EPA Introduction

UNCERTAINTY ASSESSMENT Practical Approaches.

The following draft guidance notes on uncertainty have been developed by the Dutch Emission Authority (NEa) in close liaison with the Emissions Trading Technical Support Group (ETSG), which is operated in support of the IMPEL[1] EU ETS Project. The use of these approaches is not mandatory. **Before applying the full methodology given in these guidance notes, operators should consider if they may have dispensation from the need to undertake such analysis by referring to the Monitoring and Reporting Guidelines and the presentation on uncertainty assessment given at the EPA workshop on 11 October 2007.**

UNCERTAINTY ASSESSMENT OF QUANTITY MEASUREMENTS (ACTIVITY DATA) IN RELATION TO EU ETS REQUIREMENTS – GUIDANCE NOTE I proposes a methodology for meeting the uncertainty assessment requirements of Section 7.1 in as practical a way as possible. The guidance attempts to provide core component values suitable for most operators to be able to select as appropriate, and points to requisite action where they are not. In this respect, operators are usually advised to approach the supplier of the measurement system for additional information or alternative expert judgment. It should be noted that no attempt is made to define “expert” to allow operators flexibility to seek compromise between understanding of the measurement system and the environment in which the system is being used.

UNCERTAINTY ASSESSMENT OF ACTIVITY SPECIFIC FACTORS - GUIDANCE NOTE II advises how to determine the uncertainty associated with determinations of installation-specific net calorific values, emission factors, oxidation factors, conversion factors, carbon contents, biomass fractions and composition data. This is dealt with in detail in Section 13.6 of the MRG2. **Note that this is only relevant where highest tier compliance is required.**

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[1] The European Union Network for the **Implementation and Enforcement of Environmental Law (IMPEL)** is an informal Network of the environmental authorities of the Member States, acceding and candidate countries of the European Union and Norway. The network is commonly known as the IMPEL Network. The European Commission is also a member of IMPEL and shares the chairmanship of meetings.

Uncertainty Assessment of Quantity Measurements in relation to EU ETS requirements – Guidance Note I

Introduction

This guidance note outlines a practical way to assess the uncertainty of measurement instruments and measurement systems that are used as part of an EU ETS monitoring methodology. The ETSG is of the opinion that the practical approach offered in this note is applicable in <roughly speaking> 90% of the installations, and provides in most cases a practical tool for operators and competent authorities to deal with this difficult subject.

Section 7.1 of the MRG requires operators to take account of the cumulative effect of the components of a measurement system on the uncertainty of annual amount of source stream using the error propagation law. Specific reference is made to ISO-5168:2005[2] and the Guide to Expression of Uncertainty in Measurement[3] but these standards are detailed and complicated to apply. Of course, the operator is free to use the standards, but we think that this guidance note provides a more practical and proportionate method to determine the uncertainty of the majority of EU ETS related measurement instruments and measurements systems used to measure the amount of fuel or material in an installation. If the operator has better information on the company specific measurement situation than the information in this guidance, the operator should use this better information. The onus of proving and substantiating the uncertainties in those cases shall always be on the operator (see steps 1 and 2 of section II of this note for further information).

This guidance note has been developed by the Dutch Emission Authority (NEa) in close liaison with the Emissions Trading Technical Support Group (ETSG) which is operated in support of the IMPEL EU ETS Project. The members of the ETSG endorse the methodology described in this guidance note as a very useful and suitably practical approach for the assessment of measurement instrument and measurement system uncertainty as required by the MRG. It is suggested that this note is read in conjunction with the MRG and any associated guidance provided by Member States (e.g. Guidance on CO_2 emission monitoring, issued by the Dutch Emission Authority, available on the webside of the NEa).

This guidance note consists of two sections in which the following questions are answered:

<u>Question I:</u> When to assess the measurement uncertainties in relation to MRG monitoring requirements?
<u>Question II:</u> How to assess the uncertainty of a quantity measurement of a source stream?

Note: Uncertainties will always be expressed as a 95% confidence interval around the annual values.

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[2] ISO-5168:2005 “Measurement of fluid flow – Procedures for the evaluation of uncertainties.

[3] Guide to the Expression of uncertainty in measurement, ISO/TAG 4. Published by ISO (1993; improved reprint, 1995) on behalf of BIPM, IEC, IFCC, ISO, IUPAC, IUPAP and OIML.

