 July 2016	13:35	-

EXECUTIVE SUMMARY

PROCESS DETAILS

Parameter	Process Details
Description of process	Biomass Boiler
Continuous or batch	Continuous
Product Details	Shredded Chip Pallet & Processed Wood
Part of batch to be monitored (if applicable)	N/A
Normal load, throughput or continuous rating	80 - 100%
Fuel used during monitoring	Shredded Chip Pallet & Processed Wood
Abatement	FIDA Bag Filter
Plume Appearance	None Visible

EXECUTIVE SUMMARY

Monitoring Methods

The selection of standard reference / alternative methods employed by ESG is determined, wherever possible by the hierarchy of method selection outlined in Environment Agency Technical Guidance Note (Monitoring) M2. i.e. CEN, ISO, BS, US EPA etc.

MONITORING METHODS						
Species	Method Standard Reference Method / Alternative Method	ESG Technical Procedure	UKAS Lab Number	MCERTS Accredited Method	Limit of Detection (LOD)	Calculated MU +/- %
TPM	SRM - BS EN 13284-1	AE 104	1015	Yes	0.19 mg/m ³	13%
VOCs	SRM - BS EN 12619:2013	AE 102	1015	Yes	0.40 mg/m ³	63%
NO _x	SRM - BS EN 14792	AE 102	1015	Yes	0.19 mg/m ³	3.6%
CO	SRM - BS EN 15058	AE 102	1015	Yes	1.3 mg/m ³	7.5%
O ₂	AM - BS EN 14789	AE 102	1015	Yes	0.01%	2.8%
H ₂ O	SRM - BS EN 14790	AE 105	1015	Yes	0.01%	3.7%
Velocity	SRM - BS EN ISO 16911-1	AE 154	1015	Yes	5 Pa	3.2%
Volumetric Flow Rate	SRM - BS EN ISO 16911-1	AE 154	1015	Yes	-	5.5%

EXECUTIVE SUMMARY

Analytical Methods

The following tables list the analytical methods employed together with the custody and archiving details:

SAMPLING METHODS WITH SUBSEQUENT ANALYSIS							
Species	Analytical Technique	Analytical Procedure	UKAS Lab Number	UKAS Accredited Lab Analysis	Analysis Lab (ESG or Subcontract)	Sample Archive Location	Archive Period
TPM	Gravimetric	AE 106	1015	Yes	ESG Stockport	ESG Stockport	3 months

ON-SITE TESTING							
Species	Analytical Technique	Analytical Procedure	UKAS Lab Number	MCERTS Accredited Analysis	Laboratory	Data Archive Location	Archive Period
VOCs	Flame Ionisation Detection	AE 102	1015	Yes	ESG Stockport	ESG Stockport	5 years
NO _x	Chemiluminescence	AE 102	1015	Yes	ESG Stockport	ESG Stockport	5 years
CO	Non Dispersive Infra Red	AE 102	1015	Yes	ESG Stockport	ESG Stockport	5 years
O ₂	Zirconia Cell	AE 102	1015	Yes	ESG Stockport	ESG Stockport	5 years
H ₂ O	Gravimetric	AE 105	1015	Yes	ESG Stockport	-	-

EXECUTIVE SUMMARY

SAMPLING LOCATION					
Sampling Plane Validation Criteria	Value	Units	Requirement	Compliant	Method
Lowest Differential Pressure	10	Pa	≥ 5 Pa	Yes	BS EN 15259
Lowest Gas Velocity	3.8	m/s	-	-	-
Highest Gas Velocity	3.8	m/s	-	-	-
Ratio of Gas Velocities	1.0	: 1	$< 3 : 1$	Yes	BS EN 15259
Mean Velocity	3.8	m/s	-	-	-
Maximum angle of flow with regard to duct axis	< 15	$^{\circ}$	$< 15^{\circ}$	Yes	BS EN 15259
No local negative flow	Yes	-	-	Yes	BS EN 15259

DUCT CHARACTERISTICS		
	Value	Units
Shape	Circular	-
Depth	0.49	m
Width	-	m
Area	0.19	m ²
Port Depth	70	mm

SAMPLING LINES & POINTS		
	Isokinetic	Non-Iso & Gases
Sample port size	3 inch BSP	3 inch BSP
Number of lines used	2	1
Number of points / line	2	1
Duct orientation	Vertical	Vertical
Filtration for TPM	In Stack	-

SAMPLING PLATFORM	
General Platform Information	
Permanent / Temporary Platform / Ground level / Floor Level / Roof	Permanent
Inside / Outside	Outside

M1 Platform requirements	
Is there a sufficient working area so work can be performed in a compliant manner	Yes
Platform has 2 levels of handrails (approximately 0.5 m & 1.0 m high)	Yes
Platform has vertical base boards (approximately 0.25 m high)	Yes
Platform has removable chains / self closing gates at the top of ladders	No
Handrail / obstructions do not hamper insertion of sampling equipment	Yes
Depth of Platform = $>$ Stack depth / diameter + wall and port thickness + 1.5m	Yes

Sampling Platform Improvement Recommendations (if applicable)

The sampling location meets all the requirements as specified in EA Guidance Note M1.

EXECUTIVE SUMMARY

Sampling & Analytical Method Deviations

In this instance there were no deviations from the sampling and analytical methods employed.

APPENDICES

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APPENDIX 1 - Monitoring Schedule, Calibration Checklist & Monitoring Team

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

APPENDIX 3 - Measurement Uncertainty Budget Calculations

APPENDIX 4 - Record of Report Amendments

APPENDIX 1 - Monitoring Schedule, Calibration Checklist & Monitoring Team

MONITORING SCHEDULE					
Species	Method Standard Reference Method / Alternative Method	ESG Technical Procedure	UKAS Lab Number	MCERTS Accredited Method	Number of Samples
TPM	SRM - BS EN 13284-1	AE 104	1015	Yes	1
VOCs	SRM - BS EN 12619:2013	AE 102	1015	Yes	1
NOx	SRM - BS EN 14792	AE 102	1015	Yes	1
CO	SRM - BS EN 15058	AE 102	1015	Yes	1
O ₂	AM - BS EN 14789	AE 102	1015	Yes	1
H ₂ O	SRM - BS EN 14790	AE 105	1015	Yes	1
Velocity	SRM - BS EN ISO 16911-1	AE 154	1015	Yes	1

APPENDIX 1 - Monitoring Schedule, Calibration Checklist & Monitoring Team

CALIBRATEABLE EQUIPMENT CHECKLIST					
Extractive Sampling		Instrumental Analyser/s		Miscellaneous	
Equipment	Equipment I.D.	Equipment	Equipment I.D.	Equipment	Equipment I.D.
Control Box DGM	LNO 13-03	Horiba PG-250 Analyser	LNO 21-12	Laboratory Balance	LNO 00-13, 00-12
Box Thermocouples	LNO 03-03	FT-IR Gasmet	-	Tape Measure	LNO 24-LM
Meter In Thermocouple	LNO 03-03	FT-IR Oven Box	-	Stopwatch	-
Meter Out Thermocouple	LNO 03-03	Bernath 3006 FID	-	Protractor	-
Control Box Timer	LNO 17-03	Signal 3030 FID	-	Barometer	LNO 08-LM
Oven Box	-	Servomex	-	Digital Micromanometer	-
Probe	LNO 11-02	JCT Heated Head Filter	-	Digital Temperature Meter	-
Probe Thermocouple	LNO 10-02	Thermo FID	LNO 21-03	Stack Thermocouple	-
Probe	-	Stackmaster	-	Mass Flow Controller	-
Probe Thermocouple	-	FTIR Heater Box for Heated Line	-	MFC Display module	-
S-Pitot	LNO 06-LM	Anemometer	-	1m Heated Line (1)	-
L-Pitot	-	Ecophysics NOx Analyser	-	1m Heated Line (2)	-
Site Balance	LNO 14-05	Chiller (JCT/MAK 10)	LNO 21-41	1m Heated Line (3)	-
Last Impinger Arm	-	Heated Line Controller (1)	LNO 03-93	5m Heated Line (1)	-
Dioxins Cond. Thermocouple	-	Heated Line Controller (2)	-	10m Heated Line (1)	LNO 18-43
Callipers	LNO 31-LM	Site temperature Logger	-	10m Heated Line (2)	-
Small DGM	-		-	15m Heated Line (1)	-
Heater Controller	-		-	20m Heated Line (1)	-
Inclinometer (Swirl Device)	LNO 23-LM		-	20m Heated Line (2)	-

NOTE: If the equipment I.D is represented by a dash (-), then this piece of equipment has not been used for this test.

CALIBRATION GASES					
Gas (traceable to ISO 17025)	Cylinder I.D Number	Supplier	ppm	%	Analytical Tolerance +/- %
Oxygen	187867	BOC	-	10.23	2.0
Propane	242494	BOC	82.1	-	2.0
Nitric Oxide	100678	BOC	82.2	-	2.0
Carbon Monoxide	HPC 819	BOC	160	-	2.0

STACK EMISSIONS MONITORING TEAM

MONITORING TEAM								
Personnel	MCERTS Number	MCERTS		TE / H&S Qualifications and Expiry Date				
		Level	Expiry	TE1	TE2	TE3	TE4	H&S
Lawrence Mason	MM 07 849	MCERTS Level 2	Jul-17	Jun-18	Dec-20	Sep-21	Sep-20	Jul-17
Dominic Eaton	MM 15 1353	MCERTS Trainee	Apr-17	-	-	-	-	Apr-17

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

TOTAL PARTICULATE MATTER SUMMARY					
Parameter	Sampling Times	Concentration mg/m ³	Uncertainty mg/m ³	Limit mg/m ³	Emission Rate g/hr
Run 1	14:35 - 15:36 26 July 2016	4.2	0.53	60	6.6
Blank	-	0.19	-	-	-

Reference conditions are 273K, 101.3kPa, wet gas 11% Oxygen.

Acetone Blank Value mg/l	Acceptable Value mg/l
2.0	10

FILTER INFORMATION

SAMPLES								
Test	Filter & Probe Rinse Number	Filter Start Weight g	Filter End Weight g	Mass Gained on Filter g	Probe Rinse Start Weight g	Probe Rinse End Weight g	Mass Gained on Probe g	Combined Total Mass Gained g
Run 1	G5322	0.10493	0.10896	0.00403	185.00250	185.00240	-0.00010	0.00393

If total mass gained is less than the LOD then the LOD is reported

BLANKS								
Test	Filter & Probe Number	Filter Start Weight g	Filter End Weight g	Mass Gained Filter g	Probe Start Weight g	Probe End Weight g	Mass Gained Probe g	Combined Total Mass Gained g
Run 1	G5323	0.10294	0.10291	-0.00003	183.51740	183.51760	0.00020	0.00024

If total mass gained is less than the LOD then the LOD is reported

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

ISOKINETIC SAMPLING EQUATIONS - RUN 1				TPM
Absolute pressure of stack gas, P_s				
Barometric pressure, P _b	mm Hg	754.51		
Stack static pressure, P _{static}	mm H ₂ O	1.02		
$P_s = P_b + (P_{static})$	mm Hg	754.58		
$P_s = \frac{P_b + (P_{static})}{13.6}$				
Vol. of water vapour collected, V_{wstd}				
Moisture trap weight increase, V _{lc}	g	53.2		
$V_{wstd} = (0.001246)(V_{lc})$	m ³	0.0662872		
Volume of gas metered dry, V_{mstd}				
Volume of gas sample through gas meter, V _m		1.232		
Gas meter correction factor, Y _d		1.0494		
Mean dry gas meter temperature, T _m		26.083		
Mean pressure drop across orifice, DH mmH ₂ O		40.457		
$V_{mstd} = \frac{(0.3592)(V_m)(P_b + (DH/13.6))(Y_d)}{T_m + 273}$		1.176		
Volume of gas metered wet, V_{mstw}				
$V_{mstw} = V_{mstd} + V_{wstd}$	m ³	1.2425		
Vol. of gas metered at O₂ Ref. Cond., V_{mstd@X%O₂}				
Is the process burning hazardous waste? (If yes, no favourable oxygen correction)	No			
% oxygen measured in gas stream, act%O ₂	13.0			
% oxygen reference condition	11			
O ₂ Reference O ₂ Ref = 21.0 - act%O ₂	0.80			
Factor $\frac{21.0 - ref\%O_2}{21.0 - act\%O_2}$				
$V_{mstd@X\%oxygen} = (V_{mstd}) (O_2 Ref)$	m ³	0.9409		
Moisture content, B_{w0}				
$B_{w0} = \frac{V_{wstd}}{V_{mstd} + V_{wstd}}$	%	5.34		
Moisture by FTIR				
	%	-		
Velocity of stack gas, V_s				
Pitot tube velocity constant, K _p		34.97		
Velocity pressure coefficient, C _p		0.843		
Mean of velocity heads, DP _{avg} mm H ₂ O		1.31		
Mean square root of velocity heads, ÖDP		1.14		
Mean stack gas temperature, T _s °C		131		
$V_s = \frac{(K_p)(C_p)(\ddot{O}DP)(\ddot{O}(T_s + 273))}{(M_s)(P_s)}$	m/s	4.55		
Molecular weight of dry gas, M_d				
CO ₂	%	9.28		
O ₂	%	13.00		
Total	%	22.28		
N ₂ (100 - Total)	%	77.72		
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$		30.00		
Molecular weight of wet gas, M_s				
$M_s = M_d(1 - B_{w0}) + 18(B_{w0})$	g/gmol	29.36		
Actual flow of stack gas, Q_a				
Area of stack, A _s	m ²	0.19		
$Q_a = (60)(A_s)(V_s)$	m ³ /min	51.5		
Total flow of stack gas, Q				
Conversion factor (K/mm.Hg)		0.3592		
$Q_{std} = \frac{(Q_a)P_s(0.3592)(1 - B_{w0})}{(T_s) + 273}$	Dry	32.7		
$Q_{stdO_2} = \frac{(Q_a)P_s(0.3592)(1 - B_{w0})(O_2 REF)}{(T_s) + 273}$	@O ₂ ref	26.17		
$Q_{stw} = \frac{(Q_a)P_s(0.3592)}{(T_s) + 273}$	Wet	34.56		
Percent isokinetic, %I				
Nozzle diameter, D _n	mm	11.90		
Nozzle area, A _n	mm ²	111.23		
Total sampling time, q	min	60		
$\%I = \frac{(4.6398E6)(T_s + 273)(V_{mstd})}{(P_s)(V_s)(A_n)(q)(1 - B_{w0})}$	%	101.6		
Acceptable isokinetic range 95% to 115%		Yes		
Particulate Concentration, C				
Mass collected on filter, M _f	g	0.00403		
Mass collected in probe, M _p	g	-0.00010		
Total mass collected, M _n	g	0.00393		
$C_{wet} = \frac{M_n}{V_{mstw}}$	mg/m ³	3.163		
$C_{dry} = \frac{M_n}{V_{mstd}}$	mg/m ³	3.341		
$C_{dry@X\%O_2} = \frac{M_n}{V_{mstd@X\%oxygen}}$	mg/m ³	4.177		
Particulate Emission Rates, E				
$E = [(C_{wet})(Q_{stw})(60)] / 1000$		6.56		

