

# Guidance for preparing Monitoring Plans and Emission Reports for stationary Installations in the 3<sup>rd</sup> Trading Period (2013-2020) in Germany

## Editorial information

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## Editorial comments on version changes:

Updates of the composite paper „Guidance for preparing monitoring plans and emission reports for stationary installations in the 3<sup>rd</sup> trading period (2013-2020)” published on December 3, 2013 are summarised in the table below.

#	Date of update	Chapter	Short description
32	28 <sup>th</sup> November 2017	20.1.2	Concretisation of the determination method for weighted calculation factors for the annual reporting.
31	28 <sup>th</sup> November 2017	9.3	Concretisation of the formulas for determining the total uncertainty of the GHG mass flow (especially with regard to the correction parameter "water vapor content in the flue gas")
30	28 <sup>th</sup> November 2017	9.2	QAL3 test results (control charts) as well as the documentation of the measurement institution according to § 29b BImSchG must be taken into account by the verifier when verifying the emissions report.
29	28 <sup>th</sup> November 2017	9.1, 9.2	Simplification of reporting when using an evaluation instrument that has been tested for suitability in accordance with the requirements of the "Uniform nationwide practice for monitoring emissions" from 23.01.2017.
28	28 <sup>th</sup> November 2017	Annex 9	Specification of the term "standard deviation" for assessment of the uncertainty associated with the determination of the storage density
27	28 <sup>th</sup> November 2017	6.1.1	Providing evidence for a sufficient quality assurance of measuring instruments subject to legal metrological control through labelling.
26	28 <sup>th</sup> November 2017	Annex 5	Update of the table with maximum permissible errors and maximum permissible errors in service as well as periods of validity for selected measuring instruments according to the Measuring and Verification Ordinance (MessEV).
25	28 <sup>th</sup> November 2017	23.4	Meaning of a qualified verifier's opinion.
24	20 <sup>th</sup> December 2016	24.2	Correction of the CO <sub>2</sub> emissions calculation concerning the regeneration of catalytic converter from crack and reforming processes by additional feeding in of nitrogen. Amendment of the individual determination of the uncertainty contribution.
23	20 <sup>th</sup> December 2016	20.1.2	Amendment of the precise determination method of weighted calculation factors for the annual reporting.
22	20 <sup>th</sup> December 2016	6.1.2, Anhang 6, Anhang 7	Individual derivation of the uncertainty contribution of the influencing parameter "long-term stability" (drift) on the example of a belt weigher.
21	20 <sup>th</sup> December 2016	6.1.1, Anhang 5	Measuring devices, for which the conformity with the requirements of the Measuring and Verification Ordinance is proven, will be considered on the same level as officially verified measuring devices.
20	20 <sup>th</sup> December 2016	23.6.2	The prerequisites for waiving a site visit by the verifier have been adjusted by the European Commission.
19	20 <sup>th</sup> December 2016	23.7	New subsection for the verifiers: explanation of the fields in FMS for the documentation of open misstatements and nonconformities as well as deviations from the MRR and recommendations for improvements.
18	20 <sup>th</sup> December 2016	9.1, 9.2 und 9.4.1	Shortfall of a measuring device as a part of the CEMS for more than five consecutive days has to be reported immediately to the DEHSt. Passage has been defined more precisely. Addition of the criterias for a QAL2-recalibration. The standard deviation to create surrogate data refers to all valid measured hourly values of the reporting period. Formulation has been clarified.
17	11 <sup>th</sup> February, 2016	3.2	Adaptation of version description for monitoring plans in FMS.



#	Date of update	Chapter	Short description
16	11 <sup>th</sup> February, 2016	8.3	Concretisation of necessary evidences for biomethane from natural gas grids
15	11 <sup>th</sup> February, 2016	18.4	Update of covering page of FMS for emission reports. Relevant quantities for entering verified emissions in the Union Registry (cf. No. 11) are now available on the covering page.
14	5 <sup>th</sup> August, 2015	18.5	Change due to the jurisdiction of the ECJ and the administrative courts on inadmissibility of the imposition of a payment obligation pursuant to § 30 (1) TEHG
13	5 <sup>th</sup> August, 2015	13.4 and 20.1.4	Clarification of surrender obligation for transferred CO <sub>2</sub> .
12	5 <sup>th</sup> August, 2015	9	Editorial adaptation because this chapter is also important for continuous N <sub>2</sub> O emission measurement.
11	5 <sup>th</sup> August, 2015	18.4	Verified emissions of an installation have had to be entered separately for CO <sub>2</sub> , N <sub>2</sub> O and PFC (in CO <sub>2</sub> (e)) in the Union Registry since 04.02.2015. Description of where the relevant quantities can be found in the emissions report.
10	5 <sup>th</sup> August, 2015	Annex 9	Procedure description for determining the uncertainty of storage density.
9	5 <sup>th</sup> August, 2015	8.4.1 and 8.4.2	Sustainability of liquid biofuels: clarification of those cases where evidence of sustainability is required and how this evidence must be provided.
8	17 <sup>th</sup> December, 2014	18.4	New regulation for entering verified emissions in the Union Registry: if a verifiers' authorised representative enters the VET value, he can also confirm the entry. However, the option remains for another verifiers' authorised representative to confirm the entry.
7	17 <sup>th</sup> December, 2014	3.2 and 17.2	Note on saving the monitoring plan that the emissions report is based on
6	17 <sup>th</sup> December, 2014	6.2	As a simplification, uncertainty components of parts of a source stream can be neglected when the quantity of the source stream comprising this part accounts for a maximum of 5% of the annual quantity of the total source stream.
5	17 <sup>th</sup> December, 2014	7.2.3	The parameters (source stream quantity and calculation factors) included in the emissions calculation must have the same reference condition (for example, degree of humidity) according to Art. 30 MRR. Supplement of a note on the amended Annex VII MRR (minimum analysis frequencies, Art. 35).
4	17 <sup>th</sup> December, 2014	9	Supplements to quality assurance and providing evidence, procedure for determining the total uncertainty of CO <sub>2</sub> mass streams and the ongoing monitoring of continuous emission measurement systems (CEMS).
3	19 <sup>th</sup> September, 2014	23.6	New chapter „Waiver of site visits” according to Art. 31 AVR
2	22 <sup>nd</sup> April, 2014	19.4 and 19.4.2	A temporary (downward) deviation from the approved tier for an individual measurement value does not require conservative surcharges as long as the tier will still be met for the full reporting year.
1	8 <sup>th</sup> January, 2014	2.4	Exchanging measuring instruments is only considered a significant change (and thus has to be reported to DEHSt immediately) if the change leads to an adjustment of the uncertainty assessment for ensuring compliance of the required tier (see also FAQ No. MRR 010).

## Introduction

The monitoring and reporting of greenhouse gas emissions (hereinafter termed emissions) within the European Emissions Trading Scheme will be carried out primarily according to the specifications of the Monitoring Regulation (Regulation 601/2012/EU, MRR) as from 1 January 2013. For the 3<sup>rd</sup> trading period, MRR replaces the Monitoring Guidelines (MRG) 2008-2012 from the date of its publication. MRR is directly binding on all operators, competent authorities and verifiers in the EU Member States. Next to MRR, the German Greenhouse Gas Emission Trading Act (Treibhausgas-Emissionshandelsgesetz, TEHG) as well as the German Emissions Trading Regulation (Emissionshandelsverordnung, EHV) provide rules in relation to monitoring and reporting. The Allocation Ordinance (Zuteilungsverordnung, ZuV 2020) is furthermore relevant regarding annual reporting on explaining changes in operation. The European Accreditation and Verification Regulation (Regulation 600/2012/EU, AVR) comprises rules regarding verification of emission reports by independent verifiers.

This Guidance describes the requirements for the monitoring methods which must be adhered to by each operator in a monitoring plan specific to the installation and approved by the German Emissions Trading Authority (DEHSt). DEHSt provides the so-called Form Management System (FMS) for this purpose. It helps operators to compile the required information and data and should simplify the implementation of legal requirements for operators, verifiers and DEHSt.

**Part 1** of the Guidance provides an overview of the process and participants involved in the preparation of monitoring plans and emission reports. **Part 2** describes fundamental aspects in preparing a monitoring plan as well as the required information in FMS. **Part 3** addresses the preparation of emission reports as well as requirements on third party verification and explains respective FMS forms. Special aspects regarding monitoring and reporting of some activities will be addressed separately in Chapter 24 „Activity specific requirements“.

## Part 1: General

### 1 Stakeholders and their tasks

#### 1.1 Operators of installations subject to emissions trading

Pursuant to § 5 (1) TEHG, operators of installations subject to emissions trading are obliged to determine and report their emissions based on Annex 2 Part 2 TEHG and otherwise according to MRR. This statutory monitoring and reporting requirement also applies to installations subject to emissions trading that do not obtain a free allocation.

Methods to monitor emissions are to be defined in an installation-specific monitoring plan by the operator and are required to be approved by DEHSt. The approved monitoring plan is binding and serves as basis for emission monitoring and reporting (see. Art. 11 MRR).

Based on the installation-specific monitoring plan and monitoring methodology described therein operators determine emissions from their installations and prepare their annual emissions report. The report will be submitted to DEHSt by 31 March for the preceding calendar year. The annual emissions report must be verified by independent verifiers before submission.

Operators of installations must surrender the quantity of emission allowances that correspond to the emissions released in tonnes of CO<sub>2</sub>(e) by their activity/activities in the reporting year. The emission allowances of the reporting year must be surrendered by 30 April of the following year.

#### 1.2 The German Emissions Trading Authority (DEHST)

Unlike in the first and second trading period, the relevant state (Bundesland) is no longer the competent authority responsible for approval of monitoring plans (cf. § 19 (1) No 3 TEHG). This responsibility has been moved to DEHSt.

DEHSt is also responsible for the assessment of emissions reports. If no emissions report meeting the requirements of § 5 TEHG – and thus also Annex 2 TEHG and MRR – has been submitted to DEHSt by 31 March, or the surrender liability has not been fulfilled by the 30<sup>th</sup> April in the year following the reporting year, DEHSt will enforce the report and surrender liability (cf. §§ 29 and 30 TEHG).

#### 1.3 State (Land) authorities

In accordance with the federal emission control act, the competent state authorities are responsible for granting the emission permits (cf. § 4 TEHG and § 19 (1) No 1 TEHG). The competent state authorities use these permits to decide what (i.e. what installations or activities) must be monitored.

