**Gasification and Pyrolysis:**

**Fuel Measurement and Sampling Procedures Questionnaire**

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| Gasification and Pyrolysis Fuel Measurement and Sampling (FMS) Questionnaire Guidance | |
| Overview: | The submission and approval of this questionnaire document forms part of the Renewables Obligation (RO) accreditation process for gasification and pyrolysis generating stations. These stations are required to undertake FMS procedures on a monthly basis in order to substantiate the figures submitted as part of monthly Renewables Obligation Certificate (ROC) claims.  Before completing this document please read the ‘FMS procedures for Advanced Conversion Technologies’ section of Ofgem’s ‘Renewables Obligation: Fuel measurement and sampling guidance’ document. This can be downloaded from the fuelled generator page of the Ofgem website, [here](http://www.ofgem.gov.uk/Sustainability/Environment/RenewablObl/FuelledStations/Pages/FS.aspx). For further information on when this questionnaire should be updated please refer to the ‘When to submit FMS procedures’ section of the FMS guidance document.  After the first submission of your questionnaire, Ofgem will work with you in order to develop the procedures outlined in your initial proposal further and ensure they are capable of providing accurate and reliable results to support your monthly ROC claim submissions on the Renewables and CHP register (R&CHP register).  Although supplementary documents may be required to provide additional information regarding your proposed FMS procedures, it is essential we have a concise record of your FMS procedures and as such this questionnaire document must be completed fully and approved by Ofgem as part of the RO application process.  This questionnaire document is not for Anaerobic Digestion (AD) generating stations. |
| Questionnaire Completion: | This questionnaire document covers both the **final fuel** e.g. syngas[[1]](#footnote-1) or liquid bio-oil produced e.g. that used for generation, and also the **feedstock(s)** from which these are produced e.g. waste or biomass fuels.  Please provide a suitable level of detail when answering questions in order to clearly outline your procedures. This will aid Ofgem in the review of your questionnaire and reduce unnecessary delays in the approval process. The size of the text box available for response should indicate the length of reply expected. If additional space is required in order to answer a question however, this is available in section G.  Some questions are compulsory for all generating stations. Compulsory questions must be answered and are marked with a **🏱** symbol.Others questions however, are only applicable in some cases and will not be relevant to all generating stations. In these cases you are welcome to state ‘not applicable (N/A)’ in the answer field or leave the answer blank where appropriate.  Some questions within this document are free text and a written answer is expected. Others are restricted however and you should select a set option either from a drop down list, option button or provide confirmation through checking a tick box. The drop down menus embedded within this questionnaire will not function in Word 2003 and any previous versions of the software. If you do not have access to Word 2007 please contact Ofgem for an alternative version of the questionnaire. If required, copy and pasting can be undertaken using the Ctrl+C (copy) and Ctrl+V (paste) keys.  When making reference to any industry standards please include the name, issuing body and reference number of the standard. In addition, please note that where Article 22(3) purposes are mentioned in the questionnaire this corresponds to Article 21(3) of the NIRO Order. |
| Questionnaire Submission: | Your initial FMS questionnaire will be submitted alongside your application via the R&CHP Register. Ofgem will review your initial proposal and then make contact with you directly with a set of comments to be addressed. From this point forward updated versions can be submitted directly to the member of Ofgem’s staff dealing with your FMS procedures until no further comments are raised and an agreement is confirmed.  Please ensure the title of the FMS questionnaire document includes the generating station name (as appears on the R&CHP register application) and the version number e.g. revision (rev) 1. |
| Contacting Ofgem: | For general questions relating to FMS, the contact details for our fuelling team are as follows:   * E-mail: renewable@ofgem.gov.uk / Telephone: 020 7901 7310.   Once you have submitted the FMS questionnaire correspondence should take place directly with the member of staff handling your FMS procedures. |

**Section A. Application Information:**

Please provide the following general information regarding the generating station, fuel(s) and feedstock(s) to which these procedures relate to.

1. Name of generating station (as appears on the R&CHP register) **🏱**:



1. Capacity of generating station (DNC[[2]](#footnote-2) kW) **🏱**: 
2. Proposed technology**🏱**: **Choose an item.**
3. Final fuel(s) produced e.g. syngas or liquid bio-oil **🏱**:



1. Feedstock(s) utilised e.g. waste or biomass fuels **🏱**:



**Section B. Version History:**

This section should only be completed for any revisions made **after the initial approval of procedures** has been given by Ofgem.

1. Please indicate the version number of these FMS procedures N.B. Rev 0 is the procedures as originally approved: **Choose an item.**
2. Date of latest version submission: **Click here to enter a date.**
3. State the purpose of this latest revision and indicate the changes made (making reference to specific question numbers e.g. E7):



**Section C. Fossil Fuel Use:**

This section should be completed where fossil fuels are used at the generating station.