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

TOTAL PARTICULATE MATTER QUALITY ASSURANCE CHECKLIST

LEAK RATE						
Run	Mean Sampling Rate litre/min	Pre-sampling Leak Rate litre/min	Post-sampling Leak Rate litre/min	Maximum Vacuum mm Hg	Acceptable Leak Rate litre/min	Leak Tests Acceptable?
Run 1	21.55	0.11	0.12	-381	0.43	Yes

ISOKINETICITY		
Run	Isokinetic Variation %	Acceptable Isokineticity
Run 1	101.60	Yes

Acceptable isokinetic range 95% to 115%

WEIGHING BALANCE UNCERTAINTY			
Run	Result mg/m ³	5% ELV mg/m ³	LOD < 5% ELV
Run 1	0.19	3.0	Yes

The above is based on both the Filter and rinse uncertainty

BLANK VALUE				
Run	Overall Blank Value mg/m ³	Daily Emission Limit Value mg/m ³	Acceptable Blank Value mg/m ³	Overall Blank Acceptable mg/m ³
Blank 1	0.19	60	6.0	Yes

FILTERS					
Run	Filter Material	Filter Size mm	Max Filtration Temperature °C	Pre-use Filter Conditioning Temperature °C	Post-use Filter Conditioning Temperature °C
Run 1	Glass Fibre	47	147	180	160

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

VOLATILE ORGANIC COMPOUNDS SUMMARY

Test	Sampling Times	Concentration mg/m ³	LOD mg/m ³	Limit mg/m ³	Emission Rate g/hr
Run 1	14:35 - 15:35 26 July 2016	2.1	0.40	20	3.6

Reference conditions are 273K, 101.3kPa, wet gas 11% Oxygen.

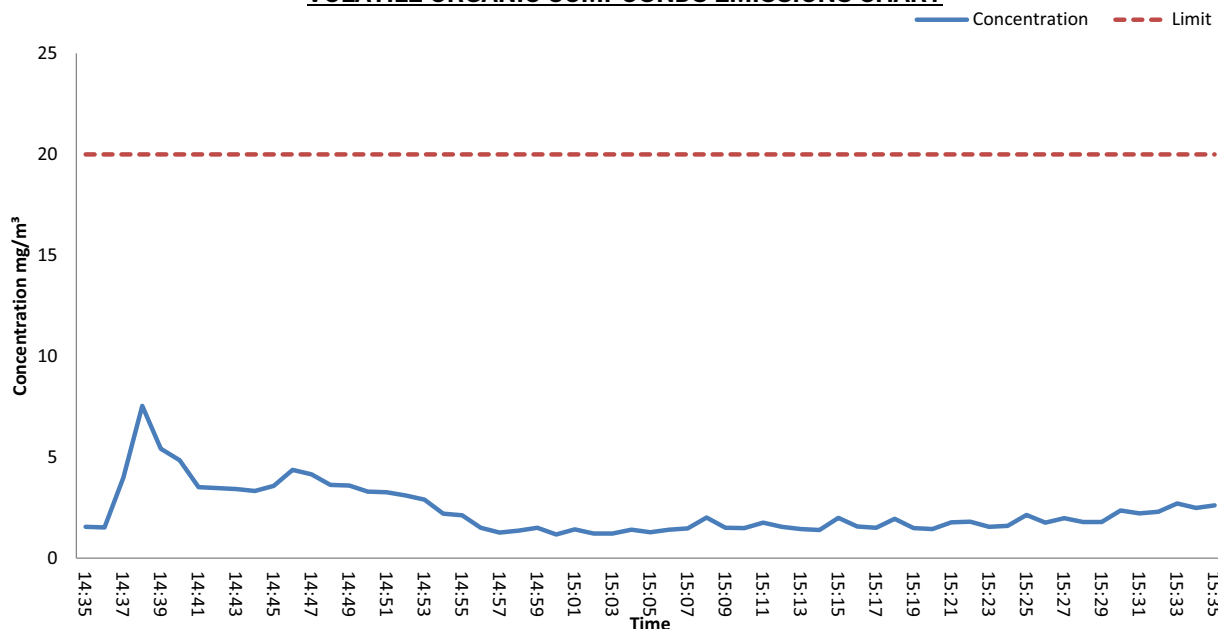
INSTRUMENTAL SPAN & ZERO CHECKS

PRE-SAMPLING CALIBRATION CHECKS RUN 1								
Date	26 July 2016							
Start Time	13:37							
End Time	13:44							
Gas	Gas Conc (ppm)	Range	Instrument Zero Reading	Instrument Span Reading	Instrument Zero Reading	Zero Down line reading	Span down line reading	Leak Rate (%)
Propane	82.1	100	0.40	82.1	0.40	0.20	82.0	0.12

Zero and Span gas contained 10% Oxygen

POST-SAMPLING CALIBRATION CHECKS RUN 1				
Date	26 July 2016			
Start Time	15:39			
End Time	15:44			
Gas	Zero down line reading	Span down line reading	Zero Drift (%)	Span Drift (%)
Propane	0.30	81.6	0.12	-0.61

VOLATILE ORGANIC COMPOUNDS EMISSIONS CHART



Reference conditions are 273K, 101.3kPa, wet gas 11% Oxygen.

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

COMBUSTION GASES SUMMARY

Test	Sampling Time and Date	Concentration mg/m ³	LOD mg/m ³	Limit mg/m ³	Emission Rate g/hr
NO _x	14:35 - 15:35 26 July 2016	223	0.19	400	378
CO	14:35 - 15:35 26 July 2016	172	1.3	250	292

Test	Sampling Time and Date	Concentration %	LOD %
O ₂	14:35 - 15:35 26 July 2016	11.3	0.01

Reference conditions are 273K, 101.3kPa, wet gas 11% Oxygen.

PRE-SAMPLING CALIBRATION DATA

Date	26 July 2016
Start Time	13:50
End Time	14:05

Chiller Temperature (°C)	2.6
Requirement	< 4°C
Compliant	Yes

Gas	Range (ppm / %)	Zero Reading at analyser	Span Reading at analyser	Zero Check at analyser	Zero Check down line	Span Check down line	Response Time (Secs)	Leak Rate %
NO	100	0.00	82.1	0.10	0.10	81.8	45	0.37
CO	1000	0.00	160.0	0.10	0.20	159.0	30	0.62
O ₂	25	0.00	10.23	0.01	0.03	10.26	30	-0.29

POST-SAMPLING CALIBRATION DATA

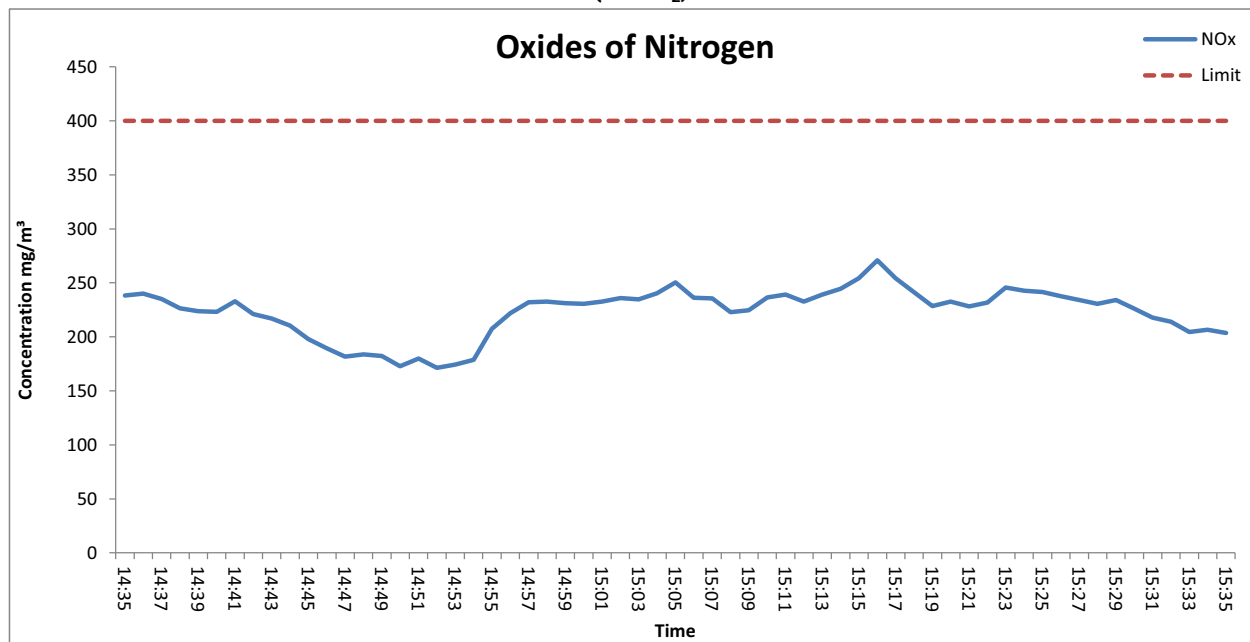
Date	26 July 2016
Start Time	15:46
End Time	15:55

Chiller Temperature (°C)	2.2
Requirement	< 4°C
Compliant	Yes

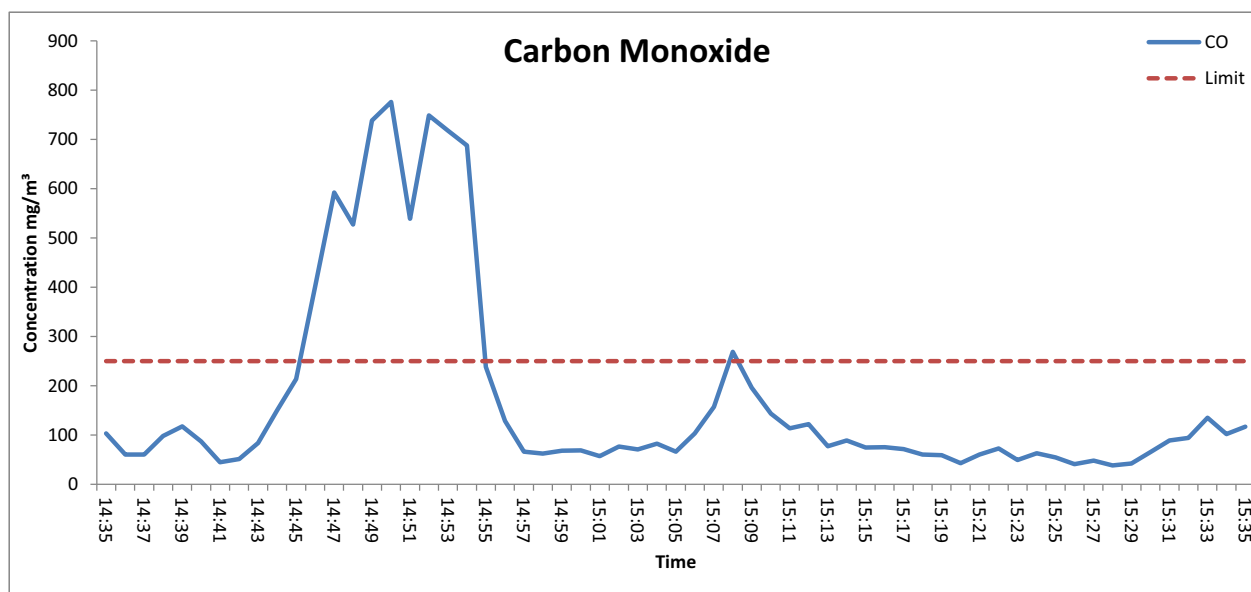
Gas	Zero Check down line	Span Check down line	Zero Drift (%)	Span Drift (%)
NO	0.30	81.5	0.20	-0.50
CO	0.30	158.0	0.01	-0.11
O ₂	0.04	10.28	0.04	0.04