#### 1.4 Verification Bodies

Another participant in the annual process of emissions reporting is the verifier. Verifiers are independent experts commissioned by the operator (according to. § 5 (2) TEHG) to verify the annual emissions report. After verification the operator submits the report for final assessment to DEHSt.

In detail, the verifier's tasks are laid down in the Accreditation and Verification Regulation (Regulation 600/2012/EU; AVR). According to this, the main task is to check emission reports as well as underlying data for correctness and completeness. The aim of verification is to determine if the report is “free from material misstatements” “with reasonable assurance”.

The verification report is integrated in FMS forms for emissions reports.

According to Art. 35 (4) Registry Regulation (Regulation 389/2013), it is the verifier's task to confirm the correctness of the installation's emissions entered into the registry as part of the verification of emission reports, and the underlying approval and evidences. Furthermore, the verifier has to confirm in FMS annually that changes in operation of an installation which have to be explained according to § 22 ZuV 2020 are monitored and reported in accordance with the approved monitoring plan (Art. 17 (4) and Art. 27 (2) o AVR). According to § 22 ZuV 2020, this requirement was applied originally on notices that covered the period from 1<sup>st</sup> January 2013 to 31<sup>st</sup> December 2013.

## Part 2: Monitoring Plan

### 2 Basic Aspects

#### 2.1 Role and importance of a monitoring plan

The monitoring plan is the basis of the annual emissions report. It specifies and describes where and how installation emissions will be determined. Basically, emissions monitoring must be transparent, complete, comparable, consistent and accurate (see Chapter I Section 2 MRR).

The monitoring plan specifies the requirements of TEHG, MRR as well as EHV and ZuV 2020. To facilitate the preparation of monitoring plans, DEHSt provides forms in the FMS that use a pre-structured format to query the necessary data and information (see Chapter 3.2).

#### 2.2 Relevant legal basis

The requirements on the determination of emission are regulated in Annex II TEHG, MRR and—if liquid biofuels are monitored from 1<sup>st</sup> January 2014 in the EHV.

Emission monitoring and reporting methods are principally regulated by MRR. MRR refers to “accepted standards” (CEN, ISO, DIN standards etc.) at various points. These standards must be considered and applied when performing measurement, sampling and analysis procedures required by MRR in accordance with MRR's hierarchy (cf. Art. 32 and 42 MRR).

A particular feature is that TEHG prescribes – as previously – the compulsory use of an oxidation factor of 1.

In addition, TEHG and ZuV 2020 (Allocation Regulation) envisage a series of simplifications for small emitters who are exempt pursuant to § 27 TEHG (i.e. installations with annual emissions of less than 25,000 tonnes of CO<sub>2</sub>(e)).

Art. 31 (1) c) MRR now authorises DEHSt to publish standard factors for certain substances. These standard factors precede others listed for example in the national inventory or in Annex VI MRR. Respective standard factors are published on DEHSt's websites and their sources (e.g. DEHSt list) in FMS selection lists (see Chapter 7.1).

In connection with the use of standard factors, it should be noted that the consistency requirement (see Annex 2 Part 1 No 3 TEHG 2004) of the second trading period no longer applies for installations with allocation based on historical emissions. In particular, emission values for certain products (“benchmarks”) underlying the allocation must not be used as the basis for emissions reporting.

## 2.3 Regulatory approvals

### 2.3.1 Emissions permit and refusal of emissions trading obligation

All installations within the scope of TEHG require an emissions permit.

Installations that have been approved under the Federal Immission Control Act (Bundes-Immissionsschutzgesetz, BImSchG) before 31/12/2012 do not need a separate emissions permit. For them, the permit according to BImSchG also qualifies as an emissions permit. Pursuant to § 2 (4) TEHG, this permit then specifies to what extent the individual installation is subject to emissions trading and thus to monitoring. Regardless of that, emission permits can also be obtained separately from the competent state authority according to § 4 (1) TEHG. This is especially recommended where it is difficult to delineate the TEHG's scope solely on the basis of the permit(s) according to BImSchG.

Installations that have been approved after 01/01/2013 according to the BImSchG, obtain their emissions permit pursuant to § 19 (1) No 1 TEHG also by the competent state (Bundesland) authority.

For installations that do not require approval according to BImSchG, DEHSt will issue the emissions permit pursuant to § 19 (1) No 3 TEHG.

Advice on the scope is published in the DEHSt paper „[TEHG-Anwendungsbereich](#)“ (available in German). The paper includes an interpretation by DEHSt only for selected activities and questions and is not binding for state authorities regarding decisions on TEHG scope.

DEHSt must also be given the opportunity pursuant to § 4 (6) TEHG to comment on such procedures where the state authority issues an emissions permit.

### 2.3.2 Approval of the monitoring plan

According to Annex II part 1 No. 1. b TEHG new entrants<sup>1</sup> have to submit the monitoring plan to DEHSt for approval before starting operations. “Starting operations” includes every kind of operation not only the “regular operation”. The TEHG scope applies to all installations meeting the threshold according to Annex I part 1 TEHG independent from the installation purpose.<sup>2</sup> This also means that emissions from trial operations are to be monitored and reported irrespective of the fact that the operator has disposed of the installation or the installation contractor is still testing it. If the operator is not able to deliver all relevant information according to MRR at this early stage, he should develop and submit a monitoring plan with as much information as possible and coordinate relevant timeframes for completion with DEHSt. In any case the operator has to monitor and report as well as surrender certificates for emissions which were emitted when the installation was not under his control.

The decision of the state authority on “what” needs to be monitored is the basis for DEHSt's decision as to “how” it is to be monitored. The state authorities are involved and able to comment on the approval of monitoring plans.

## 2.4 Changes in the monitoring plan

According to Art. 15 MRR, significant and non-significant changes of monitoring plans are to be differentiated. The result is different obligations of notification.

Significant changes are:

- ▶ Inclusion of new source streams or emission sources which were not part of the monitoring plan,
- ▶ Change of the applied tier,
- ▶ Change of monitoring methodology, e.g. from standard method to mass balance or from standard method to continuous emissions measurement,

<sup>1</sup> Those facilities are concerned new facilities that went into operation after 29.02.2012.

<sup>2</sup> ZuV 2020 §18 para. 4 shows a similar approach. An additional allocation is granted for emissions arising from operations before starting “regular operations”

- ▶ Change of measuring instruments if proof for tier compliance is changing at the same time (except exchanges of a measuring instrument for a verified measuring instruments),
- ▶ Change of laboratory (except change to DIN EN ISO/IEC 17025 accredited laboratory),
- ▶ Change of sampling plan in terms of applied standards, sampling procedure or treatment, reduction of sampling frequency,
- ▶ Reduction of analysis frequency,
- ▶ Change of defined standard values in the monitoring plan (except values of „DEHSt-Liste“ or Annex VI MRR),
- ▶ Change of installation category or classification of source streams that lead to the application of a higher tier.

All significant changes in the monitoring plan must always be immediately notified to DEHSt (Art. 15 (1) MRR). If possible, significant changes should be indicated to DEHSt before implementation. Only in this case operators can be sure that the change is legally secure and approvable. Furthermore an additional delay through verification of the annual emissions report can be ruled out (see Art. 7 (6) AVR).

The operator submits an updated monitoring plan (ZIP-file) including the required documents of proof to DEHSt via the Virtual Post Office (VPS). Changes are to be described in FMS field „Änderungen gegenüber der letzten eingereichten Version“ (changes after the last version submitted) on the covering page as well as on additional documents in detail if required:

- ▶ Description of the change,
- ▶ Reason for the change.

Non-significant Changes are changes that serve to adjust the already described information in the monitoring plan as well as all other changes than described above. For example:

- ▶ Change of address and contact name,
- ▶ Change of rated thermal output resp. production capacity according to TEHG, change of active installation parts and technology used, change of installation category or source streams classification which do not lead to higher tier obligations according to MRR compared to the approved monitoring plan,
- ▶ Changes of data collection by the supplier, if the approved monitoring plan secures (by the operator's evidence), that the requirements of the MRR are met,
- ▶ Change of monitoring methodology regarding a change in operation that has to be explained according to § 22 ZuV 2020 (see chapter 12.4.3).

All non-significant changes of the monitoring plan should be collected and submitted to DEHSt together with the next upcoming significant change, but not later than January 31<sup>st</sup> of the following year. For this a revised monitoring plan (zip-file) should be handed in to DEHSt via VPS.

Non-notifiable changes are changes which neither lead to a modification of the monitoring plan nor of the supplementary documents providing evidence of meeting the required tier (e.g. uncertainty assessment for non-verified measuring instruments or equivalence proof for non-accredited laboratories). For example, this could include:

- ▶ Update of internal process descriptions. Operators carry out the update under their own responsibility.

- ▶ Change of measuring devices by „regular and rotational replacement“ (regular and rotational change of measuring instruments which only differ in serial numbers). “Regular and rotational replacements” have to be described in FMS fields for quality assurance on the form for measuring instruments (form „Messgerät“) in the monitoring plan.

The operator must document all non-notifiable changes, such as a change of measuring devices. The documentation should be provided to the verifier during the annual verification process, and to DEHSt only in individual cases on demand.

If DEHSt considers that a reported change does not require approval, it shall immediately inform the operator (Art. 15 (2) subparagraph 2 MRR).

## 2.5 Monitoring obligation in case of change of operator

If an operator’s identity or legal status changes, DEHSt must be notified immediately. If the installation is subject to permit according to the BImSchG, the competent state authority for the emissions permit must also be immediately notified. The new operator has to make sure that also he reports emissions that his predecessor has not submitted in an emissions report (§ 25 (1) TEHG).

## 2.6 Commercial and industrial secrecy

All commercial and industrial information included in monitoring plans and corresponding data are treated confidentiality according to the law.

# 3 Electronic Preparation and Submission of Monitoring Plans

## 3.1 Mandatory electronic communication

Monitoring plans must be prepared using the electronic templates ([Forms Management System](#), FMS) provided on DEHSt’s website. Submission and signature of the monitoring plans must also be made electronically via the Virtual Post Office (Virtuelle Poststelle, VPS). (Published in the electronic Federal Gazette (elektronischer Bundesanzeiger, eBAnz) of 31/05/2012 in conjunction with § 23 TEHG and Art. 74 (1) MRR).


