# Carbon-14 (14C) Fuel Measurement and Sampling Questionnaire

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| **14C 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 generating stations proposing to use carbon-14 (14C) radiocarbon techniques as part of their FMS procedures each month. This questionnaire relates only to the determination of the contamination percentage and as such is required to be submitted as a supplementary document to the appropriate FMS questionnaire. The agreement of FMS procedures is required in order to substantiate the figures submitted as part of monthly ROC claims. In order to determine the number of Renewable Obligation Certificates (ROCs) a generating station is entitled to, the operator of the generating station is required to determine the fraction of the energy content of the fuel which is derived from biogenic sources and is therefore renewable. This is what is termed the ‘Qualifying Percentage’ on the Renewables and CHP (R&CHP) register. The fraction of the energy content which is fossil derived is termed ‘Contamination Percentage’ on the same R&CHP register. The completion of this questionnaire is mandatory where 14C techniques are proposed to be used as part of a generating station’s FMS procedures. For further information on when FMS questionnaire(s) should be updated please refer to the ‘When to submit FMS procedures’ section in chapter three of the FMS guidance. Ofgem is happy to discuss initial pre-application queries regarding FMS requirements by telephone. After the first submission of your questionnaire, Ofgem will assist with any query you have in the process of developing the procedures outlined in your initial proposal. You will need to ensure the procedures are capable of providing accurate and reliable results to support your monthly ROC claim submissions on the R&CHP register. Although supplementary documents may be submitted 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 accreditation application process.Further information can be obtained from Ofgem’s ‘Renewables Obligation: Fuel measurement and sampling guidance’ document, which 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). |
| **Questionnaire Completion:** | 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 proposal and reduce unnecessary delays in the approval process. The size of the text box available for response should indicate the length of reply expected. However, if additional space is required in order to answer a question, 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 or fill a check box. Copy and pasting can be undertaken using the Ctrl+C (copy) and Ctrl+V (paste) keys (you cannot right click in text boxes to copy and paste). The drop down menus embedded within this questionnaire will not function in Word 2003 and any previous versions. If you do not have access to Word 2007 please contact Ofgem for an alternative version. When making reference to any industry standards please include the name, issuing body and reference number of the standard.If you are intending to sample pre-combustion, answer Section C, if you are intending to sample post-combustion, answer Section D.You may wish to consult the Fichtner report to aid in the completion of this questionnaire. This can be found on the REA website [here](http://www.r-e-a.net/resources/pdf/59/S0920-0010-0056SMO_C14_Report_-_Rev04.pdf). |
| **Questionnaire** **Submission**: | This FMS questionnaire can be submitted via e-mail, alongside the relevant accompanying FMS questionnaire, to: renewable@ofgem.gov.uk.Ofgem will review your initial proposal and then make contact with you directly and if necessary, with a set of comments to be addressed. Once we have made contact, updated versions can be submitted directly to the member of Ofgem’s staff dealing with your FMS procedures 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 and fuel(s)[[1]](#footnote-1) to which these procedures relate to.

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



1. Fuel(s) utilised **🏱**



## 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. Date of previously agreed FMS procedures Click here to enter a date.
2. Please indicate the version number of these FMS procedures N.B. Rev 0 is the procedures as originally approved Version number
3. State the purpose of this latest revision and indicate the changes made (making reference to specific questions e.g. D3) in the space provided below



## Section C – Pre-Combustion Sampling

This section should only be completed for generators proposing to use pre-combustion samples for 14C analysis.

1. Outline how you will extract a representative sample of your feedstock/fuel for 14C analysis. 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 grams) and if the sample extraction is in line with any recognised standards **🏱**



1. State the regularity of which individual samples are taken e.g. from every delivery, once a day **🏱**



1. If composite samples are formed, state how this is done – include the number of composites produced per month, their individual size (e.g. in grams) and if your composite production procedure is in line with any recognised standards, in your answer **🏱**



1. State the sample size sent for analysis and if this undergoes any processing beforehand e.g. shredding **🏱**



## Section D – Post-Combustion Gas Sampling

In order for 14C analysis to produce accurate and reliable results the gas sample on which analysis is undertaken must be extracted from the stream according to best practice. As such Ofgem requires that robust procedures for the extraction of a flue gas sample for analysis are in place.