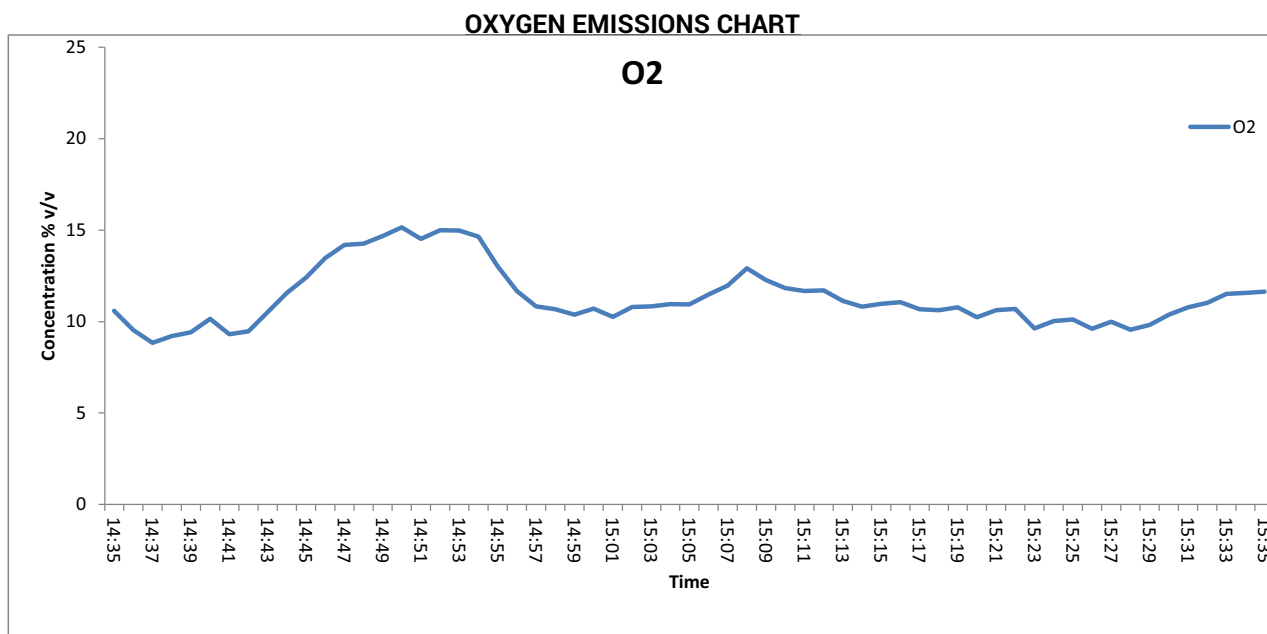
APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

OXIDES OF NITROGEN (as NO₂) EMISSIONS CHART



CARBON MONOXIDE EMISSIONS CHART





APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

MOISTURE CALCULATIONS

Moisture Determination - Isokinetic							
Test Number	Sampling Time and Date	Start Weight	End Weight	Total gain	Concentration	LOD	Uncertainty
		kg	kg	kg	%	%	%
Run 1	14:35 - 15:36 26 July 2016	3.3304	3.3836	0.0532	5.3	0.010	3.7

Moisture Quality Assurance							
Test Number	Sampling Duration	Total Volume Sampled	Sampling Rate	Start Leak Rate	End Leak Rate	Acceptable Leak Rate	Leak Tests Acceptable?
	mins	l	l/min	l/min	l/min	l/min	
Run 1	60	1242	21.5	0.11	0.12	0.43	Yes

PRELIMINARY STACK SURVEY

Stack Characteristics		
Stack Diameter / Depth, D	0.49	m
Stack Width, W	-	m
Stack Area, A	0.19	m ²
Average stack gas temperature	110	°C
Stack static pressure	0.01	kPa
Barometric Pressure	100.6	kPa

Stack Gas Composition & Molecular Weights								
Component	Molar Mass	Density	Conc	Dry Volume	Dry Conc	Conc	Wet Volume	Wet Conc
	M	kg/m ³	Dry	Fraction	kg/m ³	Wet	Fraction	kg/m ³
		p	% Vol	r	pi	% Vol	r	pi
CO ₂	44	1.963059	9.276298	0.092763	0.182099	8.781390	0.087814	0.172384
O ₂	32	1.427679	11.312432	0.113124	0.161505	10.708892	0.107089	0.152889
N ₂	28	1.249219	79.411270	0.794113	0.992021	75.174529	0.751745	0.939095
H ₂ O	18	0.803070	-	-	-	5.335190	0.053352	0.042845

Where: $p = M / 22.41$ $pi = r \times p$

Calculation of Stack Gas Densities		
Determinand	Result	Units
Dry Density (STP), P_{STD}	1.3356	kg/m ³
Wet Density (STP), P_{STW}	1.3072	kg/m ³
Dry Density (Actual), P_{Actual}	0.9455	kg/m ³
Average Wet Density (Actual), $P_{ActualW}$	0.925	kg/m ³

Where:

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

$P_{STW} = (P_{STD} + pi \text{ of H}_2\text{O}) / (1 + (pi \text{ of H}_2\text{O} / 0.8036))$

$P_{Actual} = P_{STD} \times (Ts / Ps) \times (Pa / Ta)$

$P_{ActualW} = P_{STW} \times (Ts / Ps) \times (Pa / Ta)$

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

PRELIMINARY STACK SURVEY

TRAVERSE 1

Date of Survey	26 July 2016
Time of Survey	13:35
Velocity Measurement Device:	S-Type Pitot

Sampling Line A								
Traverse Point	Distance into duct (m)	DP pt mmH ₂ O (average of 3 readings)	DP pt Pa (average of 3 readings)	Temp °C	Velocity m/s	Volumetric Flow Rate (actual) m ³ /s	O ₂ % Vol	Angle of Swirl °
1	0.07	1.0	10	110	3.8	0.72	-	<15
2	0.42	1.0	10	110	3.8	0.72	-	<15
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
Mean	-	1.0	10	110	3.8	0.72	-	-

Sampling Line B								
Traverse Point	Distance into duct (m)	DP pt mmH ₂ O (average of 3 readings)	DP pt Pa (average of 3 readings)	Temp °C	Velocity m/s	Volumetric Flow Rate (actual) m ³ /s	O ₂ % Vol	Angle of Swirl °
1	0.07	1.0	10	110	3.8	0.72	-	<15
2	0.42	1.0	10	110	3.8	0.72	-	<15
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
Mean	-	1.0	10	110	3.8	0.72	-	-

PRELIMINARY STACK SURVEY QUALITY ASSURANCE CHECKLIST

PITOT LEAK CHECK								
Run	Pre Traverse Leak Rate				Post Traverse Leak Rate			
	Start Value mmH ₂ O	End Value mmH ₂ O	Difference %	Outcome	Start Value mmH ₂ O	End Value mmH ₂ O	Difference %	Outcome
Run 1	130	125	3.8	Pass	150	145	3.3	Pass

To complete a compliant pitot leak check a pressure of over 80 mmH₂O (or 800 Pa) is applied and the pressure drop monitored over 5 mins. A drop of less than 5% must be observed.

S-Type Pitot Stagnation Check				
Run	Stagnation (Pa)	Reference (Pa)	Difference (Pa)	Outcome (Permitted +/- 10 Pa)
Run 1	10	10	0.0	Pass

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

PRELIMINARY STACK SURVEY (CONTINUED)

Sampling Plane Validation Criteria				
EA Technical Guidance Note (Monitoring) M1	Result	Units	Requirement	Compliant
Lowest Differential Pressure	10	Pa	≥ 5 Pa	Yes
Lowest Gas Velocity	3.8	m/s	-	-
Highest Gas Velocity	3.8	m/s	-	-
Ratio of Gas Velocities	1.0	-	$< 3 : 1$	Yes
Maximum angle of flow with regard to duct axis	< 15	$^{\circ}$	$< 15^{\circ}$	Yes
No local negative flow	Yes	-	-	Yes

Calculation of Stack Gas Velocity, V		
Velocity at Traverse Point, $V = K_{pt} \times (1-e) \times \sqrt{2 \times DP_{pt} / \rho_{ActualW}}$		
Where: K_{pt} = Pitot tube calibration coefficient $(1-e)$ = Compressibility correction factor, assumed at a constant 0.998		
Average Stack Gas Velocity, V_a	3.8	m/s

Calculation of Stack Gas Volumetric Flowrate, Q			
Duct gas flow conditions	Actual	Reference	Units
Temperature	110	0	$^{\circ}\text{C}$
Total Pressure	100.61	101.3	kPa
Oxygen	11.3	11	%
Moisture	5.34	5.34	%
Pitot tube calibration coefficient, K_{pt}	0.84		

Gas Volumetric Flowrate	Result	Units
Average Stack Gas Velocity (V_a)	3.84	m/s
Stack Area (A)	0.19	m^2
Gas Volumetric Flowrate (Actual), Q_{Actual}	2606	m^3/hr
Gas Volumetric Flowrate (STP, Wet), Q_{STP}	1845	m^3/hr
Gas Volumetric Flowrate (STP, Dry), $Q_{STP,Dry}$	1747	m^3/hr
Gas Volumetric Flowrate (REF), Q_{Ref}	1692	m^3/hr

Where:

$$Q_{Actual} = V_a \times A \times 3600$$

$$Q_{STP} = Q_{Actual} \times (T_s / T_a) \times (P_a / P_s) \times 3600$$

$$Q_{STP,Dry} = Q_{STP} / (100 - (100 / Ma)) \times 3600$$

$$Q_{Ref} = Q_{STP} \times ((100 - Ma) / (100 - Ms)) \times ((20.9 - O_{2a}) / (20.9 - O_{2s}))$$

Nomenclature:

T_s = Absolute Temperature, Standard Conditions, 273 K

P_s = Absolute Pressure, Standard Conditions, 101.3 kPa

T_a = Absolute Temperature, Actual Conditions, K

P_a = Absolute Pressure, Actual Conditions, kPa

Ma = Water vapour, Actual Conditions, % Vol

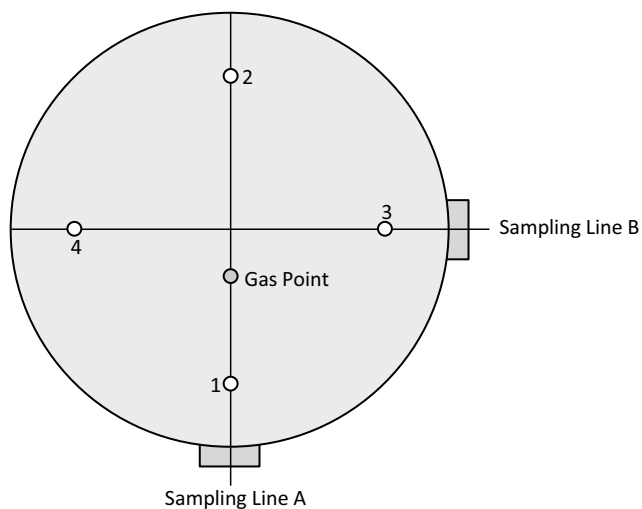
Ms = Water vapour, Reference Conditions, % Vol

O_{2a} = Oxygen, Actual Conditions, % Vol

O_{2s} = Oxygen, Reference Conditions, % Vol

STACK DIAGRAM

	Value	Units
Stack Depth	0.49	m
Stack Width	-	m
Area	0.19	m ²



- Isokinetic sampling point
- Isokinetic sampling points not used
- Non Isokinetic/Gases sampling point

Non-Isokinetic/Gases Sampling			
Sampling Point	Distance (% of Depth)	Distance into Stack	Units
A	50	0.25	m

[illegible]

A tall, shiny, cylindrical metal chimney or vent pipe extends vertically from a corrugated metal roof. The pipe is highly reflective, showing clear reflections of the surrounding environment, including the sky and distant trees. It features several horizontal bands or flanges. Near the top, there is a small, dark, circular cap or valve. The roof itself is made of dark, weathered corrugated metal with some lighter patches. In the background, a cloudy sky and a line of green trees are visible. A metal railing is partially visible in the foreground, suggesting the photo was taken from a rooftop or elevated platform.

APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - TOTAL PARTICULATE MATTER

Run	Sampled Volume m ³	Sampled Gas Temp K	Sampled Gas Pressure kPa	Sampled Gas Humidity % by volume	Oxygen Content % by volume	Limit of Detection % by mass	Leak %	Uncollected Mass mg
MU required	≤ 2%	≤ 2%	≤ 1%	≤ 1%	≤ 10%	≤ 5% of ELV	≤ 2%	≤ 10% of ELV
Run 1	0.001	2.0	0.50	1.0	0.1	0.24	-	-
as a %	0.08	0.67	0.50	1.0	0.77	0.43	0.56	0.0004
compliant?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Run	Volume (STP) m ³	Mass of particulate mg	O ₂ Correction -	Leak mg/m ³	Uncollected Mass mg	Combined uncertainty
Run 1	1.13	3.9300	1.3	0.013	0.0001	-
MU as mg/m ³	0.05	0.2551	0.05	0.013	0.0001	0.27
MU as %	1.30	6.1069	-	0.322	0.0035	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	0.53	mg/m³	13	%
---	-------------	-------------------------	-----------	----------

(k is a coverage factor which gives a 95% confidence in the quoted figures)

Developed for the STA by R Robinson, NPL

APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - MOISTURE

Run	Sampled Volume m ³	Sampled Gas Temp K	Sampled Gas Pressure kPa	Sampled Gas Humidity % by volume	Oxygen Content % by volume	Leak %
MU required	≤ 2%	≤ 2%	≤ 1%	≤ 1%	≤ 10%	≤ 2%
Run 1	0.001	2.0	0.50	1.0	0.1	-
as a %	0.08	0.67	0.50	1.0	0.77	0.56
compliant?	Yes	Yes	Yes	Yes	Yes	Yes
Run	Volume (STP) m ³	Mass Gained mg	O ₂ Correction -	Leak mg/m ³	Uncollected Mass mg	Combined uncertainty
Run 1	1.13	53200	1.3	137.67	58	-
MU as % v/v	0.07	0.01	0.07	0.02	0.006	0.10
MU as %	1.30	0.19	1.25	0.32	0.11	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	0.20	% v/v	3.7	%
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APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - VOLATILE ORGANIC COMPOUNDS RUN 1

Measured Concentration	2.1	mg/m ³
Limit	20	mg/m ³
Calibration Gas Concentration	131.36	mg/m ³
Range	160	mg/m ³

Performance characteristics	Value	Units	specification	MU Met?
Response time	30	seconds	<180	Yes
Logger sampling interval	60	seconds	-	-
Measurement period	60	minutes	-	-
Number of readings in measurement	60	-	-	-
Repeatability at zero	0.25	% full scale	<1 % range	Yes
Repeatability at span level	0.15	% full scale	<2 % range	Yes
Deviation from linearity	0.70	% of value	<2 % range	Yes
Zero drift	0.12	% full scale	<2% range / 24hr	Yes
Span drift	-0.61	% full scale	<2% range / 24hr	Yes
volume or pressure flow dependence	0.02	% of full scale/3 kPa	<2 % / 3 kPa	Yes
atmospheric pressure dependence	0.80	% of full scale/2 kPa	<3% / 2 kPa	Yes
ambient temperature dependence	0.01	% full scale/10K	<3% range / 10 K	Yes
dependence on voltage	0.10	% full scale/10V	< 0.1%vol /10 volt	Yes
losses in the line (leak)	0.12	% of value	< 2% of span gas value	Yes
Uncertainty of calibration gas	1.0	% of value	< 2% of value	Yes

Performance characteristic	Uncertainty	Value of uncertainty quantity
Standard deviation of repeatability at zero	ur0	0.02
Standard deviation of repeatability at span level	urs	0.02
Lack of fit	ufit	0.65
Drift	u0dr	0.06
volume or pressure flow dependence	uspres	0.001
atmospheric pressure dependence	uapres	0.04
ambient temperature dependence	utemp	0.00001
Dependence on voltage	uvolt	0.14
losses in the line (leak)	uleak	0.001
Uncertainty of calibration gas	ucalib	0.01
Uncertainty in factor	uf	0.04

Measurement uncertainty Measured Concentration	2.13	mg/m ³
Combined uncertainty	0.67	mg/m ³
Expanded uncertainty	1.33	mg/m ³

Expanded uncertainty expressed with a level of confidence of 95%	6.7	% ELV
Expanded uncertainty expressed with a level of confidence of 95%	1.3	mg/m ³
Expanded uncertainty expressed with a level of confidence of 95%	63	% value

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APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - OXIDES OF NITROGEN

Limit value	400	mg/m ³
Concentration @ Ref conditions	223.3	mg/m ³
Cal gas conc	168.51	mg/m ³
Analyser Full Scale	205	mg/m ³

Performance characteristics	Value	Units	specification	MU Met?
Response time	45	seconds	180	Yes
Logger sampling interval	60	seconds	-	-
Measurement period	60	minutes	-	-
Number of readings in measurement	60	-	-	-
Repeatability at zero	0.25	% full scale	<1 % range	Yes
Repeatability at span level	0.15	% full scale	<2 % range	Yes
Deviation from linearity	0.70	% of value	<2 % range	Yes
Zero drift	0.20	% full scale	<2% range / 24hr	Yes
Span drift	-0.50	% full scale	<2% range/24hr	Yes
volume or pressure flow dependence	0.02	% of full scale/3 kPa	<2 % / 3 kPa	Yes
atmospheric pressure dependence	0.80	% of full scale/2 kPa	<3% / 2 kPa	Yes
ambient temperature dependence	0.01	% full scale/10K	<3% range / 10 K	Yes
dependence on voltage	0.10	% full scale/10V	< 0.1%vol /10 volt	Yes
losses in the line (leak)	0.37	% of value	< 2% of value	Yes
Uncertainty of calibration gas	1.0	% of value	< 2% of value	Yes

Performance characteristic	Uncertainty	Value of uncertainty quantity
Standard deviation of repeatability at zero	ur0	0.02
Standard deviation of repeatability at span level	urs	0.02
Lack of fit	ufit	0.83
Drift	u0dr	-0.31
volume or pressure flow dependence	uspres	0.001
atmospheric pressure dependence	uapres	0.05
ambient temperature dependence	utemp	0.00001
Dependence on voltage	uvolt	0.18
losses in the line (leak)	uleak	0.52
Uncertainty of calibration gas	ucalib	1.42
Uncertainty in factor	uf	4.01

Measurement uncertainty (Concentration Measured)	245.71	mg/m ³
Combined uncertainty	4.38	mg/m ³
Expanded at a 95% confidence interval	8.76	mg/m ³

Expanded uncertainty expressed with a level of confidence of 95%	2.2	% ELV
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Expanded uncertainty expressed with a level of confidence of 95%	8.8	mg/m ³
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Expanded uncertainty expressed with a level of confidence of 95%	3.6	% value
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APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - CARBON MONOXIDE

Limit value	250	mg/m ³
Concentration @ Ref conditions	172.4	mg/m ³
Cal gas conc	200	mg/m ³
Analyser Full Scale	1250	mg/m ³

Performance characteristics	Value	Units	specification	MU Met?
Response time	30	seconds	180	Yes
Logger sampling interval	60	seconds	-	-
Measurement period	60	minutes	-	-
Number of readings in measurement	60	-	-	-
Repeatability at zero	0.25	% full scale	<1 % range	Yes
Repeatability at span level	0.15	% full scale	<2 % range	Yes
Deviation from linearity	0.70	% of value	<2 % range	Yes
Zero drift	0.01	% full scale	<2% range / 24hr	Yes
Span drift	-0.11	% full scale	<2% range/24hr	Yes
volume or pressure flow dependence	0.02	% of full scale/3 kPa	<2 % / 3 kPa	Yes
atmospheric pressure dependence	0.80	% of full scale/2 kPa	<3% / 2 kPa	Yes
ambient temperature dependence	0.01	% full scale/10K	<3% range / 10 K	Yes
dependence on voltage	0.10	% full scale/10V	< 0.1%vol /10 volt	Yes
losses in the line (leak)	0.62	% of value	< 2% of value	Yes
Uncertainty of calibration gas	1.0	% of value	< 2% of value	Yes

Performance characteristic	Uncertainty	Value of uncertainty quantity
Standard deviation of repeatability at zero	ur0	0.02
Standard deviation of repeatability at span level	urs	0.02
Lack of fit	ufit	5.05
Drift	u0dr	-0.05
volume or pressure flow dependence	uspres	0.005
atmospheric pressure dependence	uapres	0.31
ambient temperature dependence	utemp	0.00001
Dependence on voltage	uvolt	1.08
losses in the line (leak)	uleak	0.57
Uncertainty of calibration gas	ucalib	0.91
Uncertainty in factor	uf	2.57

Measurement uncertainty (Concentration Measured)	157.2	mg/m ³
Combined uncertainty	5.9	mg/m ³
Expanded uncertainty	11.7	mg/m ³

Expanded uncertainty expressed with a level of confidence of 95%	4.7	% ELV
Expanded uncertainty expressed with a level of confidence of 95%	12	mg/m ³
Expanded uncertainty expressed with a level of confidence of 95%	7.5	% value

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APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - OXYGEN

Reference	11	%vol
Reported Concentration	11.31	%vol
Calibration gas	10.23	%vol
Analyser Full Scale	25	%vol

Performance characteristics	Value	Units	specification	MU Met?
Response time	30	seconds	< 200 s	Yes
Logger sampling interval	60	seconds	-	-
Measurement period	60	minutes	-	-
Number of readings in measurement	60	-	-	-
Repeatability at zero	0.015	% by volume	<0.2 % range	Yes
Repeatability at span level	0.014	% by volume	<0.4 % range	Yes
Deviation from linearity	0.13	% vol	<0.3 % volume	Yes
Zero drift (during measurement period)	0.01	% vol at zero level	<2% of volume / 24hr	Yes
Span drift (during measurement period)	0.01	% vol at span level	<2% volume/24hr	Yes
volume or pressure flow dependence	0.02	% of fs / 10l/h	<1% range	Yes
atmospheric pressure dependence	0.80	% of fs/kPa	< 1.5 % range	Yes
ambient temperature dependence	0.01	% by volume /10K	<0.3% volume 10 K	Yes
Combined interference	0.14	% range	<2% range	Yes
Dependence on voltage	0.10	% by volume /10V	< 0.1%vol /10 volt	Yes
Losses in the line (leak)	-0.29	% of value	< 2% of value	Yes
Uncertainty of calibration gas	1.0	% of value	< 2% of value	Yes

Performance characteristic	Uncertainty	Value of uncertainty quantity
Standard deviation of repeatability at zero	ur0	-
Standard deviation of repeatability at span level	urs	0.0018
Lack of fit	ufit	0.08
Drift	u0dr	0.0122
volume or pressure flow dependence	uspres	0.00003
atmospheric pressure dependence	uapres	0.01
ambient temperature dependence	utemp	0.0005
Combined interference (from mcerts)	-	0.08
dependence on voltage	uvolt	0.09
losses in the line (leak)	uleak	-0.02
Uncertainty of calibration gas	ucalib	0.07

Measurement uncertainty (Concentration Measured)	11.31	%vol
Combined uncertainty	0.16	%vol
% of value	1.38	%

Expanded uncertainty expressed with a level of confidence of 95%	2.8	% of value
Expanded uncertainty expressed with a level of confidence of 95%	0.31	% vol

Developed for the STA by R Robinson, NPL

APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - VELOCITY & VOLUMETRIC FLOW RATE

Measured Velocity at Actual Conditions	3.8	m/s
Measured Volumetric Flow rate at Actual Conditions	2606	m ³ /hr

Performance Characteristics & Source of Value	Units	Values	Requirement	Compliant
Uncertainty of Local Gas Velocity Determination				
Uncertainty of pitot tube coefficient	-	0.010		
Uncertainty of mean local dynamic pressures	-	0.33		
Factor loading, function of the number of measurements.	3 readings	0.591	minimum 3	Yes
Range of measurement device	pa	1000		
Resolution	pa	1.00		
Calibration uncertainty	pa	2.10	<1% of Value or 20 Pa whichever is greater	Yes
Drift	% range	0.10		
Linearity	% range	0.06	<2% of value	Yes
Uncertainty of gas density determination				
Uncertainty of molar mass determination	kg/mol	0.00005		
Uncertainty of temperature measurement	K	1.95	<1% of value	Yes
Uncertainty of absolute pressure in the duct	pa	513		
Uncertainty associated with the estimate of density	-	0.008		
Uncertainty associated with the measurement of local velocity	-	0.0001		
Uncertainty associated with the measurement of mean velocity	-	0.0003		

Measurement Uncertainty - Velocity	m/s
Combined uncertainty	0.06
Expanded uncertainty at a 95% Confidence Interval	0.12

Note - The expanded uncertainty uses a coverage factor of $k = 2$.

Expanded Measurement Uncertainty of Velocity at a 95% Confidence Interval	%
Expressed as a % of the Measured Concentration	1.6
Expanded uncertainty at a 95% Confidence Interval	3.2

Measurement Uncertainty Volumetric Flow Rate	m ³ /hr
Combined uncertainty	74
Expanded uncertainty at a 95% Confidence Interval	144

Note - The expanded uncertainty uses a coverage factor of $k = 2$.

Expanded Measurement Uncertainty of Volumetric Flow Rate at a 95% Confidence Interval	%
Expressed as a % of the Measured Concentration	2.8
Expanded uncertainty at a 95% Confidence Interval	5.5

APPENDIX 4 - Record of Report Amendments

Version	Issue Date	Amendments
2	02 August 2016	Operator Details
3	02 August 2016	Further change to operator details
4	15 August 2016	CO limit changed

END OF REPORT

Supporting Information Document

Appendix VI

Environmental Management System

ENVIRONMENTAL MANAGEMENT SYSTEM - BIOMASS BOILER

ASH Heat and Power Limited

VERSION:	1.5	DATE:	02/02/2017		
DOC. REF:	3557-426-A	AUTHOR:	JE	CHECKED:	
CLIENT NO:	426	JOB NO:	3557		



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REGISTERED IN THE UK | COMPANY NO. 4850754

Document History:

<i>Version</i>	<i>Issue date</i>	<i>Author</i>	<i>Checked</i>	<i>Description</i>
1.0	14/10/2016	JE		Draft for internal review
1.1	18/10/2016	JE		Revised following comments from client (SR)
1.2	21/10/2016	JE		Revised following comments from client (MK)
1.3	24/10/2016	JE		For submission to WCBC with Part B permit application
1.4	19/01/2016	JE	DY	Updated draft for client approval
1.5	02/02/2017	JE	DY	Updated in response to client comments

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- Appendix II - Planning Consent
- Appendix III - Record Keeping Forms

1 General Considerations

1.1 Site Operator/Permit Holder

1.1.1 ASH Heat and Power Limited are applying for a Part B Environmental Permit to operate two biomass boilers to provide renewable heating to a site at Redwither Road, Wrexham Industrial Estate, Wrexham LL13 9RD. The boilers will be fuelled by Grade A waste wood.