## 3.2 Form Management System (FMS)


FMS allows users to efficiently prepare a monitoring plan. In addition to direct data entry, FMS also supports the importing of monitoring plans previously created by the software and locally saved. Detailed information on import options can be found in “Benutzerhandbuch für die Software Überwachungspläne 2013-2020” ([User’s Guide for 2013-2020 Monitoring Plan Software](#), available in German).

### Versioning

Version control for monitoring plans is an innovation in FMS. This feature will enable simple version management.

For this purpose, the monitoring plan can be setup in one of two modes.

**Read only mode:** In read only mode, the monitoring plan data can only be read. On opening an available monitoring plan in FMS, it is automatically put into read only mode. One can return to the read only mode after pressing the button  [Edit mode] by selecting „Im Lesemodus verbleiben“ (Stay in read only mode). If a monitoring plan is opened in order to check whether it should be selected as the basis for the creation of the emissions report, we recommend using the read only mode and not putting the version in edit mode.

**Edit mode:** In edit mode all editing functions are enabled for the monitoring plan. However, this should only be used if it is intended to actually change the monitoring plan. The button  must be selected in the open monitoring plan to activate the edit mode.



Now the query appears „Möchten Sie die ausgewählte Version bearbeiten und ändern?“ (Do you want to edit and change the selected version?). If you want to continue with „Bearbeiten“ (Editing) the monitoring plan, it should be born in mind that this will create a new version of the monitoring plan after the next step. This new version will need to be sent to DEHSt if an emissions report is to be based on it.

After answering the „Bearbeiten“ (Editing) question, another query appears: „Möchten Sie den bisherigen Stand vor der weiteren Bearbeitung sichern?“ (Do you want to save the current state before proceeding further?). On answering the question with „Ja“ (Yes), a copy of the open monitoring plan is created. This copy will be changed into edit mode and opened. The original remains unchanged and is saved in the system. It can always be selected in the data browser. When revisions are necessary in the monitoring plan, we recommend creating a new version in this way, which will be transferred to DEHSt for approval after completing the amendments.

When the answer to the query is „Nein“ (No), the monitoring plan is changed into edit mode without creating a copy. The previous version is overwritten and will no longer be available in FMS. This variant of the edit mode should not be applied to a version of the monitoring plan selected as the basis for creating the emissions report. The underlying monitoring plan should be permanently saved and be reproducible at any time to ensure that the data in the emission report remain traceable.

### Form structure

Figure 1 gives an overview of the structure in FMS.

The forms in bold are always created initially in the monitoring plan. All other forms can be created by the operator as necessary as described below.

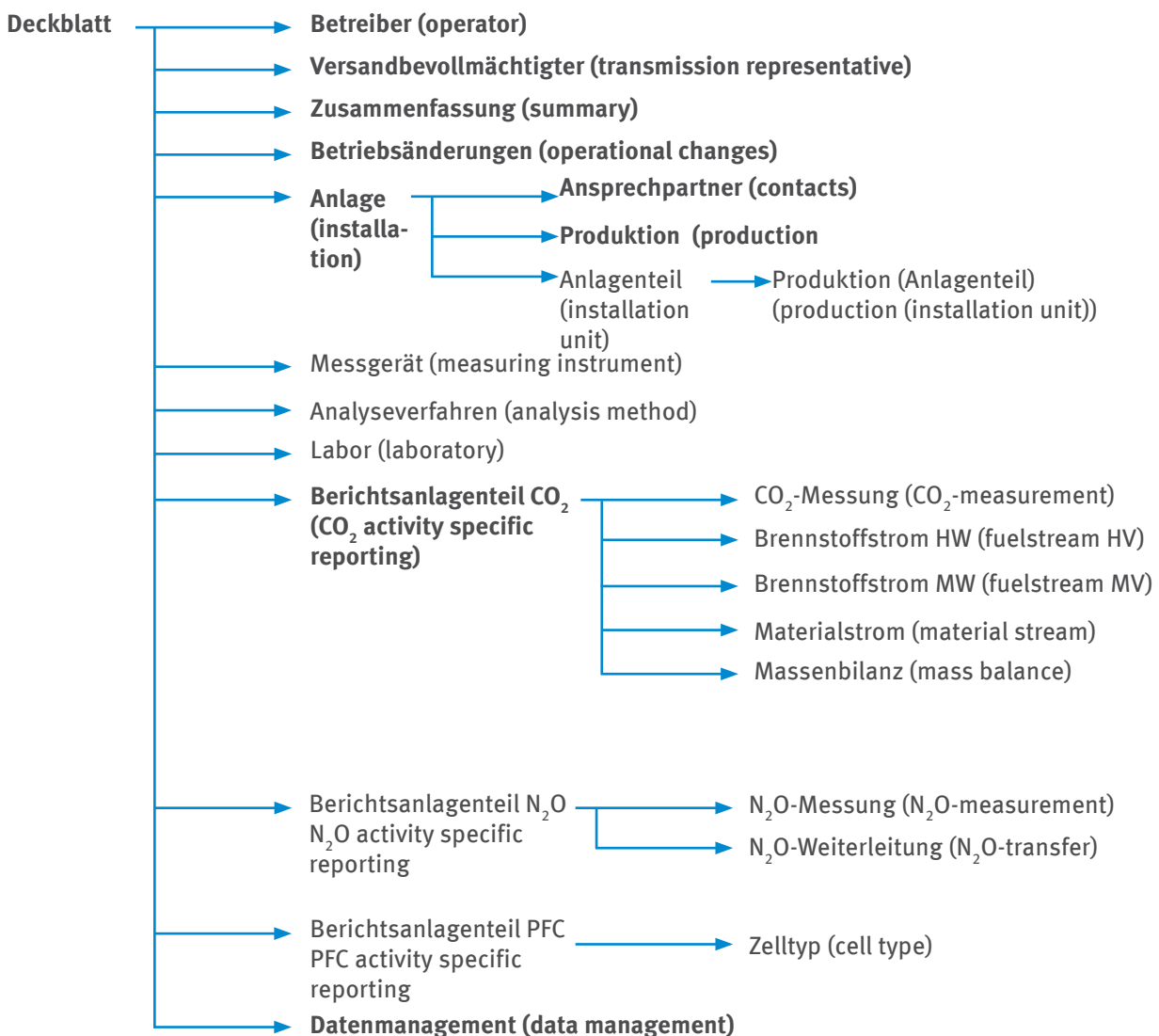


Figure 1: Structure of forms in FMS



To add forms, the parent form must be selected in the directory tree. For example, if a “Messgerät” (measuring instrument) form needs to be created, the operator must first select the “Deckblatt” (covering page) form. Then the possible forms that can be created appear above the directory tree (cf. Figure 2). Only those forms that are required by the installation configuration should be created.



Figure 2: Directory tree in FMS

A more detailed description of FMS is compiled in “[Benutzerhandbuch für die Software Überwachungspläne 2013-2020](#)” (User’s Guide for 2013-2020 Monitoring Plan Software, available in German). This and the XML schemeto describe the XML interface and the accompanying documents are available on the DEHSt website ([www.dehst.de](http://www.dehst.de)) under the heading “Monitoring 2013-2020”.

### 3.3 Virtual Post Office (VPS)

Electronic communication with DEHSt is performed via the Virtual Post Office (Virtuelle Poststelle, VPS). VPS is a kind of electronic post office to which electronic messages can be sent in a secure manner and where incoming messages can be picked up. VPS ensures that only the intended recipient can decrypt and read the message. The so-called E2E (end to end) encryption of the message makes it possible to transmit messages securely over the internet. The qualified electronic signature (QES) is also supported by this application.

Information for setting up and activating a VPS mailbox can be found on the DEHSt website at “Einrichten eines VPS-Postfachs” ([Setting up a post box at the Virtual Post Office](#)).

### 3.4 Signature

A signature card (smart card) with a valid qualified signature (QES) and a suitable card reader (smart card reader) are required for sending messages via the VPS. Information on obtaining a signature card with QES is available on the DEHSt website under Elektronische Signatur ([Electronic Signature](#)).

## 4 General Principles of Emissions Monitoring

Note: All installations subject to emissions trading must create a monitoring plan and submit it to DEHSt for approval regardless whether they receive a free allocation of emission allowances for the period 2013 to 2020. The allocation methodology with its definitions for sub-installations and how the installation is distributed into them basically does not play a role as far as emissions monitoring is concerned. The only exception is monitoring of operational changes pursuant to § 22 ZuV 2020 (cf. Chapter 12.4).

## 4.1 Monitoring Methods (Standard method, Mass balance method and Continuous emission measurement)

Depending on the greenhouse gas, operators can use calculation-based methods and/or continuous emission measurement for the monitoring of emissions of an installation (see Art. 21 (1) MRR). Calculation methods include the so-called standard methodology and the mass balance methodology.

If emissions are calculated using the standard methodology, the operator determines emissions based on the installation's fuel or material input or production output and additional calculation factors. For emissions arising from the combustion of a substance, the operator determines the quantity of the fuel used and multiplies it by its net calorific value and the corresponding emission factor. The oxidation factor is set to the value of 1 according to Annex 2 Part 1 TEHG. The operator determines process emissions from a source stream by multiplying the quantity of material used or the production output by the relevant emission factor and possibly by an installation-specific conversion factor (cf. Art. 24 MRR).

If emissions are calculated using the mass balance methodology, the operator determines the amount of CO<sub>2</sub> that corresponds to each individual source stream entering and leaving the boundaries of the mass balance (mass balance elements). For this, he multiplies the respective material quantity by the carbon content of the material and the factor 3.664 t CO<sub>2</sub>/t C (cf. Art. 25 MRR).

For continuous emission measurement, the concentrations of the relevant components of the gas flow and the volume flow of flue gas must be determined. Unlike in the first and second trading period, the method of continuous emission measurement for the determination of CO<sub>2</sub> emissions considered equivalent to the calculation methods (see Chapter 13.3). The use of continuous emission measurement is mandatory for determining N<sub>2</sub>O emissions according to Annex IV para 16 MRR, CO<sub>2</sub> transferred to CCS installations according to Art. 49 MRR and CO<sub>2</sub> emissions in regeneration of catalytic crackers and other catalysts as well as flexicokers. A corroborating calculation is unnecessary in these cases. In all other cases where the continuous emission measurement is used, a tier-independent corroborating calculation is required.