1. Is any fossil fuel used within the generating station which could lead to the generation of electricity? **🏱**

N.B. This refers to the combustion of the final fuel within the generating station and not the pyrolysis or gasification of the feedstock(s).

If you have answered ‘yes’ to question C1, then questions C2-C5 should also be answered.

1. Please outline the type of fossil fuel used which results in the generation of electricity: 
2. Please state the purpose of fossil fuel use[[3]](#footnote-3): **Choose an item.**
3. If fossil fuel is being use for Article 22(3) purposes please state the specific purpose(s):



1. Please indicate briefly how the mass / volume and gross calorific value (GCV) of any fossil fuel used each month are known or will be measured, including how you will evidence this figure to Ofgem on a monthly basis:



N.B. You are not required to provide an in depth explanation of fossil fuel procedures here.

**Section D. Volume of the final fuel produced:**

If you have answered ‘yes’ to question C1, or there is another fuel other than the final fuel which will lead to generation, you should answer the following question regarding the measurement of the volume of the final fuel.If only the final fuel is used for generation simply state as such in this section.

1. State how you will measure the volume of the final fuel combusted in a month. State the position that measurement is taken and unit of measurement. Also provide details of any equipment used e.g. a flow meter, and confirm its accuracy.



**Section E. Determining the GCV of the final fuel:**

ROCs can be awarded for generation from gasification and pyrolysis generating stations under the ‘standard gasification / pyrolysis’ and ‘advanced gasification / pyrolysis’ ROC bands as defined within the RO Order[[4]](#footnote-4). Which of these ROC bands is awarded on a month by month basis is determined by the average GCV of the final fuel produced for the month in question.

Questions E2 - E14 refer only to gaseous final fuels (syngas). Ofgem considers that the most accurate method of obtaining the average GCV of the syngas produced is to utilise an analyser to sample the GCV of the gas at frequent intervals. An alternative method of obtaining a GCV figure is to use bag samples supported with a back-calculation.The average GCV of the final fuel over a month determines the band under which ROCs are issued.

1. Please state the method used for measuring the GCV of the syngas**🏱**: **Choose an item.**

If using an analyser, questions **E2 – E6** are compulsory**🏱**

1. State the model of analyser to be installed and its accuracy e.g. +/- %.



You are required to provide a technical specification for the analyser selected to Ofgem. This can be submitted via e-mail to the member of staff reviewing your FMS procedures.

1. At what frequency is a gas sample extracted and sampled by the analyser:



N.B. Ofgem do not accredit analyser technologies[[5]](#footnote-5), our requirement is that they are able to accurately measure the GCV of the final fuel at the conditions stated in the RO order.

1. Please tick the appropriate box to confirm that:

* The analyser is situated at the inlet of the generating station:
* You have provided a schematic diagram to Ofgem that shows that the analyser is located at the inlet to the generating station (this can be submitted via e-mail to the member of staff reviewing your FMS procedures):

1. The RO Order requires that GCV measurements are made at the following temperature and pressure conditions: 25°C and 0.1 MPa[[6]](#footnote-6). Outline here that you will measure the GCV at these conditions, or if the measurement is taken at other conditions state how the readings will be normalised :



1. If any alternative means of GCV sampling will be undertaken to verify the results from the analyser, such as bag samples, please provide details of this e.g. frequency of sampling, where the sample will be taken, how it will be extracted and what test(s) it will be subjected to:



If using bag samples supported with a back calculation, questions **E7 – E14** are compulsory**🏱**.

1. What will be the total number of bag samples taken in a month, and at what intervals will samples be taken e.g. weekly?



1. Outline who will extract the sample, and why they are suitably qualified to undertake sampling. Please mention any relevant qualifications.



1. Into what vessel or container will the gas sample be captured and how will it be stored prior to laboratory analysis?



1. Please state where the samples will be analysed for GCV e.g. if samples are sent to a laboratory or analysed in-house. If utilising a laboratory state any accreditation(s) it holds. Also state what test will be conducted on the sample to give a GCV value, mentioning any relevant standards, and also how the result will be normalised to the following temperature and pressure conditions: 25°C and 0.1 MPa.



1. Please provide an explanation of the back calculation which will be performed in order to provide frequent GCV values for the final fuel. This should outline what data is required and provide the formula used. For further information on this calculation please consult Chapter 3 of the ‘Renewables Obligation: Fuel Measurement and Sampling Guidance’ document.



1. Please state how you derive the key input values for the back-calculation, including the name, location and accuracy of any equipment used?