1. How will a gas sample be collected? **🏱** Choose an item
2. Please expand on your proposed approach, as stated in D1, to extract a flue gas sample for analysis **🏱**



1. If you have selected ‘manually’ in response to question D1, outline who will extract the sample e.g. internal staff or external organisation, and how they are suitably qualified technicians to undertake this. Mention any relevant accreditation e.g. from UKAS[[2]](#footnote-2) or under the Environment Agency’s mandatory certification scheme (MCERTS[[3]](#footnote-3))



1. Please highlight the principal sources of error associated with your gas sampling approach and state measures taken to minimise them **🏱**



1. Please provide a description of the location from which the emissions sample is extracted e.g. vertical or horizontal duct, explaining why this is suitable to produce a sample representative of the overall gas stream, as described in e.g. ISO 10396 **🏱**



A schematic diagram showing the sampling point should also be submitted to Ofgem alongside this document.

1. Please explain how will you ensure no stagnant gas will be present at the sampling point **🏱**



1. If you are intending to use ‘constant rate sampling, please explain why this is appropriate. If not, how will you ensure that the sample is proportionate to the stack flow rate for ‘proportional sampling’, in accordance with ISO 13833? **🏱**



1. If you are intending to sample exhaust gases, how you will ensure that samples are only taken from the exhaust gases of the plant during normal operation and when it is generating electricity **🏱**



1. Outline the regularity of sample extraction, and why this is appropriate – taking into account changes in the waste stream. Also outline how the sample increment frequency has been calculated **🏱**



1. Will composite samples of emissions gases be formed for analysis? **🏱** Choose an item
2. If you have answered ‘Yes’ to the question above, please state the number of composites analysed per month Choose an item
3. Once extracted, how will the gas sample be stored? E.g. into a vessel such as a tedler bag or canister? And where will it be retained prior to analysis? **🏱**



1. Please confirm samples will be kept sealed until testing **🏱** **[ ]** Check box to confirm this is the case
2. Outline the steps you intend to take to ensure there is no leakage of the sample and that sample integrity has been maintained **🏱**



1. Ofgem encourages emissions sampling to be conducted in accordance with relevant standards for emissions testing. Please state the standards on which your approach is based and how they link to your procedures **🏱**



## Section E – 14C Analysis

This section relates to how you will undertake radiocarbon analysis on the sample(s) produced to calculate the renewable and fossil derived carbon fractions of the fuel utilised in a given month. It would be expected that a suitably qualified test house or laboratory will be selected to undertake 14C analysis.

1. Please state where your sample(s) will be analysed, and any relevant external accreditations held by the analysing laboratory **🏱**



1. Please choose the method of radiocarbon analysis which will be utilised to analyse the gas sample for biogenic and fossil derived carbon mass fraction[[4]](#footnote-4) Choose an item

N.B. Our independent technical research indicates that AMS radiocarbon analysis can offer higher accuracy and a quicker turnaround time than alternative methods available. As such this is Ofgem’s preferred approach. In addition, it has been highlighted that significant errors can be reported when using LSC radiocarbon techniques (potentially in the region of 15%).

1. If ‘LSC’ is your preferred method of analysis, please quantify the error associated with its use here, and how this will be minimised



Ofgem will review and assess if this is deemed suitable.

1. Ofgem encourage that radiocarbon analysis should be undertaken in accordance with a recognised standard. A non exhaustive list of standards relevant to 14C analysis can be found in the table below. Please state any associated standards to your chosen technique **🏱**



There is a possibility of error due to the presence of atmospheric air which passes through the combustion process. Where the biomass carbon in the feedstock is > 20% the error can be considered negligible. However, where the biomass fraction of the same is low e.g. in co-firing applications this error may need to be corrected.