With DEHSt's permission, the operator may combine a standard methodology, mass balance methodology and measurement-based methodology for different emission sources and source streams that belong to the same installation if they neither lead to gaps nor double counting and the method is allowed for the relevant activity according to MRR.

## 4.2 Classification of installations in categories A, B and C, and the tier concept

Art. 19 (1) MRR specifies that the minimum requirements for monitoring (tiers) depend on the amount of installation emissions and respective source stream emissions (see Chapter 4.3.2). An installation is categorised based on its average annual emissions of the whole previous trading period (without CO<sub>2</sub> from biomass and before subtracting transferred CO<sub>2</sub>). If verified average annual emissions of the previous trading period are not available or are no longer representative because of changes, the operator estimates average annual emissions conservatively.

The determination of the threshold value and the classification of installations into categories A, B or C are defined in Art. 19 (2) MRR:

- ▶ category A installations: ≤ 50,000 t CO<sub>2</sub>(e) per year
- ▶ category B installations: > 50,000 t CO<sub>2</sub>(e) per year and ≤ 500,000 t CO<sub>2</sub>(e) per year
- ▶ category C installations: > 500,000 t CO<sub>2</sub>(e) per year

The tier concept, established in the second trading period, remains in force for monitoring major fuel and source streams in installations covered by the EU ETS (Art. 26 (1) subparagraph 1 MRR).

- ▶ For category A installations, the tiers specified in Annex V MRR are relevant.
- ▶ For category B and C installations, the highest tiers are relevant in accordance with Annex II, in conjunction with the respective sector-specific requirements in Annex IV MRR.

Tiers according to Annex V MRR can be used for calculation factors of commercial standard fuels, regardless of the installation category.

Simplifications can be claimed for minor and de-minimis source streams (see Chapter 4.3.2).

## 4.3 Deviation from MRR's requirements

Art. 26 (1) subparagraph 2 MRR enables the operator to deviate from the required tiers according to Art. 26 (1) subparagraph 1 MRR (see Chapter 4.2) when it has been proven to DEHSt that the required tier is unreasonable (disproportionate) (see Chapter 4.3.1). Simplifications can generally be applied for minor and de-minimis source streams (see Chapter 4.3.2) as well as the fall-back methodology (see Chapter 4.3.3).

**Note:** A deviation in terms of this Guidance is only relevant if the operator deviates to a lower tier than required by MRR. The use of a higher tier does not represent any deviation and requires no justification. Moreover, in individual cases where an operator already has more precise data – it is actually required.

### 4.3.1 Unreasonable costs

Unreasonable costs and technical non-feasibility in the MVO, and previously in MRG, are referred to the prerequisites, under which the requested accuracy requirement may be deviated.

The costs of a measure are considered unreasonable if they exceed their expected total benefit. The expected total benefit is determined by multiplying an “improvement factor” by the reference price of 20 Euros per emission allowance. For the cost of a measure, an appropriate depreciation period must be considered (Art. 18 (1) MRR). The AfA-tables (depreciation of fixed assets) issued by the Federal Ministry of Finance and a linear depreciation must be applied.

For source (fuel or material) quantities the improvement factor will be calculated as the difference between the currently attained uncertainty and the uncertainty of the required tier multiplied by the average emission values of the relevant source stream over the last three years (Art. 18 (2) MRR).

If the emission values from the last three years are not known or they are no longer representative, the operator must produce a conservative estimate of the average annual emissions (without CO<sub>2</sub> emissions from biomass and before subtracting transferred CO<sub>2</sub>).

**Example:** An operator uses a non-verified and non-calibrated flow meter with an individually determined uncertainty of 2.4 % to determine the quantity of blast furnace gas. The emissions resulting from the source stream are 45,000 tonnes of CO<sub>2</sub> per year. The average annual emissions from the installation quantity to 300,000 tonnes of CO<sub>2</sub>. Thus tier 4 (1.5 %) is relevant for the determination of the quantity of the blast furnace gas. To comply with the required tier, the operator must replace the existing flow meter with a new, more precise instrument, which can be acquired for 35,000 Euros on the market. The installation costs are 5,000 Euros and the annual operating costs (including calibration) are 2,000 Euros.

$$\text{Cost: } \frac{35,000 \text{ Euros} + 5,000 \text{ Euros}}{8 \text{ years}} + 2,000 \text{ Euros/year} = 7,000 \text{ Euros/year}$$

$$\text{Benefit: } (2.4 \% - 1.5 \%) * 45,000 \text{ tCO}_2/\text{year} * 20 \text{ Euros}/\text{t CO}_2 = 8,100 \text{ Euros/year}$$

In this simplified example, the cost of the measure is less than the benefit. The measure is therefore reasonable.

For measures which improve the quality of reported emissions, (e.g. increasing the number of analyses, Art. 18 (3) MRR) but do not directly affect accuracy, an improvement factor of 1 % in the average annual emissions of the relevant source stream over the last three years is assumed for the assessment of the cost-benefit ratio.

Regarding the costs of analysis, 40 Euros must be assumed for a single-component analysis (e.g. calorific value) and 200 Euros for a multi-component analysis (e.g. calorific value, carbon content) to ensure equal treatment among operators. Differing costs have to be justified and proved by the operator.

**Example:** The operator of a power plant with average annual emissions of 750,000 tonnes of CO<sub>2</sub> is obliged in accordance with MRR to determine calculation factors for major source streams individually (see Chapter 7.2).

The average annual emissions resulting from the relevant source stream are 151,000 tonnes of CO<sub>2</sub>. So far, the analyses of the calorific value were carried out in a non-accredited in-house laboratory. The cost of the analysis of the calorific value in an ISO 17025 accredited laboratory is 40 Euros. To ensure the results are representative, eight analyses must be performed. Sampling will continue to be conducted in-house.

Cost:  $8 * 40 \text{ Euros} = 320 \text{ Euros}$

Benefit:  $1 \% * 151,000 \text{ t CO}_2 * 20 \text{ Euros/t CO}_2 = 30,200 \text{ Euros}$

In this example, the cost of the measure is less than the benefit. The measure is therefore reasonable.

Art. 18 (4) MRR contains in addition that measures to improve monitoring methods of an installation according to Art. 69 MRR are always considered reasonable if they cost 2,000 Euros or less, or in installations with low emissions (see Chapter 4.4), 500 Euros or less.

### 4.3.2 Minor and de-minimis source streams

The tier requirements may be waived for minor and de-minimis source streams without any evidence of disproportion. To classify source streams, the operator compares each source stream with the sum of the absolute values of fossil CO<sub>2</sub> and CO<sub>2</sub>(e) from all source streams and emission sources in the installation. In the case of mass balances, the sum of the absolute values of all input and output flows is produced by assigning positive signs to output flows in the summation. This will be done before subtracting transferred CO<sub>2</sub>. The thresholds for classification of a source stream as “minor” and “de-minimis source stream” are specified by Art. 19 (3) MRR.

The only change to MRG’s requirements is that de-minimis source streams are no longer part of minor source streams. Thus they will not be taken into account in the accumulation of minor fuel or material streams.

- ▶ Minor fuel/material streams are those source streams selected by the operator which jointly correspond to less than 5,000 tonnes of fossil CO<sub>2</sub> per year or to less than 10 % (up to a total maximum contribution of 100,000 tonnes of fossil CO<sub>2</sub> per year) whichever is the highest in terms of absolute value. The highest tier must be applied, that can be achieved without any additional effort, with a minimum of tier 1.
- ▶ De-minimis fuel/material streams are those flows selected by the operator which jointly correspond to less than 1,000 tonnes of fossil CO<sub>2</sub> per year or to less than 2 % (up to a total maximum contribution of 20,000 tonnes of fossil CO<sub>2</sub> per year) whichever is the highest in terms of absolute value. A conservative estimate may be applied instead of tiers, unless a tier can be achieved without any additional effort.

### 4.3.3 Fall-back methodology

The operator may use a monitoring methodology that is not based on tiers (hereinafter called ‘the fall-back methodology’) (see Art. 22 MRR) if the following conditions are met:

- ▶ applying at least tier 1 under the calculation-based methodology for one or more major or minor source streams is technically not feasible or would incur unreasonable costs, and
- ▶ applying tier 1 in a continuous emission measurement for at least one emission source in connection with the same source streams is technically not feasible or leads to unreasonable costs.

In this case, the operator must produce a comprehensive description of the fall-back methodology and an uncertainty analysis which demonstrates that the overall uncertainty threshold for the annual emissions from the whole installation is not exceeded (category A installations: 7.5 %, category B installations: 5.0 %, category C installations: 2.5 %).

## 4.4 Installations with low emissions (small emitters)

Installations with low emissions are those installations that emit less than 25,000 tonnes of CO<sub>2</sub>(e) per year. The classification is based on the reported average annual emissions in the second trading period (without CO<sub>2</sub> from biomass and before subtracting transferred CO<sub>2</sub>, see Art. 47 (2) MRR). If these emission reports are no longer relevant due to operational changes or the installation was not participating in emissions trading at that time, a conservative estimate is needed as to whether or not the above mentioned threshold will be exceeded in the next five years.

Small emitters may use the following special simplifications according to Art. 47 (3) to (7) MRR (cf. also [FAO No MVO 001](#), available in German) in addition to general ones (see Chapter 4.3.1 to 4.3.3). These simplifications are not allowed for activities with N<sub>2</sub>O emissions, see Art. 47 (1) subparagraph 2 MRR:

- ▶ Compliance with the tiers specified in the monitoring plan and uncertainties for the individual activity data and calculation factors need not be proved.
- ▶ It need not be proved that there has been appropriate countermeasure to the identified error and control risks, i.e. notification of the outcome of the risk assessment pursuant to Art. 12 (1) b) MRR is not required.
- ▶ An improvement report according to Art. 69 (4) MRR based on recommendations in the verification report of the verifier is not necessary (see Chapter 5).
- ▶ Deployed fuel and material quantities can be proved through purchasing records, as well as stock changes can be estimated.
- ▶ Unless the operator already has more precise values, calculation factors and activity data will be complied with tier 1.

When an installation with low emissions unexpectedly exceeds the 25,000 tonnes of CO<sub>2</sub>(e) threshold in a calendar year, it must be immediately notified to DEHSt. Likewise, the operator must immediately submit a correspondingly revised monitoring plan to DEHSt for approval. The monitoring plan need not be changed if the operator can demonstrate that the threshold has not been exceeded in the previous five reporting periods and will not be exceeded again in the future (cf. Art. 47 (8) MRR).