1. At what frequency are GCV values determined by the back-calculation?



1. Please tick the appropriate box to confirm that:

* Bag sampling is performed at the inlet of the generating station:
* You have provided a schematic diagram to Ofgem that shows the location at which bag samples are extracted from in relation to the generating station (this can be submitted via e-mail to the member of staff reviewing your FMS procedures):

Please be aware that if this approach is used the results from both the average of the bag samples analysed in the month and the average GCV from the back calculation undertaken must both be at least 2 MJ/m3 to demonstrate eligibility for support under the RO for the month in question, with the lower of these two values being entered into the Fuel Measurements page of the R&CHP register each month.

For liquid final fuels question **E15** is compulsory **🏱**.

1. For liquid final fuels please outline the procedures to be utilised to accurately determine the GCV of the final fuel on a monthly basis. Include information on the location and frequency of sampling, and any equipment used (including its accuracy).



For both liquid and gaseous final fuels, **E16** is compulsory**🏱**.

1. Explain how you will evidence to Ofgem the average GCV of the final fuel in a given month **🏱**:



N.B. Normal practice here is the submission of a spreadsheet containing the average daily values and an overall monthly average figure.

**Section F. Determination of qualifying percentage:**

As detailed in the legislation ROC certificates can only be awarded on generation which has resulted from renewable sources. Therefore, since it is technically challenging to measure the fossil derived energy content, termed contamination, of the final fuel we require analysis of the contamination % present within the feedstock(s). The FMS procedures in this section are used to determine contamination percentage. This is then applied to the final fuel on the R&CHP register.

1. Will the feedstock(s) used to produce the final fuel contain any fossil derived contamination? **🏱**



If you have answered ‘yes’ to question F1, questions F2 – F7 and sub sections FA-FD should be completed. If there is no fossil derived contamination present in your feedstock(s) this is not required and you can progress directly to section G. However, Ofgem will require a fuel specification, contract or official letter from your supplier(s) to state that the feedstock(s) in question are “100% biomass by energy content and do not contain any fossil derived contamination.”

1. What type(s) of fossil derived energy contamination is / are present in your feedstock(s)?



1. How will a feedstock sample be extracted to test for fossil derived energy content? State the location from which the sample is taken and make reference to any apparatus utilised, the size of the sample extracted (e.g. in kg) and if sample extraction is in line with any recognised standards:



1. State the regularity of sample extraction. If any composites are formed provide further information regarding the number of composites formed per month, how they are produced and their size (e.g. in kg):



1. Please state where the samples will be analysed for fossil derived contamination, what test(s) will be conducted on the sample to give a contamination percentage and mention any relevant standards. If samples are sent to a laboratory please state any relevant accreditation(s) it holds:



1. Where more than one sample / composite of the same fuel type is analysed per month please outline how the final contamination percentage figure will be calculated from multiple sample results (e.g. average taken):



1. How will you evidence the contamination percentage figure of the feedstock to Ofgem on a monthly basis e.g. laboratory report?



Section F is now split into four sub sections:

* F-A: Determining the mass of feedstock(s) utilised per month to produce the final fuel.
* F-B: Determining the GCV of the feedstock(s) utilised per month to produce the final fuel.
* F-C: Determining the mass and GCV of char produced each month.
* F-D: Calculating the final percentage contamination figure.

These procedures all form part of the calculation of fossil drived contamination percentage which is required to be submitted on the R&CHP register on a monthly basis[[7]](#footnote-7). Therefore, if you have answered ‘yes’ to question F1, sections F-A to F-D should all be completed.

**Section F-A: Determining the mass of feedstock(s) utilised per month to produce the final fuel:**

The mass of feedstock(s) utilised per month is required as this is multiplied by the GCV of the feedstock(s) to determine their total energy content.

1. Please outline the proposed approach to measure the mass of the feedstocks(s) utilised in a calendar month for production of the final fuel. Refer to the location at which mass is measured and any equipment utilised:



1. Please state the accuracy of any equipment utilised for mass measurement (as a percentage or using units e.g. +/- X% or X kg). Also make reference to any steps taken to ensuring ongoing accuracy, such as any calibration undertaken on a periodic basis (including relevant standards this would be conducted to):



1. If any fuel is carried over from one month to the next please outline how the mass of this will be accounted for and any steps taken to ensure this is accurate[[8]](#footnote-8):



1. Please confirm that the mass figure reflects the feedstock used in a month to within twelve hours either side of midnight on the last day of the month, with measurement undertaken at the same time each month:  Click on box to confirm this is the case.
2. Each month what evidence will you provide to Ofgem to substantiate the mass figure for each feedstock utilised in contamination percentage calculations:



**Section F-B: Determining the GCV of the feedstock(s) utilised per month to produce the final fuel:**

The GCV of feedstock(s) utilised per month is required as this is multiplied by their mass to determine total energy content.This is required for the determination of contamination percentage.