I. When to assess the measurement uncertainties in relation to MRG monitoring requirements?

The operator has to describe in his monitoring plan how from each source stream the CO_2 emissions will be determined. In principle the uncertainty associated with the amount of a source stream (fuel, raw material, auxiliary and product) has to be submitted and substantiated in the monitoring plan. Section II of this guidance document outlines how to assess the uncertainty of a quantity measurement of a source stream.

Before continuing, it is important to note that there are some situations where the MRG does
not require the operator to provide written proof of the uncertainty associated with the determination of the amount of fuel or material. **The uncertainty does not have to be assessed** for the following source streams:

- Commercially traded (or standard) fuels or materials: the uncertainty requirements applicable to the measurements will be guaranteed by national legislation or the proven application of relevant national and international standards. The total amount of fuel or material and the net calorific value of the fuel can be derived from supplier invoices without considering and substantiating the uncertainty of the measurement instrument. [4]
- De minimis source streams: when determining the amount of these source streams, operators do not have to comply with a set uncertainty level. For these source streams a no tier approach may be used.
- All quantities of major and minor source streams within small installations (those that emit in total less than 25 ktonnes of fossil CO_2 annually, according to MRG Section 16): the uncertainty associated with the amount of these source streams does not have to be substantiated or assessed. Operators may base the determination of the amount of fuel or material on registered purchasing data (invoices) and/or estimated stock changes. The quantity measurement instrument does not have to be guaranteed by national legislation or the proven application of relevant national and international standards. When substantiating the uncertainty of internal meters operators may use the uncertainty advised by the meter supplier irrespective of the circumstances in which it is being used (see step 2 for further information).

> *Example:*
> An installation uses only natural gas that is being measured by the main gas meter of the mains manager. This main meter has to comply with the national measurement standard. As the entire installation falls under CO_2 emission trading, no other meters apart from the main gas meter are relevant for determining the CO_2 emissions. The uncertainty for the quantity measurement does not have to be assessed.

The operator has to assess the uncertainty for the quantity measurements of the following source streams.

1. All major and minor source streams (within installations emitting ≥ 25 ktonnes of fossil CO_2 annually) that are not commercially traded (or standard) fuels or materials;

[4] Approval of the competent authority is required either through validation of the monitoring plan or in certain countries through separate authorization

2. All major and minor source streams (within installations emitting ≥ 25 ktonnes of fossil CO_2 annually) that belong to commercially traded (or standard) fuels or materials but that are not or not only being measured by guaranteed main meters;
3. Major and minor source streams within small installations (those that emit in total less than 25 ktonnes of fossil CO_2 annually, according to MRG Section 16) where the amount of fuel or material cannot be determined on the basis of supplier data and/or stock changes. When supplier data, invoices and stock changes cannot be used by the operator, small installations are allowed to use the information specified by the manufacturer of the measurement instrument in order to estimate the uncertainty of activity data. The same is true for situations in which the operator cannot use supplier data of internal meters (please see step 2 for further information).

Example:
A large installation (emitting ≥ 25 ktonnes fossil CO_2/year) uses only natural gas that is being measured by the main gas meter of the mains manager. This main gas meter is covered by the national measurement standard. However, not all the installation falls under EU ETS, and the sub-source stream natural gas that is being measured by the sub-meter is deducted from the main stream. In this situation the uncertainty of the guaranteed main gas meter does not have to be assessed. However the uncertainty of the internal sub-meter that is not guaranteed as well as the total uncertainty of the source stream do have to be assessed and substantiated according to the steps described in part two of this guidance.

II How to determine the uncertainty of a quantity measurement of a source stream?

The required tiers for the quantity measurement are related to each source stream. As a result
the achieved uncertainty for each source stream has to be assessed. It should be noted that for emissions trading the operator needs to assess the uncertainty of the measurement data over a year, rather than the uncertainty of an individual observation at one particular moment in time. Random errors are a major factor in the uncertainty of an individual observation, but not the uncertainty of measurement data over a year. In this case systematic errors are more significant. Random errors tend to average during the year.

The practical way to determine and assess the uncertainty associated to the amount of a source stream consists of the following five steps:

- Step 1: Assess the uncertainty of the measurement instrument;
- Step 2: Assess the additional uncertainty of "context specific" factors (i.e. how the measurement instrument is used in practice);
- Step 3: Assess the uncertainty of pressure and temperature corrections for gas meters;
- Step 4: Sum up the uncertainties of steps 1, 2 and 3;
- Step 5: Assess the uncertainty of the amount of the source stream.