## 4.5 Installations without emissions

Installations that perform activities of Annex 1 Part 2 TEHG and have a permit for the release of emissions are subject to emissions trading, even if they are unable to emit emissions for factual reasons. Operators of such installations must therefore also submit a monitoring plan to DEHSt for approval.

The extent of the monitoring plan may be limited to completing the following forms: “Deckblatt” (Covering page), “Versandbevollmächtigter” (sending entity), “Betriebsänderungen” (Operational changes), “Anlage” (Installation), “Ansprechpartner” (Contacts), “Produktion” (production), “Datenmanagement” (Data management) and the appropriate “Berichtsanlagenteil” (activity specific reporting form). The operator must comprehensibly and transparently indicate in the field “Beschreibung des Berichtsanlagenteils” (description of the activity specific reporting) on the “Berichtsanlagenteil” (activity specific reporting form) why the installation is unable to emit any emissions. The verifier in the required annual emissions report must confirm this data.

For installations that are currently not emitting any emissions, but are technically fully capable of doing so, a complete monitoring plan must be produced. This refers to, for example, installations whose emissions are not emitted by their own stakes, but are entirely transferred to other installations for further processing or flaring off, so that the installation that triggers the emissions does not actually emit any.

## 5 Developing an Improvement Report

Art. 69 MRR requires improvement reports to be submitted to DEHSt

1. for high-major emission source streams in Category B and C installations (those with more than 50,000 t CO<sub>2</sub>(e) /a) when their monitoring is not yet complying with the highest tiers according to MRR,
2. for high-major emission source streams in Category A installations (those with more than 50,000 t CO<sub>2</sub>(e) /a), when monitoring has been lagging falling behind those mitigations simplifications already permitted allowed by the MRR,
3. for installations with a minimum of 25,000 t CO<sub>2</sub>(e) /a, for which the verifiers have recommended improvements to monitoring,
4. for a fall-back monitoring methodology pursuant to Art. Art. 22 MRR.

An improvement report can be waived for installations with low emissions (< 25,000 t CO<sub>2</sub>(e) /a) in response to verifiers’ recommendations (see Section 4.4). An improvement report must be submitted for these installations when the operator is falling behind the simplification allowed by the MRR for installations with low emissions



(see Section 4.4, e.g. using estimation techniques methods instead of at least tier 1 for the determination of source stream quantities and calculation factors).

Evidence must be newly provided about the disproportion of tier compliance for the above mentioned items 1, 2 and 4 in the improvement report. However, if the respective tier can be adhered to in the near future, the operator shall submit a proposal to DEHSt together with the improvement report indicating when the necessary changes in monitoring should be implemented.

If the improvement potential in the mentioned cases has been already implemented and monitoring plans duly amended and submitted to DEHSt, then no additional improvement report is needed. The same applies in individual cases if the way forward has been already agreed with DEHSt as to how the improvement in monitoring should be handled.

Affected Category C installations have to submit an improvement report to DEHSt by 30.06.2014 for the first time and every year thereafter (if they continue to deviate from the tier requirements), affected Category B installations every two years (initially by 30.06.2015) and affected Category A installations every four years (initially by 06.30.2017). If there are instructions or recommendations for improvement from the verifiers, an improvement report must be submitted every year.

## 6 Determination of Source Stream Quantities

Depending on the emission level of the installation and the activity carried out, certain maximum uncertainties must be adhered to in determining the emission-relevant substance quantities for the specific source streams. It must therefore be demonstrated for each emission-relevant source stream (except de-minimis) that the uncertainty thresholds of MRR applicable to the particular installation are adhered to (see Chapter 4.2). In order to provide evidence of a source stream, the operator must first consider all measuring instruments whose readings contribute to determining the annual quantity of this source stream.

Thus, for instance, with regard to gaseous fuels, not only the gas meters which measure the gas volume during operation, but all pressure, temperature and possibly compressibility measuring instruments for gas must also be considered, because the volume at standard conditions needed in the annual emissions report can only be determined by a conversion with the help of mentioned measured parameters. Therefore, by determining the substance quantity within the demonstration of evidence, the cumulative effect of all components of a measurement system on the uncertainty must be taken into account. If necessary, this can be done by calculating the combined measurement uncertainty based on calculation formulae for error propagation on the basis of uncertainty components of the measuring instrument(s) and other uncertainty components e.g. from the determination of stock changes (see Chapter 6.2).

### 6.1 Uncertainty assessment of measuring instruments

The operator can determine the source stream quantities using his own instruments or those that are outside of his control. In either case, the operator must present the necessary documents and descriptions to demonstrate compliance with the required MRR tier. The scope of evidence is different depending on the quality assurance measures intended for the instrument.

#### 6.1.1 Officially verified measuring instruments

An individual uncertainty assessment for a measuring instrument may be omitted if there is evidence that it is subject to national legal metrological control. The verification certificate according to §37 of the Measuring and Verification Ordinance (MessEV) shall be submitted upon request to DEHSt and to the verifier within the emissions report review. According to §37 of the Measuring and Verification Law (MessEG) of 25<sup>th</sup> July 2013 measuring devices, for which the evidence of conformity with the requirements of the MessEV of 11<sup>th</sup> December 2014 is provided, correspond to officially verified measuring instruments for the duration of the calibration period commencing with the placing on the market. This means that they are equivalent to officially verified measuring instruments in regards to the monitoring and reporting of emissions according to the TEHG. In case of using such measuring instruments, the conformity declaration shall be submitted upon request to DEHSt and to the verifier within the emissions report review.

An overview of the “Legal metrology in Germany”, and maximum permissible errors as well as periods of validity of the verification for selected instruments can be found in Annex 5 of this Guidance.

If the instrument is not controlled by the operator, but for instance, by the supplier, then in the case of stationary instruments, the verification certificate or the conformity declaration shall be requested from the supplier, submitted on request to DEHSt and presented to the verifier within the emissions report review. In the case of mobile measuring instruments (e.g. a tanker flow meter), the operator must demand randomly verification certificates or conformity declarations from the supplier, submit copies of them upon request to DEHSt and provide them to verifiers within the emissions report review.

If the operator does not know the actual supplier or the supplier’s specific instrument at the time of preparing the monitoring plan, the form “Messgerät” (measuring instrument) must be completed in as much detail as possible. This means that at least the measurement method must be selected from the list in the field “Messmethode” (measuring method). The operator must ensure that during the reporting year, the measurements will be carried out with verified instruments and the relevant proofs (e.g. copies of the verification certificates or conformity declarations) are available if needed.

In any case, for instruments outside the operator’s control it must be ensured that the field “Beschreibung zur Qualitätssicherung” (Description of quality assurance) under the heading “Angaben zur Qualitätssicherung” (Data for quality assurance) is either based on legal requirements (by reference to the legal document) or based on contractual agreements with the supplier to ensure that the instrument to be used is verified.

### **6.1.2 Calibrated instruments installed in a suitable environment in accordance with their operational specifications**

For those instruments which are not subject to national metrological control but are regularly calibrated and have been installed and operated in accordance with their operational specifications, the instrument’s practical operational conditions must be locally taken into account.

A simplified proof of compliance with the tier requirement can be provided through the following four points summarised in an uncertainty calculation (this may also apply to measuring instruments outside the operator’s control):

1. Evidence that, in the instrument specifications, the manufacturer of the measuring instrument has specified application limits and maximum deviations for those relevant influencing parameters (e.g. flow rate, temperature, pressure, medium, long-term stability (calibration cycle), etc.) affecting measurement uncertainty. Alternatively, the manufacturer has bindingly declared that his instrument has been manufactured in accordance with relevant international standards or in compliance with relevant normative documents (OIML<sup>3</sup> recommendations).
2. Evidence that the application limits of the influencing parameters specified in the manufacturer’s instructions or relevant standards are adhered to.
3. Evidence that the instrument is calibrated by a DIN EN ISO/IEC 17025 accredited calibration laboratory (e.g. laboratories active in German Calibration Service (Deutscher Kalibrierdienst)) or evidence that the used calibration test stand/test equipment/reference measuring instrument has an uncertainty of less than 1/3 of the required measuring uncertainty of the instrument to be calibrated.
4. Evidence of a quality management system implemented for the instrument.

The document in which this evidence is recorded must be identified on the form “Messgerät” (measuring instrument) in the field “Beschreibung der Qualitätssicherung” (Description of quality assurance), and must be attached to the form “Messgerät” (measuring instrument) as a separate attachment (see Chapter 12.5).

#### **To item 1:**

If the manufacturer has not provided information on the application limits and the maximum deviations of relevant influencing parameters and has not assured either that his product complies with the relevant standards, the operator must perform an individual uncertainty assessment (see Chapter 6.1.3).

<sup>3</sup> Organisation Internationale de Métrologie Légale (OIML) (International Organisation of Legal Metrology)

### To item 2:

If the manufacturer has specified the application limits for relevant parameters or provided evidence that his instrument complies with the relevant standards, the operator has to demonstrate that the application limits specified in the manufacturer's instructions or in standards are adhered to. Annex 6 contains the main influencing parameters acting on the uncertainty of commonly used types of instruments. If the operator has proved that the manufacturer's specifications are adhered to for the parameters listed in Annex 6, the evidence to Item 2 has been provided. Annex 7 contains an example of evidence for an ultrasonic measuring instrument with 4 signal paths.

If the device is not operated within its limits of use, the maximum deviation of every parameter has to be evaluated individually as well as named within the uncertainty assessment.

### To item 3:

If the calibration has been carried out by a DIN EN ISO/IEC 17025 accredited test laboratory, it can be assumed that the calibration has been performed on an appropriate test equipment so that the influence of the test equipment uncertainty on the overall measurement uncertainty is negligible. Test stands or reference measuring devices are also test equipment. If measuring instruments are calibrated by other organisations or in-house, it must be demonstrated that the test equipment for calibration has no significant influence (meaning 1/3 of the required uncertainty for the measuring instrument to be calibrated) on the overall uncertainty of the measurement. If this evidence cannot be provided, the uncertainty of the test equipment has to be considered according to Item 2 or within an individual uncertainty assessment (Chapter 6.1.3).