1.1.2 The contact details for ASH Heat and Power Limited are as follows:

ASH Heat and Power Limited	Contact: Neil Hassall
Redwither Road	
Wrexham Industrial Estate	
Wrexham	Position: Director
LL13 9RD	Contact Number: 01978 663510

1.1.3 Oaktree Environmental Ltd have been engaged to act as consultants for ASH Heat and Power Limited to assist in the preparation of this Management System and to submit an application for an Environmental Permit to operate biomass boilers fuelled by Grade A waste wood.

1.1.4 Contact details for Oaktree Environmental Ltd are as follows:

Oaktree Environmental Ltd	Contact:	Jan Edwards
Lime House	Position:	Senior Consultant
Road Two	Tel:	01606 558833
Winsford	Fax:	01606 861182
Cheshire CW7 3QZ	E-mail:	jan@oaktree-environmental.co.uk

1.2 Site Location and Planning Status

- 1.2.1 The biomass boilers are to be located at Redwither Road. The proposal is to obtain Grade A waste wood which has been accepted and graded under a waste permit/exemption at other facilities. The processed Grade A wood would be transferred to the boiler feedstock storage area as shown on Drawing No. 1622B023 - SL. ASH Heat and Power Limited will quality check Grade A material to be used in the biomass boiler, and reject loads containing non-target material.
- 1.2.2 A Planning application for relevant planning consent is being prepared for submission to Wrexham Borough Council for the biomass boiler/s and the associated stack/s. A copy of the planning consent will be included within Appendix II for reference once it has been issued.

1.3 Permit Area

- 1.3.1 The area which is the subject of this Environmental Permit application is outlined in red on Drawing No. 3557/426/02. All references to 'the site' in this Environmental Management System (EMS) shall mean this area.
- 1.3.2 The Environmental Permit is required for the operation of a biomass boiler fuelled by Grade A waste wood, which will be used in addition to virgin timber.
- 1.3.3 Reference should be made to the infrastructure plan in Appendix I for the layout of operations.
- 1.3.4 This EMS documents site management procedures, providing a documented system for site management to minimise risk of air pollution to assist with compliance with the permit.

1.4 Hours of Operation

- 1.4.1 The site will be open for the receipt of waste wood as follows:

Monday to Friday	06:00 – 22.00
Saturday	06:00 – 17.00

Sundays	06:00 – 12.00
Bank/Public holidays	06:00 – 17.00

The operating hours for the handling of wood on site will be as follows:

Monday to Friday	06:00 – 18.00
Saturday	06:00 – 18.00
Sundays	06:00 – 12.00
Bank/Public holidays	06:00 – 18.00

- 1.4.2 The proposed boilers will be operated on a continuous basis, 24 hours per day, 7 days per week, except during periods of maintenance.
- 1.4.3 The only other activities on site which will be permitted outside of these hours are maintenance works, general office use and work not connected with the permit.
- 1.4.4 During times where the site is closed or not in operation, the site will be secured to prevent unauthorised vehicular and/or pedestrian access.

1.5 Staffing

- 1.5.1 The table below details the typical staff structure for the operation. This excludes external contractors used for maintenance and monitoring, which will be periodically hired in.

Table 1 Site Staffing Levels

Position	Employees	Responsibilities
Director	1	Overseeing all activities which take place at the site
Operations manager	1	Managing all site staff
General operatives	3	Operating wood processing, unloading and loading plant, weighbridge, transportation and biomass boiler
Admin	2	Managing site administration

2 Operations

2.1 Biomass Boiler Make, Model and Configuration

2.1.1 The boilers to be used are 1000KW Binder RRK1000 Boilers. Drawings of the boiler configuration are contained within Appendix I. The location of the biomass boilers are illustrated on Drawing No. 1622B023 - SL. The boilers include elevated flues to release residual emissions. The flue locations are shown on drawing no. 1622B023 - SL.

2.2 Boiler Fuel Types and Quantities

2.2.1 In addition to virgin wood/biomass, the boiler will be fuelled by Grade A waste wood. No use of Grades B, C and D waste wood will be permitted.

2.2.2 Each boiler will be fuelled continuously at a rate of up to 425kg.hour⁻¹ via walking floor fuel loader, each generating up to 1000KW of renewable heat (2000KW in total) for use on-site. The actual processing and storage of the waste wood to be used in the boiler is subject to separate regulation to the Part B permit.

2.2.3 Protocols/procedures will be in place to ensure that in addition to virgin wood/biomass, only Grade A waste wood is used in the boiler. Whilst the permit for operation of the boiler does not cover/regulate the processing operations, this document outlines the procedures that will be implemented by the site operator to ensure that the permit can be complied with, eg. assurance that in addition to virgin wood/biomass, only Grade A waste wood will be used to fuel the boiler.

2.3 Plant and Machinery

2.3.1 The following plant and machinery (or similar replacement plant if not available) will typically be used for unloading/loading of processed wood:

- Loading shovel.

2.4 Procedures for Identification and Separation of Grade A Waste Wood for Use in Boiler

2.4.1 The permit strictly prohibits the use of any other grades of waste wood in the boiler apart from Grade A. The following table outlines a description of the different types of waste wood, which has been obtained from 'DEFRA' research and can be used as a guide for identifying Grade A waste wood. Waste wood colour coded green in the table below is the only waste wood to be permitted for use in the boiler (Grade A).

Table 2 Waste Wood Identification Guide

Waste Wood Grade	Materials Within Waste Wood	Typical Non-Wood Content Prior to Processing
Grade A "Clean" Recycled Wood	Solid softwood and hardwood, packaging waste, scrap pallets, packing cases and cable drums. Process off-cuts from joinery/manufacturing	Nails and metal fixings. Minor amounts of paint, and surface coatings
Grade B Industrial Feedstock	May contain up to 60% Grade A, plus building and demolition materials and domestic furniture made from solid wood	Nails/metal fixings. Some paints, plastics, glass, grit, coatings, binders and glues
Grade C Fuel Grade	All above, plus fencing products, flat pack furniture made from boards products and DIY materials. High content of panel products such as chipboard, MDF, plywood, OSB and fibreboard	Nails and metal fixings. Paint coatings and glues, paper plastics and rubber, glass, grit. Coated and treated timber (non CCA or creosote)
Grade D Hazardous Waste	Fencing, transmission poles railway sleepers, cooling towers	Copper/chrome/arsenic preservation treatments, creosote

2.4.2 A visual check will be in place to ensure only clean uncontaminated Grade A wood (as detailed in Table 2 above) is used in the boilers.

3 Control of Air Emissions, Monitoring and Reporting

3.1 Site Diary/Logbook and Record Keeping

3.1.1 A site diary/logbook will be maintained which contains details of all site inspections, monitoring and improvements made. All plant malfunctions and spillages will also be recorded within the log book. All inspections will be completed by a person who is familiar with the requirements of the management system and permit for the site. A minimum of two years records will be kept and will be made available for inspection upon request by the regulator. Example record keeping forms are included in Appendix III of this EMS.

3.2 Control of Boiler Exhaust Emissions

3.2.1 The boilers are fitted with a cyclone and use High Velocity Air Cleaning (HVA) to control emissions of particulate matter. Carbon monoxide (CO) and nitrogen oxides (NO_x) emissions are minimised via control of combustion conditions, including excess air and use of Exhaust Gas Recirculation (EGR).

3.3 Spillages

3.3.1 Good housekeeping will be maintained on site at all times to minimise risk of fugitive dust release. All site surfaces will be inspected daily when the site is in operation. Debris will be swept as required and placed in a skip for disposal to a suitably permitted site.

3.3.2 The operator will aim for all spillages of waste and windblown litter to be cleared by the end of the working day in which they occur.

3.4 Control of Dust

3.4.1 A series of dust mitigation measures will be implemented within the Part B permit boundary area to ensure dust emissions are controlled as far as is practically possible. The measures include:

- Sheeting of vehicles delivering materials to the site (if necessary);

- Cleaning of any spillages using wet cleaning methods; and,
- Drop heights minimised to prevent dust emissions.

3.4.2 All plant and machinery will be operated in accordance with manufacturer specification. Any spillages will be cleaned using wet cleaning methods. The boiler and fuel store will be enclosed to prevent fugitive release.

3.5 Boiler Emissions Monitoring

- 3.5.1 The biomass boilers will be fitted with the following equipment to continuously monitor emissions:
- Lambda sensor to monitor exhaust oxygen content to enable control of excess air and air/fuel ratios;
- 3.5.2 In addition to the above, boiler emissions will be periodically monitored using approved methods.
- 3.5.3 Given that the boiler will be fuelled by a consistent type of feedstock (virgin biomass and Grade A waste wood), will be continuously loaded with fuel and have sensors in place to monitor and control excess air, monitoring of CO emissions is not required, in accordance with the relevant guidance. Emissions of CO would be monitored annually.
- 3.5.4 Particulate matter and organic compounds will be monitored annually by a suitably qualified contractor, using approved methods.
- 3.5.5 NO_x emissions will be monitored upon commissioning of the boiler and after any subsequent substantial change to the installation.
- 3.5.6 Oxygen will be continuously monitored using a Lambda probe.
- 3.5.7 All monitoring will be undertaken in accordance with the methods detailed in DEFRA Process Guidance Note 1/12(13), or by alternative equivalent method agreed with the regulator.
- 3.5.8 The operator will notify the regulator at least 7 days before any periodic monitoring exercise to demine compliance with emission limit values stating the provisional time and date of monitoring, pollutants to be tested and methods to be used. The results of non continuous emission testing should be forwarded to the regulator within 8 weeks of completion of the sampling.

3.5.9 Adverse results from any monitoring activity (continuous and non-continuous) should be investigated by the operator as soon as the monitoring data has been obtained.

3.5.10 The emission limits which apply to the boiler are outlined in Table 3. Emissions monitoring is required to demonstrate compliance with these emission limits.

Table 3 Boiler Emission Limits

Pollutant	Emission Limits (mg.m ⁻³) Expressed at Reference Conditions of 11% O ₂ , 273K, no correction for moisture
CO	150
Total Particulate Matter	60
NO _x	400
Organic Compounds	20

3.5.11 All monitoring results and subsequent actions will be recorded in the site log book and kept available for the regulator to examine for a minimum period of two years.

3.5.12 In the event of adverse results (non-compliance) for both continuous and non-continuous emissions monitoring, investigation will be immediately undertaken by the site operator, who will:

- Identify the cause and take corrective action;
- Clearly record as much detail as possible regarding the cause and extent of the problem, and the remedial action taken; and,
- Re-test to demonstrate compliance as soon as possible and inform the regulator of the steps taken and the re-test results.

3.6 Visual Monitoring of Stack Exhaust

3.6.1 Emissions from the combustion process should be free from visible smoke. During start up and shut down of the boiler, emissions should not exceed the equivalent of Ringelmann Shade 1 as described in British Standard BS 2742:2009. All emissions from air should be free from droplets and persistent visible emissions. Stack emissions will be visually monitored on an ongoing basis by site staff.

3.7 Complaints Procedure

- 3.7.1 A complaints procedure will be maintained during operation of the site to ensure that any complaints made in relation to air emissions (eg dust) are investigated, documented and action taken as necessary.

4 Site Management and Training

4.1 General

- 4.1.1 A log book will be kept on site which will contain records of all monitoring results, visual assessments, inspections and maintenance undertaken. All plant malfunctions and spillages will also be recorded within the log book along with the remedial action taken. A minimum of two years records will be made available for inspection upon request by the regulator. Any records maintained off-site will be made available within one week of request by the regulator.

4.2 Health and Safety

- 4.2.1 Personal Protective Equipment (PPE) will be issued to all plant operators to ensure their safety.

4.3 Staff Training - General

- 4.3.1 All relevant staff will be made aware of their responsibilities under the permit and receive training on the following:
- Steps necessary to minimise emissions during start-up and shut-down; and,
 - Actions to be taken should abnormal conditions, accidents or spillages occur

4.4 Training Needs Assessment

- 4.4.1 All new and existing site staff are subject to a specific training regime based on their responsibilities at the site to ensure all operations are carried out without harm to the environment or amenity of the surrounding area. Training with regard to the individual responsibilities of the site staff will help to prevent incidents occurring which may have an adverse impact on the environment and/or the employees and their co-workers.

4.5 Site Rules and Infrastructure Training

- 4.5.1 This information will be provided to all employees, visitors and contractors with a full understanding of the site's conditions of use, which will be communicated and documented at induction for all staff with specific induction for visitors and contractors.