1. Please state if the biogenic fraction of the gas sample is likely to be < 20% **🏱** Choose an item
2. If you have answered ‘Yes’ to the above question, please outline any procedures to take into account, and qualify, any error as a result of atmospheric CO2 within the combustion process **🏱**



1. Use the space below to describe your feedstock, please elaborate on its composition, its origin and, if possible, the approximate age of the biogenic content **🏱**



1. Please outline the evidence you will submit to Ofgem on a monthly basis to substantiate the percentage biogenic and fossil derived carbon figures e.g. a laboratory report **🏱**



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| **Standards:** | * ASTM D6866: Standard Test Methods for Determining the Bio-based Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis.
* ASTM D7459: Standard Practice for Collection of Integrated Samples for the Speciation of Biomass (Biogenic) and Fossil-Derived Carbon Dioxide Emitted from Stationary Emissions Sources.
* ISO 13833: Stationary source emissions -- Determination of the ratio of biomass (biogenic) and fossil-derived carbon dioxide -- Radiocarbon sampling and determination
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## Section F – Carbon to Energy Conversion Calculations

The biogenic content needs to be expressed in terms of energy content (on a GCV basis). As such a conversion calculation will be required to convert carbon content to energy content for both the biogenic and fossil derived proportions of the fuel.

1. State below your proposed conversion factors / ratios to convert both the biogenic and fossil derived carbon fractions to energy values, ensuring you include the relevant units **🏱**



N.B. Figures utilised for the conversion of biogenic and fossil derived carbon to energy should be based on recognised data sources or literature. These should be stated, alongside why they are relevant to the station in question.

1. Please state below how the carbon to energy conversion factors have been devised **🏱** Choose an item
2. If you have selected ‘Literature Calculations’ in answer to question F2 please cite the sources of data used and why they are relevant to the generating station and fuel(s) in question



If you have selected ‘Bespoke Calculations’ in answer to the above question, please also answer questions F4 and F5.

1. We are aware that bespoke carbon to energy conversion ratios can be developed to take into account the specifics of the fuel used on site if necessary. If a bespoke calculation has been utilised for the carbon to energy calculation, please state the data on which this is based and why it can be considered relevant



1. If any sampling on the initial fuel source has been conducted in order to establish site specific data for carbon to energy calculations please outline how this has been conducted and outline why the sampling conducted will provide accurate results. Please continue in Section G if needed.



1. Please demonstrate why the ratios of carbon content to GCV will be suitably consistent to be used on a month to month basis **🏱**



1. Will you be applying a correction factor to the carbon to energy ratios to take account of the presence of bio-plastics in the fuel mix? **🏱** Choose an item
2. If you have answered yes to the question above, please outline how this has been calculated and where it will be applied



1. Will a fossil fuel be utilised alongside the primary fuel, e.g. for Article 22(3) purposes? **🏱** Choose an item
2. In the case of Post-Combustion analysis, if you have answered ‘Yes’ to the question above, how is this corrected for in carbon to energy conversion calculations? N.B. a correction is only required if the fossil fuel will result in generation



1. What evidence will you provide to Ofgem on a monthly basis to substantiate the biogenic and fossil derived carbon to energy calculations undertaken? This could be a spreadsheet listing reference data, values and calculations **🏱**



## Section G – Additional Information

Please use the box below to state any additional information you feel is relevant to your FMS procedures or 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. F1





Many thanks for completing the Ofgem E-Serve 14C Fuel Measurement and Sampling 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. This could be feedstock(s)/fuel(s) for gasification and pyrolysis stations [↑](#footnote-ref-1)
2. United Kingdom Accreditation Service [↑](#footnote-ref-2)
3. Monitoring Certification Scheme [↑](#footnote-ref-3)
4. Mass Spectrometry – AMS / IRMS, Scintillation Counting – LSC / LSM / PSM, Avalanche Counting – BI / GPC [↑](#footnote-ref-4)