### To item 4:

Art. 59 (1) MRR requires the operator to ensure that all used measuring instruments are periodically calibrated, adjusted and checked to ensure sufficient data quality. To ensure this, the operator must implement an appropriate quality management programme. Here maintenance of measuring instruments and handling of disturbances must be addressed first. Furthermore, proper exclusion of significant contamination during operation must be ensured. When recalibrating, the status quo must be determined and documented before cleaning the instrument (see DIN EN ISO/IEC 17025). Evidence of an appropriate quality assurance of the instrument must be recorded on the form "Messgerät" (measuring instrument) under the heading "Angaben zur Verfahrensanweisung" (Statement on procedural instructions) in the field "Beschreibung des Verfahrens" (description of the method) (see also Chapter 12.5).

**Note on measurement uncertainties:** The distribution function of measured values is characterised by the mean and the standard deviation ("simple measurement uncertainty"). Mean and standard deviation describe the interval within which the results lie with a probability of 68.3 %. This means that the probability that a repeat measurement is measured within this interval is 68.3 %. However, the simple measurement uncertainty is not sufficient for a reliable characterisation of the uncertainty. Therefore, a confidence interval of 95 % is required for measurement uncertainties. This corresponds to the standard deviation multiplied by a coverage factor of  $k = 2$ . If the measurement result is composed of several input quantities which are also fraught with measurement uncertainties  $\sigma_i$  ( $i = 1 \dots N$ ), the individual measurement uncertainty components must be combined as a standard deviation (confidence level of 68.3 %) according to the rules of error propagation.

The resulting "combined standard measurement uncertainty"  $\sigma$  shall then be multiplied by the coverage factor  $k = 2$  in order to obtain the total measurement uncertainty ("expanded measurement uncertainty") of a confidence level of 95 %. Uncertainty data indicated in calibration certificates are in general based on a normal distribution since the calibration results are produced by a multiple calibration repetition, not by a single measurement. The measurement uncertainties are indicated with a 95 % confidence level.

## 6.1.3 Individual uncertainty assessment

An individual uncertainty assessment of the deployed measuring instruments must be carried out whenever the conditions for simplified uncertainty evidence in accordance with section 6.1.1 to 6.1.2 are not available. This means that individual uncertainty evidence is required for measuring instruments

- ▶ which have not been verified or which are calibrated but not installed and operated according to manufacturer's specifications, or
- ▶ for which the manufacturer has not published any application limits and maximum deviations for the



relevant influencing parameters that affect measurement uncertainty, or for which he has not declared that they meet the relevant standards, or

- ▶ which cannot be calibrated or have not been calibrated.

In such cases, uncertainty determination in determining source stream quantity requires corrections (usually extensions), which results from the practical application of the measuring instrument(s) – especially by aging, drift or deviation from the accepted technical rules for the legal measurement and verification system. In doing so, at least those factors that are mentioned in section 6.2.1 and listed in Annex 6 must be considered for similar instrument types and their uncertainty components must be assessed.

Furthermore, in order to ensure that the measurement is reasonable and exact, and to correct deviations of the measuring instrument, which for example could arise due to drift or aging, the measures that are used in place of calibration have to be described. The cycle of control and correction activities is to be specified. In the monitoring plan, the operator must identify measuring instruments for which an individual uncertainty assessment is necessary (cf. form “Messgerät” (measuring instrument), the selection field “Eichung oder Kalibrierung” (verification or calibration) is to be filled in with “Andere Methode” (other method)) and must propose alternative controls (cf. form “Messgerät” (measuring instrument), field “Beschreibung der Qualitätssicherung” (Description of quality assurance)).

## 6.2 Determination of overall uncertainty

In addition to the uncertainty of a measuring instrument or measuring system (see Section 6.1), further uncertainty components must be considered if necessary in order to determine the total uncertainty of the annual input quantities. As a simplification, by determining the overall uncertainty of the source stream the uncertainty components of parts of the source stream can be neglected, if the quantity of material of these parts accounts for a maximum of 5% of the total annual used quantity of the source stream. So uncertainties must be considered by determining stock, if the storage facilities are capable of containing at least 5% of the annual used quantity of the considered source stream (Art. 28 (2) MRR, see Annex 9). Uncertainty components that arise, for example from distributing a source stream to installations or activities, which are subject to emissions trading and to those, which are not subject to emissions trading, must be also considered.

Independent and dependent uncertainties must be distinguished when determining the overall uncertainty. As a general rule, independent uncertainties are uncertainties, when different measuring instruments are used for the measurement of part source streams. The dependent uncertainties, in the contrary, are uncertainties, when parts of a source stream are measured by the same measurement system, or various parameters of a source stream are determined using the same measurement system. Depending on the calculation method used to determine the annual input quantity, the uncertainty determination formula for a sum or multiplication shall be applied. If the input quantity of a material is determined e.g. by the addition of quantities measured by different standard orifices, the relevant uncertainty formula for a sum must be used. The following subchapters illustrate examples for independent and dependent uncertainties.

### 6.2.1 Independent uncertainty in a sum

A steam boiler installation for the production of process steam is powered by fuel gas as the main fuel. For measuring the volume of consumed fuel gas, ten different orifice plates according to DIN EN ISO 5167 are used. The uncertainty in determining the annual fuel gas consumption (uncertainty of a sum) for the boiler installation is calculated by applying the independent uncertainty formula shown below:

$$U_{total} = \frac{\sqrt{(U_1 \times x_1)^2 + (U_2 \times x_2)^2 + \dots + (U_n \times x_n)^2}}{|x_1 + x_2 + \dots + x_n|}$$

$U_{total}$ : overall uncertainty of the determination of the fuel source stream

$U_1 - U_{10}$ : the uncertainties of the individual orifice measurements

$x_1 - x_{10}$ : annual fuel gas volume to be set for each orifice measurement

**Formula 1: Calculation of the independent uncertainty in a sum**

Further examples:

a) Determination of the annual activity data of a source stream with interim storage facility:

A steam boiler facility uses heating oil EL (extra light) as fuel. Verified measuring instruments within the tanker lorry measure the delivered quantity. Before combustion, the heating oil is temporarily stored within a tank where the fill level is measured by a calibrated ultrasound-measuring device. The annual consumption rate of heating oil is determined by „quantity delivered + initial inventory – final inventory”. The uncertainty of this quantity is determined in this special case according to formula 1:

$$U_{\text{activity data}} = \frac{\sqrt{(U_d * x_d)^2 + (U_i * x_i)^2 + (U_f * x_f)^2}}{|x_d + x_i - x_f|}$$

$U_d$ : Uncertainty of the measurement of quantity delivered

$U_i$ : Uncertainty of the measurement of initial storage

$U_f$ : Uncertainty of the measurement of final storage

$x_d$ : Quantity delivered

$x_i$ : Initial inventory of the storage

$x_f$ : Final inventory of the storage

### Formula 2: Calculation of uncertainty of a source stream with interim storage facility

Due to the fact that verified measuring instruments measure the amount delivered, the uncertainty of the delivered amount is to be used as the maximum permissible error in service. Since a calibrated measuring instrument also determines the fill level of the tank, the uncertainty according to Chapter 6.1.2 has to be used.

With the assumption that the tank is filled completely at the beginning as well as at the end of the reporting period, Formula 2 is simplified to:

$$U_{\text{activity data}} = \frac{\sqrt{(U_d * x_d)^2 + 2 * (U_{\text{storage}} * x_{\text{storage}})^2}}{x_d}$$

$U_d$ : Uncertainty of the measurement of quantity delivered

$U_{\text{storage}}$ : Uncertainty of the measurement of storage

$x_d$ : Quantity delivered

$x_{\text{storage}}$ : Storage size

### Formula 3: Simplified calculation of uncertainty of a source stream with interim storage facility

b) Determination of annual activity data of a source stream by subtraction:

An installation site is supplied with natural gas. A part of the overall quantity of natural gas supplied is separated and consumed in an installation that is not subject to emissions trading. The remaining quantity is combusted in the installation that is subject to emissions trading. Due to the fact that the installation, which is a subject to emissions trading, does not have an independent gas measuring device, the combusted annual quantity is calculated by subtraction from the overall quantity of natural gas supplied and the measured separated natural gas for the installation, which is not subject to emissions trading.

A verified device measures the overall supplied quantity for the whole installation site. For simplification, the maximum permissible error in service is considered as the measuring instrument's uncertainty. The separated quantity of gas is determined with a calibrated measuring device, which is why in this case uncertainty is determined according to chapter 6.1.2 in connection with Annex 6.

The uncertainty of determination of the annual quantity combusted is calculated according to Formula 1 as followed:

$$U_{\text{activity data}} = \frac{\sqrt{(U_{\text{total}} * x_{\text{total}})^2 + (U_{\text{sa}} * x_{\text{sa}})^2}}{|x_{\text{total}} + (-x_{\text{sa}})|}$$

$U_{\text{total}}$ : Uncertainty of the measurement of the quantity for the whole site

$U_{\text{sa}}$ : Uncertainty of the measurement of the separated quantity

$x_{\text{total}}$ : Total quantity

$x_{\text{sa}}$ : Separated quantity

#### Formula 4: Calculation of uncertainty of a source stream using subtraction

### 6.2.2 Independent uncertainty in multiplication

A combined heat and power station with several boilers is fired with natural gas as the only fuel. The annual consumption of natural gas is determined by a measuring system that consists of turbine meters, pressure and temperature measurement at the central transfer station (before distribution to the individual boilers). The turbine meter measures the flow rate during operation. For emissions report however, the standard gas volume used in the installation is relevant. Therefore, for converting cubic meters (Betriebskubikmeter, Bm3) into standardised cubic meters (Normkubikmeter, Nm3), the pressure and temperature measurements are used. Thus, the uncertainty for determining the quantity of natural gas in Nm3 (uncertainty of a product) is calculated by applying the formula for independent uncertainties shown below:

$$U_{\text{total}} = \sqrt{U_1^2 + U_2^2 + \dots + U_n^2}$$

$U_{\text{total}}$ : overall uncertainty for the determination of the fuel stream in Nm3