Step 1: Assess the uncertainty of the measurement instrument

This step concerns the instrument specific uncertainty that is linked to the measurement principle of a meter. Annex I to this guidance contains standard uncertainty levels for the most common measurement instruments. The operator is allowed to submit this uncertainty level in his monitoring plan without further assessing and substantiating that number provided that the measurement instrument concerned meets the conditions laid down in Annex I and the relevant measurement principle is applicable. If the specific meter does not meet one or more conditions laid down in Annex I, the operator has to substantiate and justify that the conditions concerned do not influence the uncertainty. The operator is also allowed to make a conservative and substantiated judgement of the additional effect that the non-compliance of the conditions concerned would have on the uncertainty of the measurement instrument.

If the operator decides to use this guidance note, the operator is advised to describe in the part of the monitoring plan that relates to the quality assurance of the measurement equipment how he will meet the conditions for the measurement instrument that are

prescribed for the measurement principle concerned in Annex I. He is allowed to refer to the requirements of the manufacturer if these are applicable, provided that these requirements are available within the installation site. In any case the monitoring plan must show the frequency with which the operator carries out the maintenance and calibration of the measurement instruments.

It can be the case that the uncertainty depends on the total quantity that a measurement instrument actually measures: for example, for 0-20% of the maximum measurement range another uncertainty applies than for 20-100% of the maximum measurement range. If both situations occur within the representative company-specific circumstances of the installation, the operator does not have to calculate the weighted average uncertainty. The uncertainty of the weighted average measurement value is sufficient for those cases. Below an example of how to calculate this average is included.

> *Example:*
> A rotor meter that measures gas has an uncertainty of 3% for 0-20% of the maximum measurement range and an uncertainty of 1,5% for 20-100% of the maximum measurement range (see Annex I).
> In a year 480,000 m^3 natural gas flows through the meter during 8000 hours. The maximum flow (100%) is 220 m^3/hour. The weighted average flow corresponds to 27,3% of the maximum measurement range:
>
> $$\frac{480,000}{8,000 * 220} = 27,3\%$$
>
> Conclusion: as 27,3% is within the range of 20-100%, the operator may apply an uncertainty of 1,5%.

If the measurement instrument concerned is not mentioned in Annex I, the operator has to assess the uncertainty of that measurement instrument in a year on the basis of specifications provided by the supplier of the measurement instrument. The conditions that have to be met for that uncertainty have to be derived from supplier data. This should include specifications regarding maintenance and calibration requirements.

Step 2: Assess the additional uncertainty of context specific factors
This step is not applicable to measurement instruments within small installations (emitting less than 25 ktonnes fossil CO_2 annually, according to MRG Section 16). They can apply an uncertainty of 0% for the outcome of step 2.

To assess the additional uncertainty the following questions need to be answered:
- Is the measurement instrument installed according to the requirements of the manufacturer or, if those data are not available, according to general requirements that apply to that measurement principle?[5]
- Is the medium (gas, liquid, solid substance) that is measured by the meter a medium for which the measurement instrument has been designed according to the

[5] In some cases manufacturer data for old instruments no longer exist. For those situations general calibration and maintenance requirements that are applicable to the relevant measurement principle, can be applied.

requirements of the manufacturer or, if these data are not available, according to the general requirements applicable to that measurement principle?

- Are there no other factors that can have adverse consequences on the uncertainty of the measurement instrument?[6]

If the answer to all three above questions is yes, the operator can use an uncertainty of 0% for the outcome of step 2. If the answer to one or more of these questions is no, the operator has to make a conservative and substantiated judgement of the additional uncertainty that is connected to the factor or factors for which the operator has answered negatively. This judgement has to be done in consultation with the manufacturer of the measurement instrument or another expert.[7]

Step 3: Assess the uncertainty of the pressure and temperature corrections for gas meters

Pressure and temperature corrections are only applicable to the determination of the amount of gas and not to the measurement of liquids or solid substances. For liquids and solid substances the operator can use an uncertainty of 0% for the outcome of step 3. The operator has to correct the actual amount of gas for pressure and temperature to normal conditions. This correction is compulsory since not correcting these elements may cause major systematic errors. The following situations can occur in practice.