4.6 Vehicle /Plant Preventative Maintenance Training

- 4.6.1 This training is provided specifically for the vehicle and plant operators in order to ensure that all plant and machinery is checked regularly to prevent any occurrences which may lead to any adverse impacts on the environment or human health.
- 4.6.2 The same training will be provided to senior management enabling a dual-level maintenance programme.

4.7 Plant Operation Training

- 4.7.1 Any employees who are required to operate loading plant for the movement of wood waste will be required to undertake the necessary qualifications for the operation of the specific item of plant in question. This will be required prior to operating the plant and will be obtained through necessary external certification programmes.
- 4.7.2 Regardless of general plant operation certification, relevant operatives will be fully inducted in the operation of the specific make and/or model of plant used on site.

4.8 Permit /Management System Training

- 4.8.1 All employees will be made aware of the operating conditions as prescribed in the Environmental Permit for the site. Whilst much of the above training will provide specific guidance on many aspects of these documents, all employees will be made aware of the location of the Environmental Permit in the site office. All managerial positions will be made fully aware of the site operating conditions.

4.9 Training for Contractors

- 4.9.1 Where required general site training will be provided to any contractors who are working on the site on a temporary basis.

- 4.9.2 Where required additional training will be provided to contractors in their area of expertise. If they are dealing with specific items of plant/machinery, site operating conditions and a general understanding of the Environmental Permit conditions will be provided to prevent any adverse impacts on the environment.

5 Maintenance

- 5.1 The biomass boiler will undergo servicing as required by the manufacturer by an appropriately qualified contractor. In addition, the boiler will be cleaned on a by the site operator, in accordance with manufacture instruction/specification.

- 5.2 The site operator will maintain a written maintenance programme for all pollution control equipment and keep records of any maintenance that has been undertaken within the logbook.

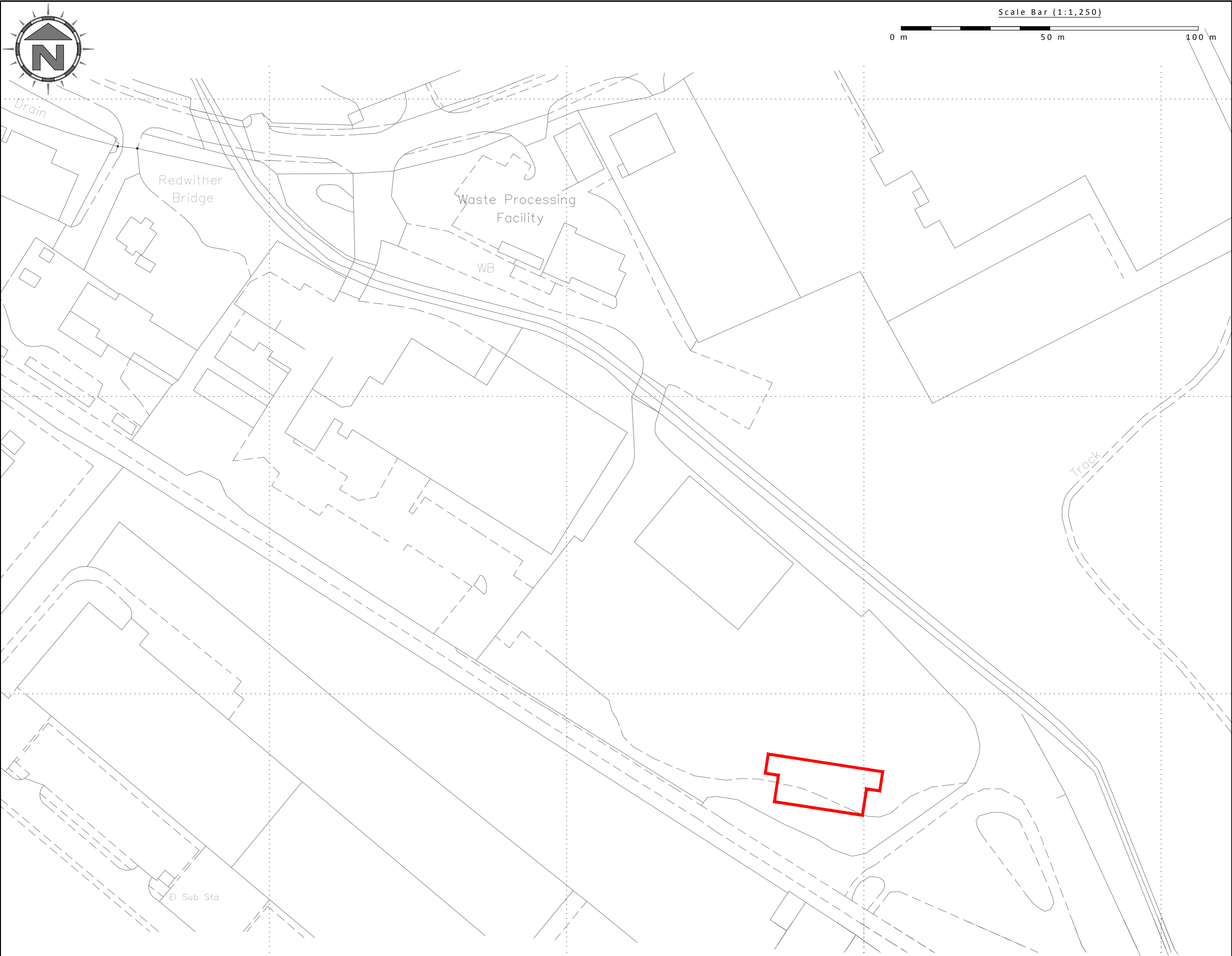
- 5.3 Essential spares for plant maintenance will be kept on site at all times or available at short notice from guaranteed local suppliers.

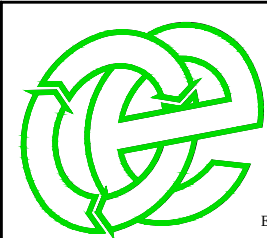
- 5.4 All checks on plant and equipment will be recorded within the log book.

- 5.5 Good housekeeping will be maintained at all times on site. Any spillages will be cleaned on a regular basis.

Appendix I

Permit Boundary Plan and Site layout Plan





Oaktree Environmental Ltd
Planning, Waste Management
and Environmental Consultants
Unit 5, Oasis Park, 19 Road One
Winsford Industrial Estate
Winsford, Cheshire CW7 3RY
Tel: 01606 558833 Fax: 01606 861182
E-mail: sales@oaktree-environmental.co.uk

Drawing No: 3557/426/02		Revision: -	
Title: PERMIT BOUNDARY PLAN			
Site: Redwither Road, Wrexham Ind. Estate, Wrexham LL13 9RD			
Client: Ash Heat and Power Ltd			
Date: 20 January 2017		Job No: 3557	
Drawn By: CP	Checked: DTY	Client No: 426	
Scale: 1:1,250		Printed At: A3	

Key:

Permit boundary

Notes:

(1) Drawing for indication only.
(2) Do not scale from this drawing.
(3) All measurements must be verified on site.

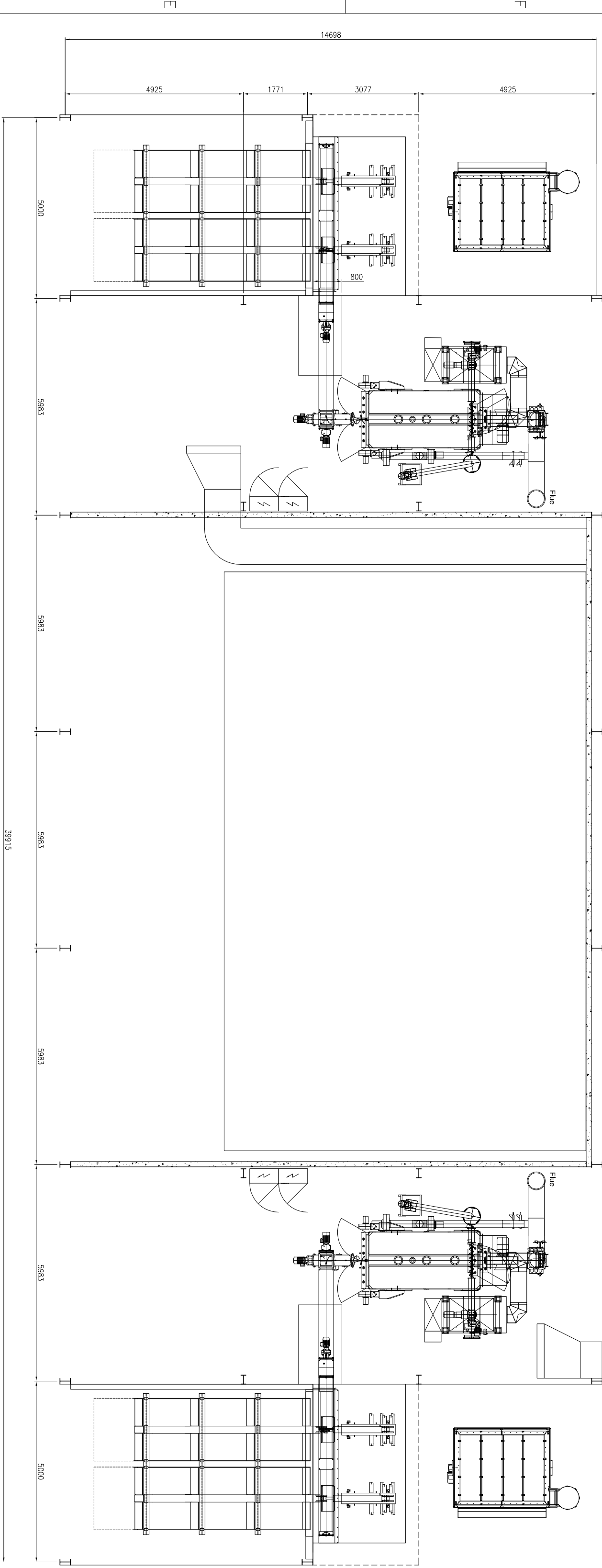
REVISION HISTORY			
Rev:	Date:	Rev:	Description:
-	20/01/17	CP	Initial drawing

NOTES:

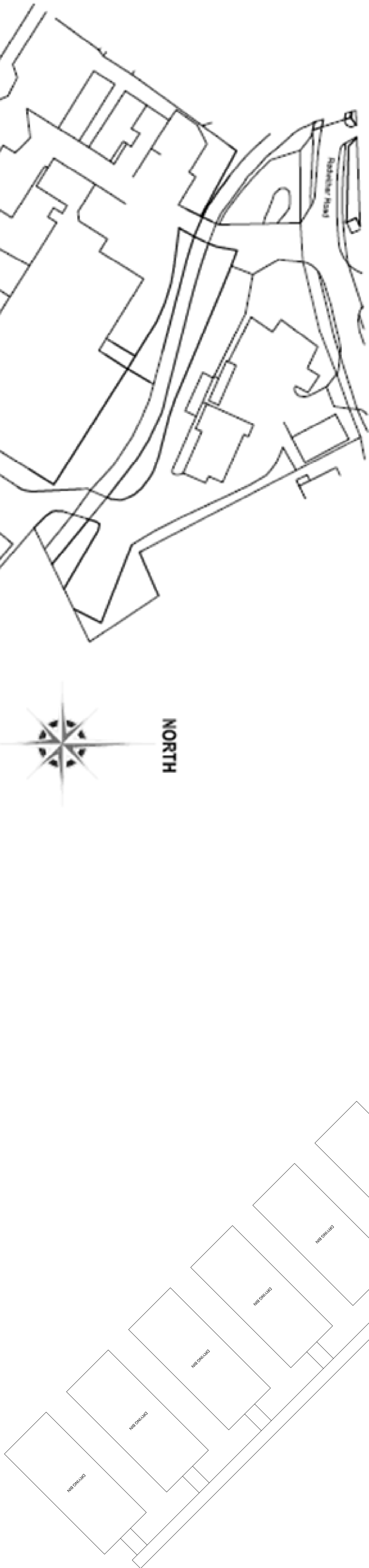
ALL DIMENSION IN mm UNLESS OTHERWISE STATED

DO NOT SCALE - IF IN DOUBT ASK

THIS DRAWING IS BASED
UPON GARETH PUGH BUILDING DRG
& WEL DRG 1622B023 - 0A - R03



PLAN



NORTH

LOCATION PLAN (NTS)

Rev	Date	Description	Drawn	Approved
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FOR INFORMATION

Client:

Consultant:

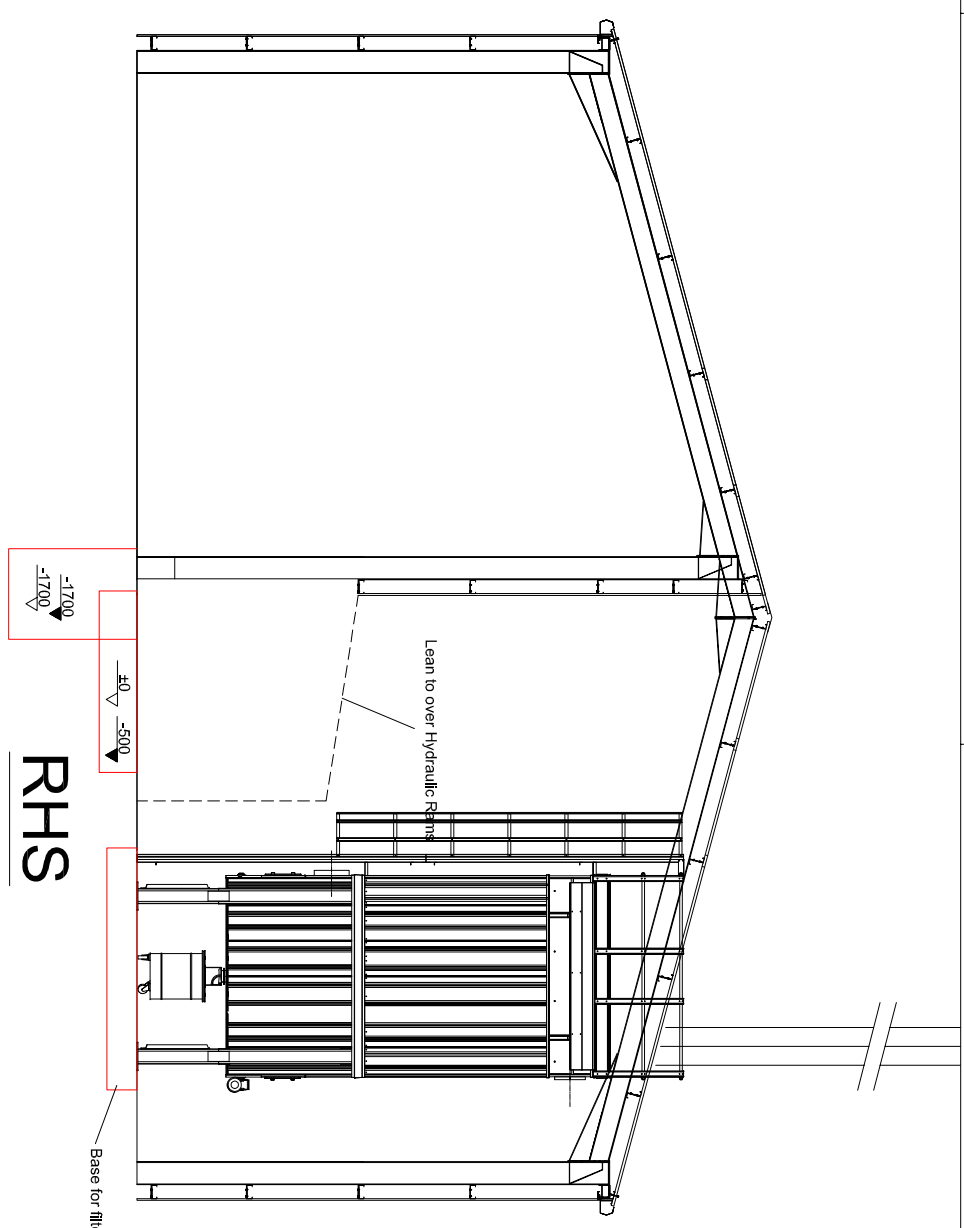
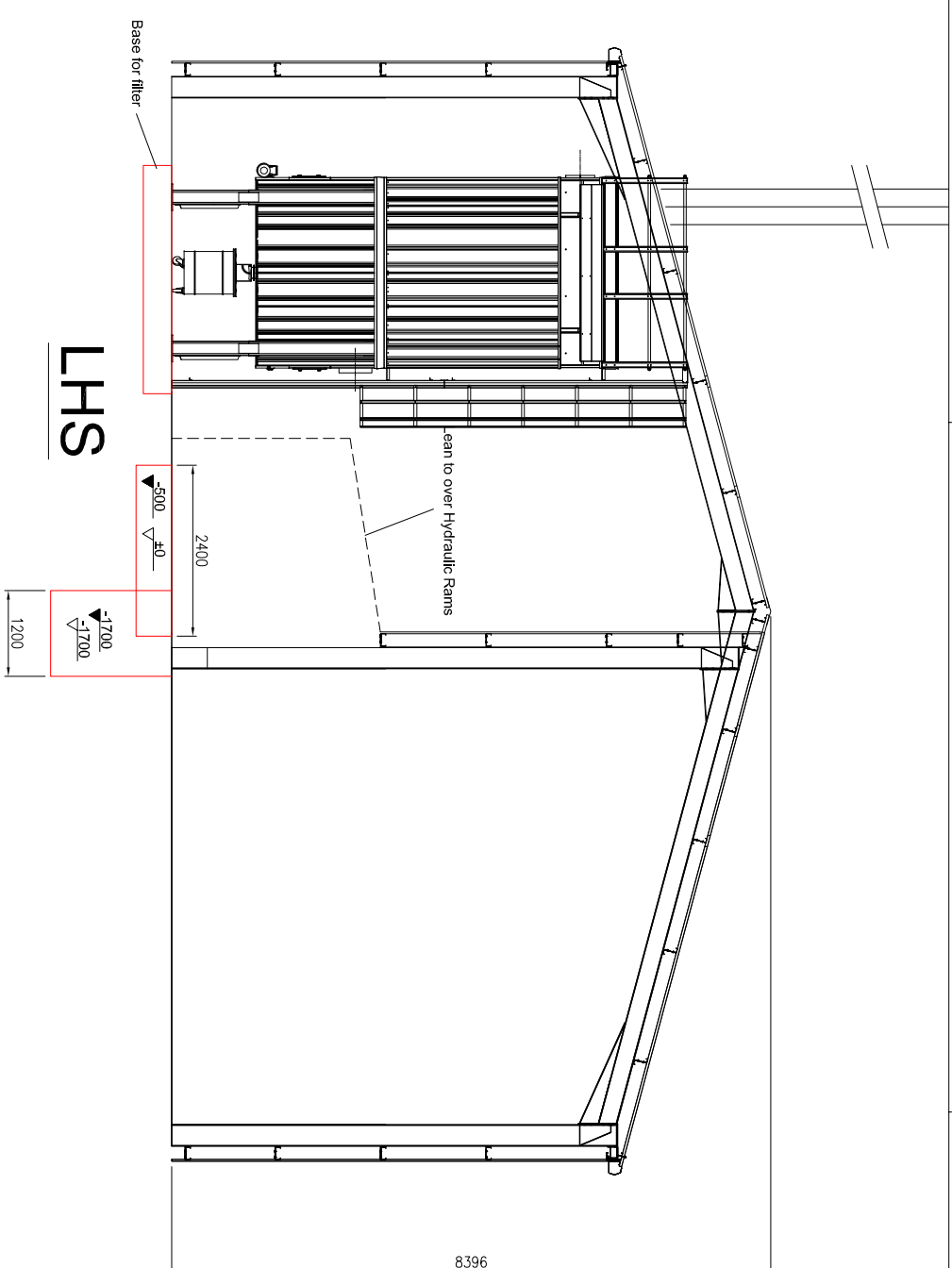
Project:
NEW BUILDING AT ASH WASTE LTD.
WREXHAM IND. EST.

Drawing Title:
SITE LAYOUT PLAN

Scale	Page No.	Page Title	Drawn By / Date
1:100	A1	KEB 06.01.17	
SF	TH	TH	TH
1622B023 - SL			R00

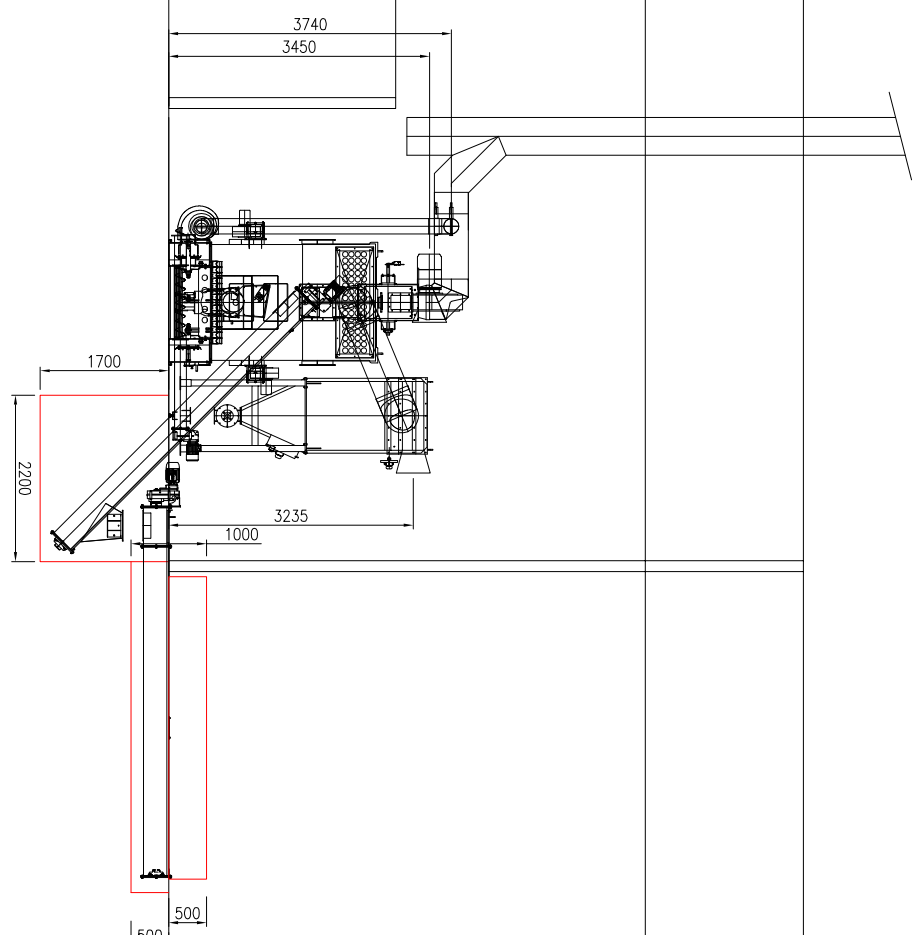
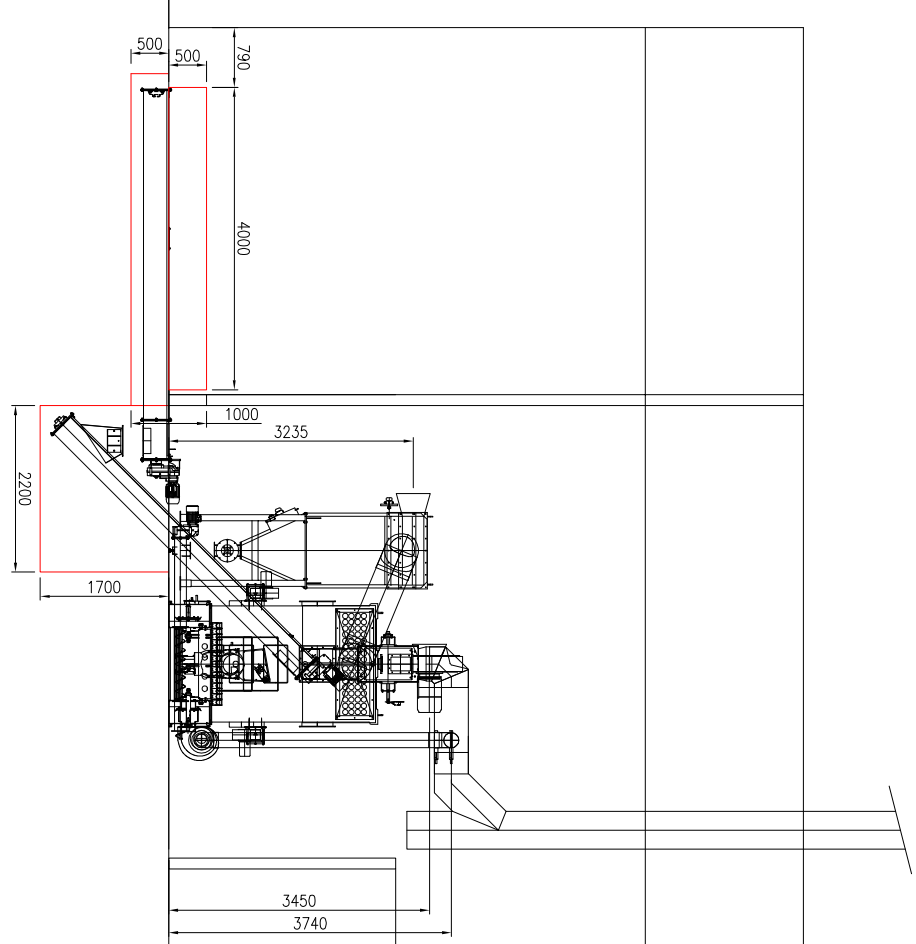
© Copyright of this drawing remains with Wood Energy Ltd and constitutes confidential information. Any form of reproduction without express written authority from Wood Energy Ltd.

- (2) All safety equipment must be available according to local regulations.
- (3) The transport of all boiler components into the boiler room must be possible.
- (4) Access for service and maintenance is required for all plant components.
- (5) The auger requires a minimum installation opening of 1000x1000mm (WXH)
- (6) The auger opening needs to be sealed by the client in accordance with local regulations.
- (7) The traverse beams within the fuel store (e.g. HEA160) as well as the walking floor anchors need to be connected to the base layer and top layer of reinforced concrete.
Hydr. ram traction ... 40t
Hydr. ram thrust ... 40t
These forces also apply to the fuel store walls.
- (8) An opening of 4000x500mm (WXH) in front of the walking floor is required.
- (9) The 2nd phase of construction of the fuel store must not start prior to finishing positioning the anchors of the hydr. rams (clearance by installing engineer).
- (10) Minimum level difference of fuel store floor is +7.3mm.
- (11) All structural engineering taking in account specified forces by client.