$U_1$ : Uncertainty of the volume measurement

$U_2$ : Uncertainty of temperature measurement

$U_3$ : uncertainty of the pressure measurement

#### Formula 5: Calculation of the independent uncertainty in a multiplication

### 6.2.3 Dependent uncertainty in a sum

A power plant is fired with coal. The annual consumption of coal is determined by weighing the delivery batches throughout the year, using the same belt weigher. The uncertainty in determining the annual coal consumption for the power plant is a result of applying the formula for dependent uncertainties shown below, taking into account the uncertainty  $U_i$  of the belt weigher and the quantity of coal of a certain delivery batch which is measured using the belt scale:

$$U_{\text{total}} = \frac{(U_1 \times x_1) + (U_2 \times x_2) + \dots + (U_n \times x_n)}{|x_1 + x_2 + \dots + x_n|}$$

$U_{\text{total}}$ : overall uncertainty of the fuel source stream determination

$U_1 - U_n$ : uncertainty of the belt weigher ( $U_1=U_2=U_n$ )

$x_1 - x_n$ : fuel quantity of a single delivery batch

#### Formula 6: Calculation of the dependent uncertainty in a sum

## 6.2.4 Dependent uncertainty in multiplication

A mineral processing plant determines ignition loss caused by burn processes, by weighing the product before and after the burning process on a bench weigher. The ignition loss is the difference in mass before and after the burning process based on the initial weight. The uncertainty of the weighing results is dependent on each other because the same weigher is used. The uncertainty in determining ignition loss is calculated by applying the formula shown below for related uncertainties, taking into account the uncertainty  $U_i$  of the bench weigher:

$$U_{total} = U_1 + U_2$$

$U_{total}$ : overall uncertainty of the specified ignition loss

$U_1, U_2$ : weighing uncertainty before and after combustion ( $U_1=U_2$ )

**Formula 7: Calculation of the dependent uncertainty in a multiplication**

## 7 Determining Calculation Factors

For calculation factors one must differentiate between the use of “standard” factors (e.g. values according to the DEHSt list) and calculation factors individually determined by the installation operator or a third party.

An individual analysis of calculation factors is usually required when the highest tiers must be met (see Chapter 4.2). For individually determined calculation factors (i.e. in accordance with international and national standards or guidelines for industry best practices), the specifications in Art. 32 to 35 MRR (see Chapter 7.2) apply. They apply regardless of whether the operator or an external organisation (e.g. supplier) performs the analysis.

### 7.1 Use of standard factors

The MRR defines a hierarchy of sources for standard factors (see Art. 31 (1) a) to e)), which can be used depending on the tier requirements. The required standard factor is defined in Annex II No 2 to 4 MRR.

Tier 1 references Annex VI or Art. 31 (1) d) or e) MRR, meaning

- ▶ the standard factors and stoichiometric factors listed in Annex VI MRR (short: IPCC reference values) or
- ▶ values guaranteed and specified by the supplier of a material, insofar as the operator can demonstrate to the competent authority that the carbon content has a 95 % confidence interval of not more than 1 % (in short: the supplier guaranteed values) or
- ▶ values based on analyses carried out in the past, insofar as the operator can demonstrate to the competent authority, that these values are representative for future batches of the same material (in short: representative, historical analysis values).

Tier 2a or 2 refer to Art. 31 (1) b) or c), meaning

- ▶ standard factors used by Member States for submitting their national inventories to the secretariat of the United Nations Framework Convention on Climate (in short: factors from the national inventory) or
- ▶ literature values agreed with the competent authority, including standard factors published by the competent authority, which are compatible with the factors referred to in point b), but are representative for less heavily aggregated fuel streams (in short: values of the DEHSt list<sup>4</sup>).

Source values from the DEHSt list precede those from the national inventory pursuant to Art. 31. Para. 1c) in conjunction with Art. 7 und 8 of MRR (see Chapter 2.2). Also note that some industry-specific sections in Annex IV MRR define tiers for calculation factors which differ from the general requirements in para. 2 to 4 of Annex II MRR (see e.g. para 9 of Annex IV MRR: Standard factor corresponding to Tier 1 for cement clinker specified as 0.525t CO/t). These industry-specific rules take precedence over the general provisions of Annex II MRR.

<sup>4</sup> The DEHSt list is provided in Annex 4.

Since, for example, the DEHSt standard factor can change with more current data, the operator shall specify the data source for the standard factor in the monitoring plan, (e.g. DEHSt list) and not the value itself (see Art. 31 (2) MRR).

Based on the provisions in Art. 24 of the MRR the value pair of emissions factor and calorific value must be used for a given source stream. Until now, for many source streams the German inventory only includes calorific value related emission factors, but without referencing the calorific value. Therefore, the national inventory may not be used as a source for a standard factor for such substances.

## 7.2 Individual determination of calculation factors

### 7.2.1 Ranking of standards

Analyses, sampling, calibration and validation for determining calculation factors must be carried out in accordance with the relevant standards. As in the second trading period, the standards hierarchy of the MRR must be applied (CEN standards, ISO standards, national standards (e.g. DIN), suitable draft standards, guidelines for the industry best practices or other scientifically established approaches, see Art. 32 MRR). A list of typical eligible standards for fuels is attached as Annex 2 and Annex 3.

### 7.2.2 Sampling

A sampling plan must be created for each source stream for which the calculation factors have to be individually determined. The sampling plan specifies the sampling procedure and includes the procedure for sample preparation, sampling locations, sampling frequency and the sample size, as well as information about the storage and transport of samples, including responsible parties. Together with the monitoring plan, the sampling plan has to be submitted for approval to DEHSt, even if sampling is carried out by an accredited laboratory.

The operator shall ensure that samples are representative and free of systematic errors. If sampling is not performed by the laboratory that analysed the corresponding source stream, the relevant elements of the sampling plan shall be coordinated with the laboratory that carries out the analysis. Proof of this agreement shall be included in the sampling plan. If the results of the analysis indicate that the heterogeneity of the affected source stream differs substantially from the heterogeneity assumed in the sampling plan, the sampling plan has to be adjusted, in agreement with the laboratory performing the analysis and with approval of the competent authority (Art. 33 MRR).

If samples are stored for analysis, it must be ensured that they are packaged and stored in a manner that does not alter the property characteristics which the sample will be tested for. In order to preclude changes of the sample, even if it is stored for a period of several months, the samples should be stored dry, in an airtight container and in a cool, dark storage. In samples where microbial decomposition may occur, freezer storage (-18 to -20 °C) can be useful.

A link to an example template of a sampling plan can be found in Annex 8.

The comments on measuring devices from suppliers in Chapter 6.1.1 apply accordingly to the use of information provided by suppliers. That means that in the monitoring plan and the documents to be attached, operators have to include all information available at the time concerning sampling and analysis. They should already mention the applicable norms or standards used by suppliers.

If the supplier cannot yet provide individual information necessary for sampling and analysis, it is necessary to explain in the monitoring plan how MRR compliance incl. relevant evidence is maintained. Appropriate evidence to ensure MRR compliance has to be collected during the reporting year. This data has to be provided to the verifier as well as DEHSt on demand.

### 7.2.3 Analysis

If the MRR introduces an activity-specific determination for the calculation factors, a form “Analyseverfahren” (Analysis procedure) has to be created in the monitoring plan for the specific analytical method, and the analysis procedure must be described (see form “Analyseverfahren” (Analysis procedure)).

For analyses that are conducted according to a specified standard it is sufficient to name the relevant method of analysis and the corresponding standard (e.g. CEN, ISO, published guidelines).

Under Art. 35 MRR, analyses must at minimum be carried out with the frequency specified in Annex VII. DEHSt may allow lower analysis frequency if

- ▶ the table in Annex VII MRR contains no analysis frequency for the source stream concerned. In this case, however, at least the framework for “Other materials” in Annex VII MRR must be complied with,
- ▶ the operator can prove that the deviation of the analysis results (historical analytical values of the source stream, including analytical values from the immediately preceding reporting year) does not exceed 1/3 of the maximum uncertainty allowed for the activity data of the source stream.
- ▶ if the analysis frequency required in the table in Annex VII MRR causes unreasonable costs (see Chapter 4.3.1).

The Excel tool linked to from Annex 8 can be to demonstrate that the deviation of the historical analytical results of the substance does not exceed 1/3 of the maximum uncertainty allowed for the activity data of the source stream.

The parameters (quantity of source stream and calculation factors) included in the calculation of emissions must have the same reference condition (for example, degree of humidity) according to Art. 30 MRR.

Annex VII MRR was amended in 2014 (European Commission Regulation No. 743/2014 of 09 July 2014): Higher requirements may apply to the analysis frequency for the use of other gases and other fuels.

For gas analysis the following particularities should be noted:

Process gas chromatographs that are approved and are operating under legal control may be used without restriction for determining calorific values and emission factors. A form “Anlyseverfahren” (Analysis procedure) has to be created and completed for them. When using other gas composition measurement devices and reconstruction systems that have design approval from the Physikalisch-Technische Bundesanstalt (PTB) (National Metrology Institute) and are operating under legal metrological control, net calorific value and emission factor can also be determined using an alternative calculation method based on the parameters needed for gas billing: gross calorific value  $H_g$ , standard density  $\rho_n$  and  $CO_2$ -fraction  $x_{CO_2}$  (see “Merkblatt des Deutschen Vereins des Gas- und Wasserfaches e.V. (leaflet of the German Technical and Scientific Association for Gas and Water (DVGW) ”Verfahren zur Ermittlung der  $CO_2$  Emissionen von Erdgasverbrennungsanlagen und deren Unsicherheiten für den Emissionshandel” (Methods for determining the  $CO_2$  emissions from natural gas combustion installations and their uncertainties for emissions trading”), [[www.dvgw.de](http://www.dvgw.de)], available in German)). Under Verification Ordinance, in contrast to determining the gross and net calorific values of natural gases, there is no design approval of the above mentioned measuring systems for the determination of the carbon content and net calorific value of other gaseous fuels and materials such as process gases or flue gas in the chemical industry. Therefore, the operator, in determining the calculation factors of other gaseous fuels and materials must employ an initial validation (see Art. 32 (2) MRR) and an annual comparison study (see Art. 32 (2) MRR) in a laboratory accredited in accordance with EN ISO 17025:2005, to prove that all the carbonaceous substances of the gas are registered and used for the calculation of the carbon content and the emissions factor.

#### **7.2.4 Suitability of the laboratories used for analysis**

In Art. 34 MRR specifies detailed requirements for proving the suitability of the laboratories (both in-house and external laboratories). They apply to analyses according to established standards and to non-standard procedures on the basis of guidelines for industry, best practices or established scientific procedures.