Situation I Gas meter with Electronic Volume Conversion Instrument (EVCI)

If the operator has a gas meter with an EVCI that determines the pressure and temperature, the following standard uncertainties and numbers can be applied for the outcome of step 3 for the ECVI.

However when a temperature and pressure measurement covers more than one meter those measurements cannot be regarded as independent from each other. Therefore step 3a is introduced which reflects the situation in which the measurement of pressure and temperature are interdependent (this would for example be the case in situation III).

$$U\_step\_3 = 0{,}5$$

$$U\_step\_3a = 0$$

The uncertainty of 0,5% can only be used if the operator meets the conditions laid down in Annex I for ECVI. These conditions have to be submitted in the part of the monitoring plan that relates to the quality assurance of measurement equipment.[8]

Situation II Gas meter using separate pressure and temperature measurement

If the operator has a gas meter using a separate pressure and temperature measurement at that meter, he has to make a conservative and substantiated judgement

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[6] A factor that can have an adverse effect could be the composition of the medium that flows through the measurement instrument. In this practical method to assess uncertainties the departing point is that the effect of ageing on the uncertainty is zero if the operator meets the calibration and maintenance requirements in Annex I.

[7] In some cases an in-house expert could be used to make an conservative judgement. An operator is allowed to use an inhouse-expert provided that he is capable of making that expert judgment and that the competent authority agrees with that in-house expert judgement in the context of validating the monitoring plan.

[8] In response to Section 4.3(m) and Section 10.3.1 of the MRG.

of the uncertainty of the pressure and temperature measurement in consultation with the manufacturer of the meter or another expert.

The uncertainty has to be calculated according to the following formula in the outcome of step 3.

$$U\_step\_3 = \sqrt{(U\_pressuremeasurement)^2 + (U\_temperaturemeasurement)^2}$$

$$U\_step\_3a = 0$$

Where:
U is the uncertainty.

Situation III Gas meter without separate pressure and temperature measurement
If there is a gas meter without separate pressure and temperature measurement at that meter (correction takes place on the basis of pressure and temperature measurement/ EVCI at the main gas meter), the operator has to make a conservative and substantiated judgement of the uncertainty of the pressure and temperature measurement at the location of the gas meter concerned in consultation with the manufacturer of the meters or another expert. The operator has to take the differences in pressure and temperature into account between the location of the pressure and temperature measurement and the location of the gas meter concerned.

The uncertainty of the pressure and temperature measurement has to be determined according to the following formula in the outcome of step 3:

$$U\_step\_3 = 0$$

$$U\_step\_3a = \sqrt{(U\_pressuremeasurement)^2 + (U\_temperaturemeasurement)^2}$$

Where:
U is the uncertainty.

Step 4: Sum up the uncertainty of step 1, 2 and 3
Steps 1, 2 and 3 lead to uncertainty levels that need to be summed up to determine the total uncertainty of the individual quantity measurement. The following formula has to be applied by the operator:

$$U\_quantitymeasurement = \sqrt{(U\_step\_1)^2 + (U\_step\_2)^2 + (U\_step\_3)^2}$$

Where:
U is the uncertainty.

Note:
The uncertainty of step 3a (U_step_3a) has to be ‘saved’ for step 5.

Step 5: Assess the uncertainty of the amount of the source stream
In steps 1 to 4 the operator has determined the uncertainty of one individual (corrected) quantity measurement. If the amount of a source stream is determined by more measurement instruments, the operator has to sum up the uncertainties of these

different individual measurements (the components of the measurement system) to determine the total cumulative uncertainty of the amount of the source stream. The following formula has to be applied by the operator:

$$U\_source\_stream = \sqrt{\left(\frac{\sqrt{(U_1 * x_1)^2 + (U_2 * x_2)^2 + (U_n * x_n)^2}}{x_1 + x_2 + x_n}\right)^2 + (U\_step\_3a)^2}$$

Where:
U_ source_stream is the total uncertainty of the source stream;
$U_1 - U_n$ are the uncertainties of the individual quantity measurements as determined in step 4;
$x_1 - x_n$ are the quantities that are measured annually by the measurement instruments concerned.

If the total uncertainty of the source stream is measured with one measurement instrument and situation I or II as described in step 3 is applicable, the outcome of step 5 is the same as the outcome of step 4.