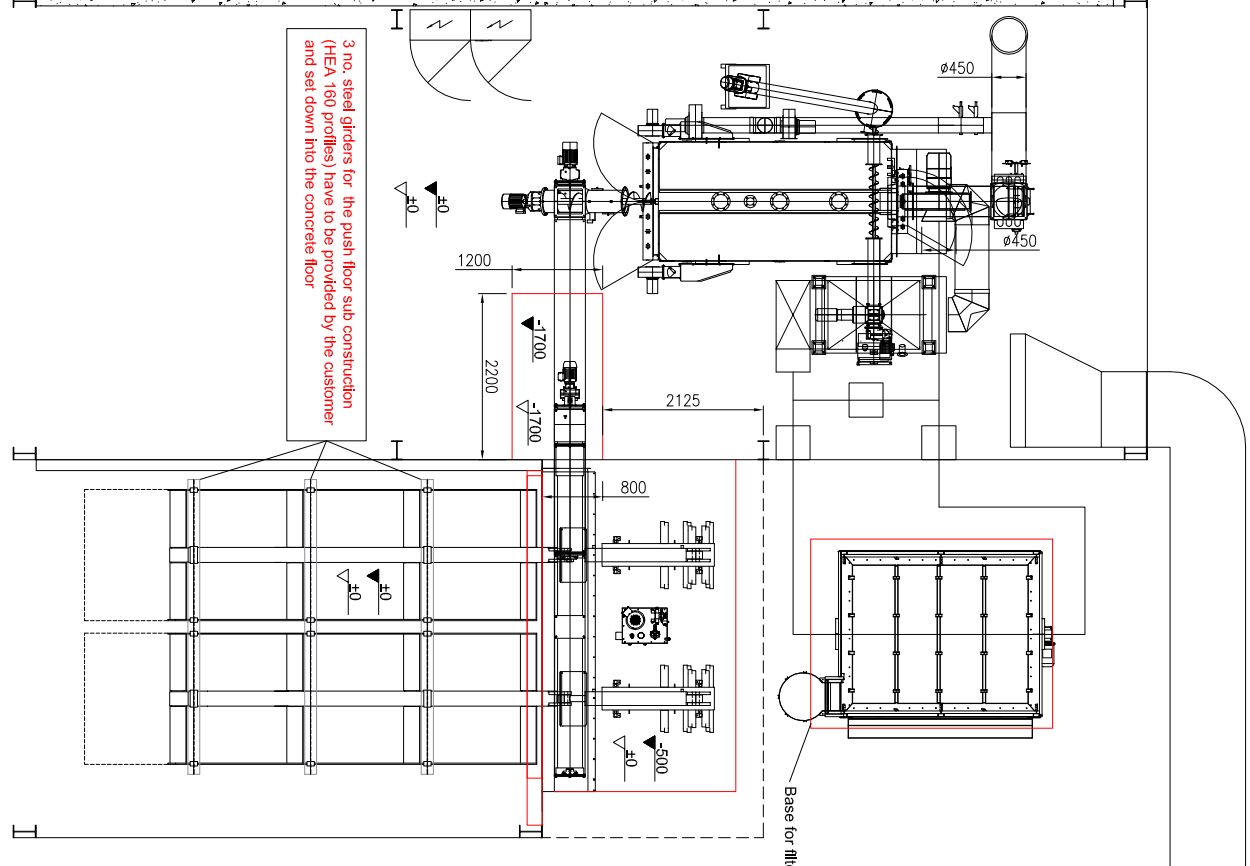
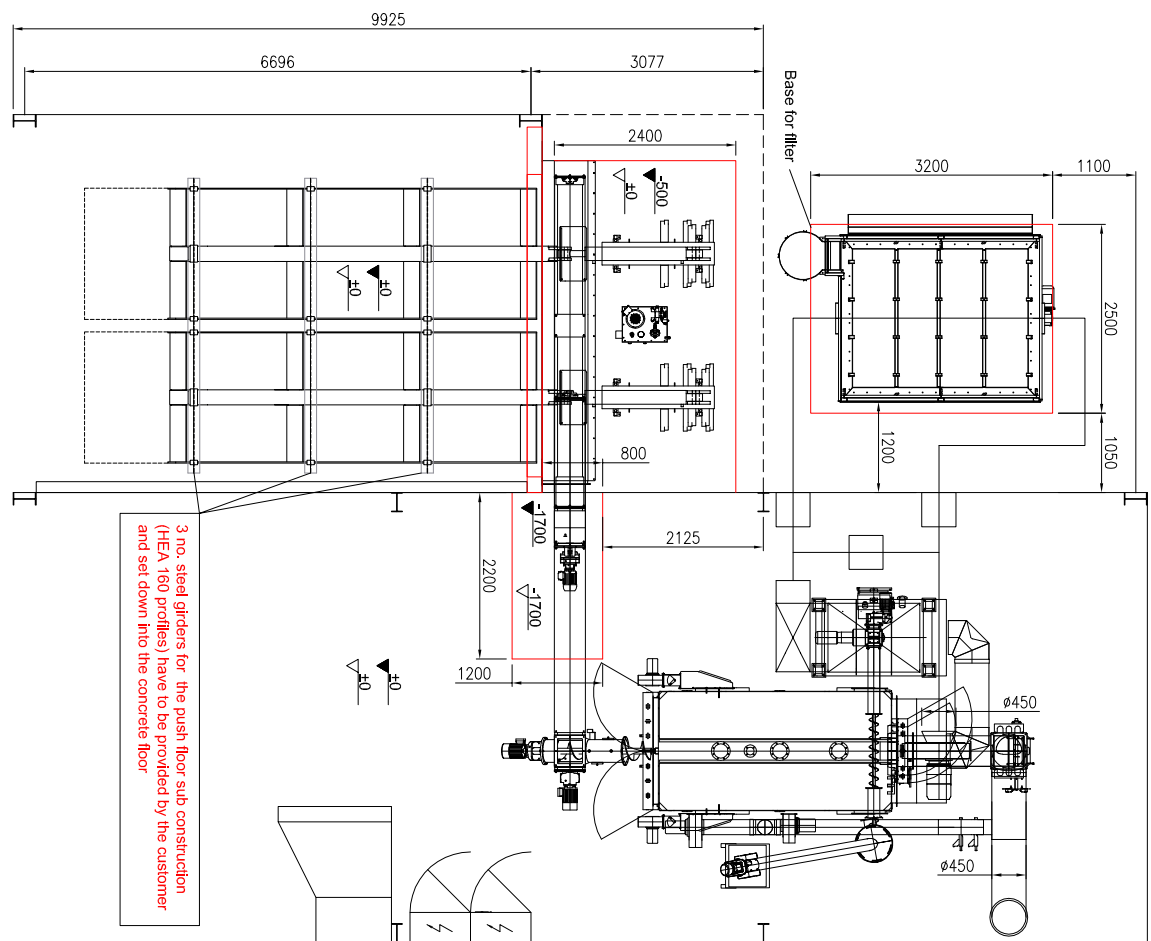
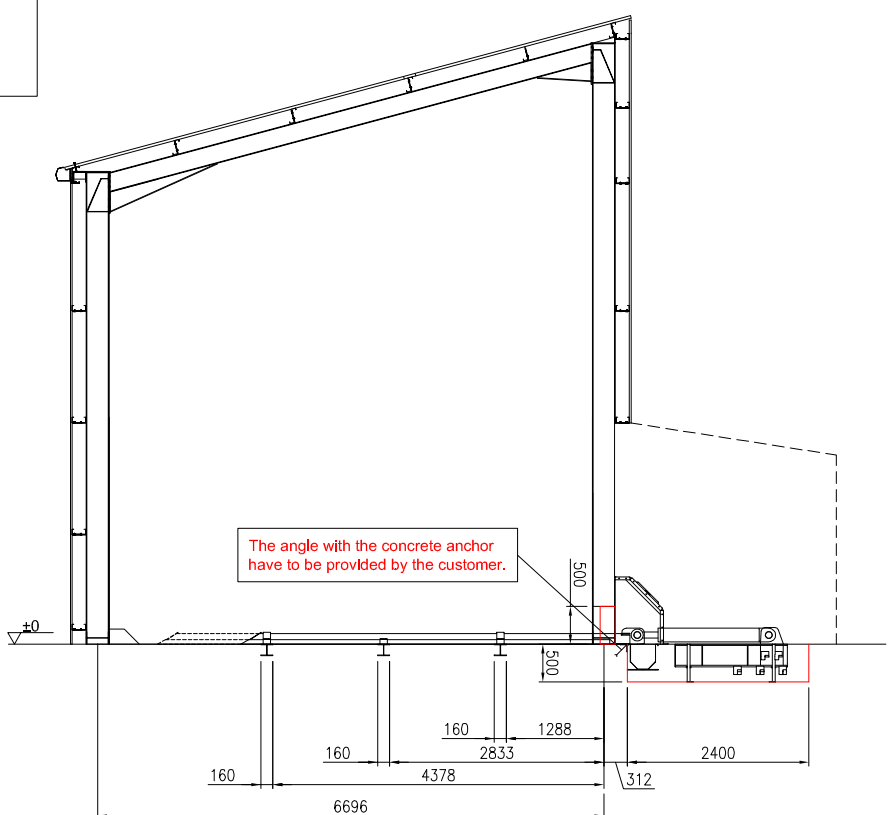


NOTES:
ALL DIMENSION IN mm UNLESS
OTHERWISE STATED
DO NOT SCALE - IF IN DOUBT ASK

THIS DRAWING IS BASED
UPON GARETH PUGH BUILDING
(Received 07.12.16)



FRONT

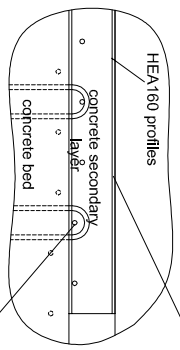


PLAN

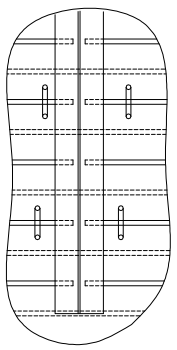
push floor sub construction
(schematic representation)

The steel girders (HEA 160 profiles) have to be flush with the upper edge of the concrete.

Detail tee square between fuel storage room and push floor hydraulic room (schematic representation)



edge of the concrete.



A structural calculation considering the specified forces has to be provided by the customer!

(HEA 160 profiles, in the fuel store have to be connected with the reinforcement of the concrete bed and the reinforcement of the concrete secondary layer.

push floor hydraulic room

tee square L 100x100x8 with welded concrete brackets

The tee square is used as edge protection and mounting aid

1st construction phase (granular sub-grade) ▼

2nd construction phase = final level ▽

construction phase 1..... before installation of the pushing floor

construction phase 2..... after installation of the pushing floor

The concrete foundation where the boiler block is positioned, has to withstand the weight of 16105kg! (The base frame can exceed temperature over 200°C)

Row	Date	Description	Owner	Assessment
06	12/21/7	Chairs replaced in med. Issues for construction	KLB	SF
04	06/01/17	Items in hall, including two armchairs for common hall, wooden table added for 30th's	KLB	SF
03	08/12/16	Upstairs with floor construction done and carpets on client building shell.	KLB	TM
02	10/11/16	13 S. 87 S. ramp and from 330x91. Better kitchen area.	KLB	TM
01	02/11/16	Upstairs after elevators. Dying lights moved to other side of building.	KLB	TM



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Fax: +44 (0) 845 070 7339
Web: www.woodenergy.com

FOR CONSTRUCTION

Client

Consultant

Consultant

NEW BUILDING AT ASH WASTE LTD.
WREXHAM IND. EST.

Drawin

2 X BINDER 1 SKT 11 MW
2 X SBA WALKING FLOORS
DRYING FLOOR AND 10 DRYING BINS

100

Full

...

1

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Appendix II

Planing Consent

Appendix III

Record Keeping Forms

STAFF TRAINING/REVIEW FORM										
EMPLOYEE NAME					DATE					
POSITION					REVIEW DUE					
TRAINING CARRIED OUT BY										
POSITION										
TRAINING REQUIRED	GENERAL OPERATIVES		HGV DRIVERS		PLANT OPERATOR		OPERATIONS MANAGER		OTHER	
CARRIED OUT?	Y/N	SIGNED BY EMPLOYEE	Y/N	SIGNED BY EMPLOYEE	Y/N	SIGNED BY EMPLOYEE	Y/N	SIGNED BY EMPLOYEE		
SITE RULES AND INFRASTRUCTURE										
EMERGENCY PROCEDURES										
FIRE SAFETY/ FIRE FIGHTING										
RECOGNITION OF WASTE TYPES										
STORAGE AREAS/LIMITS										
RECORD KEEPING										
VEHICLE CHECKS (Preventative Maintenance)										
PLANT CHECKS (Preventative Maintenance)										
DUTY OF CARE WASTE TRANSFER NOTES										
PLANT OPERATION - LOADING PLANT										
PLANT OPERATION - BOILER										
MANAGEMENT SYSTEM & PERMIT										
OTHER 1 (PLEASE SPECIFY)										
OTHER 2 (PLEASE SPECIFY)										