1. Outline how you will extract a representative sample of the fuel(s) in question for GCV analysis. Provide information on sample extraction, regularity of sampling, formation of composites and make reference to any relevant standards utilised. If GCV analysis will be undertaken on the same sample of fuel(s) produced for contamination analysis (questions F2-F7), or on a sample produced using the same approach, simply state as such here.



1. Please state where the samples will be be analysed for GCV e.g. if samples are sent to a laboratory or analysed ‘in house’. If utilising a laboratory state any relevant accreditation(s) it holds. In addition provide details on the test which will be conducted on the sample to determine its GCV value, making reference to any relevant standards:



1. Where more than one sample / composite of the same fuel type is analysed per month please outline how the final figure will be calculated from multiple sample results e.g. average taken:



1. Each month what evidence will you provide to Ofgem to substantiate the GCV figure for each feedstock as utilised in contamination percentage calculations e.g. laboratory report(s) / calculations spreadsheets:



**Section F-C: Determining the mass and GCV of char produced each month:**

Procedures are also required to account for the energy content of the char that is produced as a by-product of the gasification and pyrolysis process. This is a necessary consideration within the contamination percentage calculation because some of the energy content within the initial feedstock is transferred to the char rather than the final fuel.

1. State how you will measure the mass of char produced on a monthly basis:



1. State how you will produce a GCV value for the char. This should include information on the extraction of a sample and how it is analysed:



1. What evidence will you provide to Ofgem each month to substantiate the char mass and GCV figures utilised in contamination parentage calculations?



Ofgem understands the calorific value of the char could be composed of energy from both fossil derived and biomass sources. It is technically difficult however, to test for the energy content of the relative biomass and fossil derived proportions. Normal practice here is to assume 100% of the energy content of the char is from biomass sources[[9]](#footnote-9).

1. I will assume that all the energy content of the char is derived from biomass within contamination percentage calculations:  Click on box to confirm this is the case.

**Section F-D: Calculating the final percentage contamination figure:**

The final results obtained from the procedures in section F are utilised to calculate the contamination percentage which should be applied to the final fuel on the R&CHP register each month. The calculation for this is explained in the ‘Overall contamination percentage’ section of the FMS guidance document.

1. Please confirm that you will undertake the overall contamination percentage using the calculation outlined in Table 3 of the FMS guidance document.  Click on box to confirm this is the case.

N.B. Each month you will be required to submit a spreadsheet showing this calculation and how you arrived at the contamination percentage figure submitted on the R&CHP register.

**Section G. Additional Information and Answerspace:**

1. Please state any additional information you feel is relevant to your FMS procedures here:



1. Please use the box below to expand on any of the previous answers if you require further space. Make clear reference to the question you are answering by including the question number at the start of you reply e.g. E6.

Further additional answer space is available on the following page.



Many thanks for completing the Ofgem E-Serve gasification and pyrolysis fuel measurement and sampling procedures questionnaire. Please review your answers and ensure you have answered all compulsory questions (marked with **🏱** symbol) and a suitable level of detail has been provided. A member of Ofgem’s staff will make contact with you in due course.

1. Also termed synthesis or producer gas [↑](#footnote-ref-1)
2. Declared Net Capacity: The maximum electrical generation capacity at which a station could be operated for a sustained period without causing damage to it, less the amount of electricity that is consumed by the plant. [↑](#footnote-ref-2)
3. Article 22(3) purposes, as defined in the RO Order: (i) cleansing of other fuels from the generating station’s combustion system prior to using fossil fuel or waste to heat the combustion system to its normal temperature; (ii) the heating of the station’s combustion system to its normal operating temperature or the maintenance of that temperature; (iii) the ignition of fuels of low or variable calorific value; (iv) emission control; or (v) standby generation or the testing of standby generation capacity. [↑](#footnote-ref-3)
4. ROS in Scotland and NIRO in Northern Ireland. The definitions can also be found in Appendix 2 of the FMS guidance document. [↑](#footnote-ref-4)
5. As such there is no approved list of analyser technologies. [↑](#footnote-ref-5)
6. Megapascals. [↑](#footnote-ref-6)
7. Further information regarding this is found on the ‘Determining the renewable content of a synthetic gas’ section of the FMS guidance. [↑](#footnote-ref-7)
8. For example the use of wall markers, provision of guidance for staff, ensuring the same staff undertake visual assessments for consistency, levelling of stock prior to assessment or other industry best practice. [↑](#footnote-ref-8)
9. This has a negligible affect on final contamination percentage figure calculated. [↑](#footnote-ref-9)