To assess the uncertainties associated to the amount of the source streams in a practical way operators may consider the uncertainties in the formula as uncorrelated uncertainties. In practice the measurements may be partly interdependent and partly uncorrelated.

Annex I: standard measurement uncertainties for the most common measurement instruments

Rotor meter
Medium: gas Uncertainty for 0-20% of the maximum measurement range: 3 % Uncertainty for 20-100% of the maximum measurement range: 1,5% Conditions: - Once per 10 year cleaning, recalibration and if necessary adjusting - Annual inspection of the oil level of the carter - Application filter for polluted gas - Life span 25 years
Medium: liquid Uncertainty for 5-100% of the maximum measurement range: 0,3% Conditions: - Once per 5 year cleaning, recalibration and if necessary adjusting (or at an earlier time when flow liquid of 3500 hours × maximum range of the meter has run through the meter - Annual maintenance according to instructions of manufacturer / general instructions measurement principle - Life span 25 years

Turbine meter
Medium: gas Uncertainty for 0-20% of the maximum measurement range: 3 % Uncertainty for 20-100% of the maximum measurement range: 1,5% Conditions: - Once per 5 year cleaning, recalibration and if necessary adjusting - Annual visual inspection - Once per three months lubrication of bearings (not for permanent lubricated bearings) - Application filter for polluted gas - No pulsating gas stream - Life span 25 years - No overload of longer than 30 minutes › 120% of maximum measurement range
Medium: liquid Uncertainty for 10-100% of the maximum measurement range: 0,3% Conditions: - Once per 5 year cleaning, recalibration and if necessary adjusting - Once per three months lubrication of bearings (not for permanent lubricated bearings) - Application filter for polluted liquid - Life span 25 years - No overload of longer than 30 minutes › 120% of maximum measurement range

Bellows meter
Medium: gas

Uncertainty for 0-20% of the maximum measurement range: 6 %
Uncertainty for 20-100% of the maximum measurement range: 4%

Conditions:
- Once per 10 year cleaning, recalibration and if necessary adjusting
- Annual maintenance according to instructions of manufacturer / general instructions measurement principle
- Life span 25 years

Orifice meter

Medium: gas and liquid

Uncertainty for 30-100% of the maximum measurement range: 1,5%

Conditions:
- Annual calibration of the pressure transmitter
- Once per 5 years calibration of the orifice meter
- Annual inspection of abrasion orifice and fouling
- Annual maintenance according to instructions of manufacturer / general instructions measurement principle
- Life span 30 years
- No corrosive gases and liquids

Guidelines for building in orifices: minimum of 4D free input flow length before the orifice and 2D after the orifice: smooth surface of inner wall.

Venturi meter

Medium: gas and liquid

Uncertainty for 20-100% of the maximum measurement range: 1,5%

Conditions:
- Annual calibration of the pressure transmitter
- Once per 5 years calibration of entire measurement instrument
- Annual visual inspection
- Annual maintenance according to instructions of manufacturer / general instructions measurement principle
- Life span 30 years
- No corrosive gases and liquids

Ultrasonic meter

Medium: gas and liquid

Uncertainty for 1-100% of the maximum measurement range: 0,5%

Conditions:
- Once per 5 years cleaning, recalibration and if necessary adjusting
- Annual inspection of contact between transducer and tube wall. When there is not sufficient contact, the transducer assembly has to be replaced according to the specifications of the manufacturer.

- Annual inspection on corrosion of wall - Annual inspection of transducers - Annual maintenance according to instructions of manufacturer / general instructions measurement principle - Life span 15 years - No disturbances in frequencies - Composition of medium is known Guidelines for building in ultrasonic meters: minimum of 10D free input flow length before the meter and 5D after the meter

Vortex meter
Medium: gas Uncertainty for 10-100% of the maximum measurement range: 2% Conditions: - Once per 5 years cleaning, recalibration and if necessary adjusting - Annual inspection of sensors - Annual inspection of bluff body - Annual inspection on corrosion of wall - Annual maintenance according to instructions of manufacturer / general instructions measurement principle - Life span 10 years - Set-up is free of vibration - Avoid compressive shocks Guidelines for building in vortex meters: minimum of 15D free input flow length before the meter and 5D after the meter
Medium: liquid Uncertainty for 10-100% of the maximum measurement range: 1,5% Conditions: - Once per 5 years cleaning, recalibration and if necessary adjusting - Annual inspection of sensors - Annual inspection of bluff body - Annual inspection on corrosion of wall - Annual maintenance according to instructions of manufacturer / general instructions measurement principle - Life span 10 years - Set-up is free of vibration - Avoid compressive shocks and gas bubbles Guidelines for building in vortex meters: minimum of 15D free input flow length before the meter and 5D after the meter

Coriolis meter
Medium: gas and liquid Uncertainty for 1-100% of the maximum measurement range: 1%

Conditions:
- Once per 5 years cleaning, recalibration and if necessary adjusting
- Monthly control of adjusting zero point
- Annual inspection of corrosion and abrasion
- Annual check on sensors and transmitters
- Annual maintenance according to instructions of manufacturer / general instructions measurement principle
- Life span 10 years

Ovalrad meter

Medium: liquid

Uncertainty for 5-100% of the maximum measurement range: 0,5%

Conditions:
- Viscid liquids (oil): once per 5 years cleaning, recalibration and if necessary adjusting
- Thin liquids: once per 2 years cleaning, recalibration and if necessary adjusting
- Annual inspection of abrasion
- Annual maintenance according to instructions of manufacturer / general instructions measurement principle
- Life span 30 years

Electronic Volume Conversion Instrument (EVCI)

Medium: gas

Uncertainty for 0,95-11 bar and -10 – 40℃: 0,5%

Conditions:
- Once per 4 years recalibration and if necessary adjusting
- Replace batteries (frequency is dependent on instructions manufacturer)
- Annual maintenance according to instructions of manufacturer / general instructions measurement principle
- Life span 10 years

Note: Weighbridges may be added to this Annex in a later stage

Annex II Sources of information

All information reported in Annex I stem from the following sources;

Websites:

1. www.engineeringtoolbox.com
2. www.en.wikipedia.org
3. www.efunda.com
4. www.nl.wikipedia.org
5. www.omega.com
6. www.flowmeterdirectory.com
7. www.nmi.nl
8. www.abb.nl/ProductGuide/

Literature:

9. Praktische meettechniek; cursus materiaal Edion Trainingen Hogere gastechniek
10. Joseph P. Decarlo; Fundamentals of Flow Measurement
11. David W. Spitzer; Industrial Flow Measurement

Guidelines and standards:

12. MID (Annex MI-002)
13. OIML (Organisation Internationale de Métrologie Légale) richtlijn R117 uit 1995EN 1359
14. EN12480
15. EN12261
16. IJkregeling gasmeters 1989 (Dutch Calibration Regulation 1989)

Results from questionnaires submitted by:

17. VAF instruments
18. Dresser
19. Actaris
20. CY
21. IMeter
22. Dresser

Interviews with:

23. Dhr. M. Oosting, ODS
24. Dhr. W. Norde, CY
25. Dhr. R. Schoen; Exxonmobil
26. Dhr. W. Burgers; Infomil

Manuals and product brochures:

27. ABB
28. Elster Instromet
29. Emerson
30. Bopp & Reuter
31. Rheonik
32. Siemens
33. Yokogawa
34. Ultraflux
35. Vemmtec
36. Hoffer Instruments

Publications:

37. Daniel 1997, Fundamentals of Orifice Measurement
38. Huain et al., 1997, Theoretical uncertainty of orifice flow measurement
39. Ultrasoon flowtechniek: theorie en praktijk; ODS Barendrecht
40. Trolin en Patten: Mass meters for gas measurements (Emerson Process Management)

Introduction

According to section 13.6 MRG the sampling procedure and frequency of analyses shall be designed such that the annual average of the activity-specific factors is determined with a maximum uncertainty of less than 1/3 of the maximum uncertainty which is required for the amount of the source stream. This guidance clarifies how to determine the uncertainty for the net calorific value, emission factor, oxidation factor, conversion factor, the carbon content, the biomass fraction and the composition data. It provides for a practical method to assess that uncertainty.

1. How to assess the uncertainty of the activity-specific factors that are relevant for determining the CO_2 emissions in an installation?

Before describing this method it is important to indicate the situations in which the MRG does not require the operator to provide written proof of the uncertainty associated with the determination of the activity-specific factors. The uncertainty does not have to be assessed in the following cases:

1. The variable concerned is not relevant for determining CO_2 emissions.
2. The operator is allowed to use standard factors for the variable concerned.
3. The operator is allowed to determine the variable according to the minimum frequency of analyses indicated in MRG Table 5.[9]
4. The net calorific value of a commercially traded (or standard) fuel or material is based on accepted national or international measurement standards. In that case the operator can take the net calorific value from the invoice of the supplier. He does not have to assess and substantiate the uncertainty of the net calorific value.

Further situations where determinations are not required:

- The conversion factor is not relevant for determining the CO_2 emissions from a fuel stream.
- The oxidation factor is not relevant for determining the CO_2 emissions from a raw material stream.
- The operator uses a standard factor 1 for the oxidation factor.
- For the net calorific value and emission factor the operator uses standard factors.[10]

The operator shall assess the uncertainty for all factors that are relevant to the determination of CO_2 emissions within the installation if those factors have to be determined according to the required tier.

2. How to determine the uncertainty of the activity-specific factors

If the activity-specific factors that are relevant for determining CO_2 emissions have to be determined, the uncertainty connected to that variable is 1/3 of the maximum uncertainty that applies to the quantity measurement of the source stream.

[9] The requirement in the Guidance on CO_2 monitoring is in accordance with the frequency of analyses laid down in table 5 in section 13.6 of the MRG.

[10] Section 11 of the MRG or standard factors as reported by the respective Member State in its latest national inventory submitted to the Secretariat of the United Nations Framework Convention on Climate Change.

Example:
If the amount of coal within the installation has to be determined with a required uncertainty of 1.5% (tier 4), the net calorific value and the emission factor of coal have to be determined with an uncertainty of 1/3 * 1,5% = 0,5%.

The advantage of this approach is that the operator does not have to sample and analyse the raw materials or fuels of a constant composition to a needless extent. If the operator cannot meet the required uncertainty for one or more variables or is not able to demonstrate compliance with the uncertainty requirement, the operator can opt for applying the conservative frequency of analyses laid down in table 5 of section 13.6 of the MRG.

Method
The uncertainty in determining the variables can be reduced by increasing the number of samples and analyses. Statistically the uncertainty in the average emission factor or net calorific value will diminish with a factor $1/\sqrt{n}$ where n is the number of independent observations on which the average is based. An independent observation is the (average) resultant analyses of one sample or one mixed sample.

To meet the uncertainty requirement for the variables the operator, when drafting the monitoring plan, has to determine through historical data how often analyses and sampling have to be carried out. Subsequently analyses and sampling have to be carried out in 2008 according to the calculated frequency. On the basis of the results of the analyses the operator can calculate whether he meets the required uncertainty in practice. In view of this the operator can adjust the frequency of samples and analyses.

Helpful tool for operators
With the aid of the spreadsheet 'Uncertainty variables CO2 emissions.xls' and the historical results of analyses of the variables that are available within the installation site and applicable to the installation site concerned, the operator can discern quickly the number of analyses he has to carry out to meet the required uncertainties. This spreadsheet has attached to this note and can also be downloaded from the website of the Dutch Emission Authority (NEa)
www.emissieautoriteit.nl>mediatheek>hulpmiddelen.
In the work table 'history' the results of analyses carried out in the past and the required uncertainty of the quantity measurement can be filled in. On the basis of this the spreadsheet calculates a minimum number of samples and analyses and will advise the operator the frequency of those samples and analyses. As from 2008 the results of analyses can be filled in the worktable 'uncertainty'. This worktable will calculate the actual realised uncertainty of the variable concerned.

The spreadsheet is a simple approach that assumes that the installation will apply the annual average of the variable when monitoring CO_2 emissions without using a weighted factor for the flow. Alternatively, the operator is allowed to use a method of his own to determine the uncertainty of the variables.

Monitoring plan

If the operator uses this guidance he is advised to submit in his monitoring plan for every source stream which tier is required and which tier is achieved. For the activity-specific factors the operator has to indicate in his monitoring plan the substantiation for the uncertainty of the factor concerned. This can be done by referring to an Annex to the monitoring plan that contains a print-out of the work table 'history' in the spreadsheet for all the factors. The operator is also allowed to refer to substantiations and justifications that are available within the installation site. The part of the monitoring plan that relates to the quality assurance of the measurement equipment has to show clearly for each variable how many samples and analyses will be taken.