Basically analyses must be performed by a DIN EN ISO 17025 accredited laboratory for the particular analytical method (see Art. 34 (1) MRR). If accredited labs are used no proof of competence besides accreditation documentation, which may have to be furnished upon demand, is required.

Non-accredited laboratories may only be used if equivalence of their working methods with those of accredited laboratories is proved. Equivalence must be demonstrated both in terms of quality management and in terms of expertise.



Proof of equivalence in quality management can be performed by EN ISO 9001:2000 certification or other comparable systems. If the laboratory does not have a certified quality management system, the operator must demonstrate in another suitable manner that the laboratory reliably controls its staff, procedures, documents and tasks.

Operators have to make this evidence available to the verifier as well as DEHSt in individual cases on demand. In the monitoring plan the short explanation is sufficient.

Apart from proving sufficient quality management it must be demonstrated that the non-accredited laboratory is technically competent; meaning that is able to obtain valid results using suitable analytical methods. Operators have to ensure that all quality requirements according to Art. 34 (3) MRR are fulfilled. This requirement has to be documented over the reporting period and evidence has to be made available to the verifier as well as DEHSt in individual cases on demand.

Nevertheless, in the monitoring plan it has to be explained how quality is assured for calibration results as well as analysis incl. required measures of correction: Laboratories have to validate regularly calibration results as well as analysis, meaning once a year. Besides this internal quality assurance, laboratories have to undertake regular qualification examinations. In this respect, it has to control the suitability of its methods by analysing certified reference materials or by using comparison tests with an accredited laboratory. If required, other comparison tests can be proposed to DEHSt, e.g. interlaboratory tests.

If, within the quality assurance procedure according to Art. 34 (3j) MRR a statistical significant deviation (double standard deviation) from the reference value is detected, the relevant analysis values have to be adjusted by the difference to the reference value. This is not relevant if an underestimation of emissions can be ruled out in another way. If the moment, from which a possible underestimation of emissions could not be ruled out, cannot be precisely determined, then all analysis values collected since the last successful data quality control according to Art. 34 (3) j) MRR have to be adjusted in this way. Values that were collected after the failed quality assurance procedure have to be also adjusted. The adjustments have to be conducted until the moment where a measure according to Art. 34 (3) j) MRR can verify that the laboratory can again determine data at a reasonable quality and an underestimation of emissions can be ruled out by using this data.

If the suitability of the non-accredited laboratories was demonstrated in the manner described, disproportionality of the use of an accredited laboratory need not be proved separately. The accreditation is not an end in itself and therefore unnecessary (unreasonable) if the suitability of the laboratory is ensured by other means. Only if proof of equivalence cannot be provided, operators must demonstrate that both the use of an accredited laboratory and the fulfilment of individual equivalence requirements are unreasonable.

## 7.3 Requirements for special calculation factors

### 7.3.1 Emission factors

The MRR introduces the term “preliminary emission factor” (see Art. 3 No 35 MRR). This means the total emission factor of a source stream, based on the total carbon content (fossil and biomass carbon content). In the FMS, information for determining the total emission factor and/or carbon content as well as for the determination of the biomass carbon content are queried (see Chapter 8.3 for exception).

Under Art. 36 MRR, the operator may, instead of an energy-related emission factor, use a mass- or volume-based emission factor for emissions from combustion, as far as the use of an energy-related emission factor is unreasonable, or if the mass- or volume-based emission factor leads to at least the same high level of accuracy in the calculation of emissions.

This can make sense e.g. for monitoring emissions from thermal post-combustion of residual gases or from flare processes if the calorific value of the burned gases is not, or may not be determined with appropriate accuracy.

### 7.3.2 Calorific values

It must be ensured that calorific value data, e.g. for natural gas, do not refer to the gross calorific value (higher calorific value). If a fixed factor is used for the conversion from gross calorific to net calorific value, this factor must be specified in the monitoring plan.

For the emissions report, Annex X (1) No 6 g) MRR requires that at least “proxy data” for the net calorific value is specified if the emission factors for fuels refer to mass or volume instead of energy. Under Art. 3 No 55 MRR, proxy values are annual values that are empirically derived or stem from recognised sources, used by the operator to ensure complete reporting, when the applied monitoring methodology does not generate all the necessary data.

## 8 Rules for Biomass

### 8.1 Definition of biomass

The MRR adopted the definitions for “biomass”, “bioliquids” and “biofuels” from the EU Renewable Energy Directive (2009/28/EC Renewable Energy Directive (RED)).

According to the requirements of Art. 38 MRR, a source stream, that consists exclusively of biomass and for which an operator can guarantee that the source stream is not mixed with other materials or fuels, may be estimated independent of tiers. The guarantee is sufficient when the operator explains the origin as well as submitting a one-time analytical proof of purity, as long as both sets of information do not change.

This also applies to source streams with biomass carbon content of at least 97 % or for source streams where the emissions associated with the fossil fraction can be classified as de-minimis source stream. Peat, xylite and other fossil fractions of mixed fuels or materials are not biomass. Sludge and waste wood batches may also contain considerable quantities of fossil fuels or materials (e.g. coal in sewage sludge, plastics in waste wood, and adhesives in chipboards).

If biomass and source streams with biomass carbon content are used, they must be monitored separately, even if they are mixed before use. Such mixtures are not “exclusively” biomass, not even if the mixture has a biomass carbon content of 97 % or higher.

### 8.2 Determination of biomass carbon content

An individual analysis is usually required for waste, source streams with biomass carbon content and -where applicable- also for pure biomass (for establishing purity) (see Chapter 7.2).

If biomass carbon content is declared for fuel or material streams (“Stoffstrom” (source stream) forms, “biogener Anteil” (biomass fraction) field), the operator must explain the way the biomass carbon content was determined in the fields under the heading “Biogener Anteil am Gesamtkohlenstoffgehalt” (biomass fraction of total carbon content) on the “Stoffstrom” (source stream) forms, and transparently explain the derivation of the data in the field “Beschreibung der Ermittlungsmethode” (description of the method of determination) (may be an additional document). Additional information should be used such as:

- ▶ Results of control measurements using different methods,
- ▶ Appropriate literature,
- ▶ Supplier information (e.g. origin, composition, production and treatment procedures, product specifications, declaration analyses, contractually agreed properties),
- ▶ Statement of the institution performing the analysis, expert reports,
- ▶ Requirements for quality assurance in accordance with the supply agreement,
- ▶ Consideration of values based on experience from previous reports.

If the biomass carbon content is determined based on analytical results, the measures taken for quality assurance and control in sampling and analysis must be respected. This includes, whether the substance to be analysed is included in the scope of the method. Apart from the requirements in Chapter 7.2.4, in terms of the qualifications of the institution performing the analysis, proper implementation of sampling and analysis must be ensured e.g. through special admissions or relevant references (e.g. testing laboratories of the BGS Federal Quality Association for Derived Fuels and Wood Recycling (Bundesgütegemeinschaft Sekundärbrennstoffe und Recyclingholz e.V. (BGS)).



Especially when using the “method of selective dissolution” it is important to note whether external monitoring is performed for quality assurance of the sampling and analysis results, and that it is guaranteed that no substances (samples) are analysed which are excluded from the scope of this method. This method may not be used for fuels that contain peat, coal or lignite. When using this method for fuels and materials with ash contents of more than ten percent by mass, it must be checked whether the ash content was accurately accounted for in the determination of biomass carbon content.

Since the term “C14 method” partly summarises different sampling and analysis methods, a detailed documentation of the methodology used is important, e.g. information on sampling and sample preparation, radiometric measurement technology, C14 reference concentration in the atmosphere. It must also be ruled out that the fuel or material stream analysed contains fossil fractions e.g. peat.

More information on sampling and analysis of source streams with biomass carbon content can be found in Annex 1.

### 8.3 Biogas from natural gas grids (biomethane)

Gas from a natural gas grid can be claimed as biomethane with an emission factor of zero in the annual emissions report if it is proven

- ▶ that the heat equivalent of the volume of gas extracted from the grid corresponds to the volume of biomethane fed into the grid elsewhere during the reporting period, (if the data refer to the gross calorific value, they must be converted to net calorific value by multiplying them by 0.903),
- ▶ there is a supply contract for this volume between the operator of the installation subject to emissions trading and the party feeding in the biogas or an intermediary,
- ▶ that for the entire transportation and distribution of the gas, a mass balance system is used in accordance with the requirements of Art. 18 (1) of Directive 2009/28/EC<sup>5</sup>,
- ▶ the injected quantity of biogas was determined using officially verified meters,
- ▶ and that a double accounting of the reported biogas quantity can be ruled out.

As a simplification for the proof of the above requirements for the biomethane extracted, DEHSt recognises an extract from the German Biogas Registry <sup>6</sup>, using the so-called delivery model (Liefermodell) or a similar reliable evidence such as the mass balance through the natural gas biomass balance system (BiMas).

If the operator does not submit either of the two evidences for the acquired biomethane, the alternative implementation of the above-mentioned requirements must be explained in the monitoring plan in detail.

Proof via an analytical determination of the biomass carbon content of natural gas from the gas grid is not permitted according to Art. 39 MRR. This means, in particular, that an installation that only obtains biogas from the network by chance, but has actually purchased natural gas, cannot take into account the biomass when reporting.

The documentation can be done in the FMS in the “Brennstoffstrom\_HW“ (fuel stream CV - calorific value) form as natural gas with a biomass fraction. The data on the quantity consumed, emission factor and net calorific value must refer to natural gas actually extracted from the natural gas network.

In the “Biogener Anteil am Gesamtkohlenstoffgehalt” (biomass fraction of total carbon content) section, the following information is required:

<sup>5</sup> The requirements described in Art. 18 (1) of Directive 2009/28/EC define the mass balance systems for sustainability proof. The requirements apply equally for biomethane proof.

<sup>6</sup> The German Biogas Registry, operated by the German Energy Agency (dena) is a platform for the standardised documentation of the verification of biogas quantities and qualities in the natural gas grid ([www.biogasregister.de](http://www.biogasregister.de)).

<sup>7</sup> In this case, unlike in Art. 3 No 37 MRR, “Biomass fraction” is not to be understood as the ratio of fossil carbon to total carbon content of a fuel or material.

**Table 1:** “Brennstoffstrom\_MV” (Fuel stream\_MV) form, page 4, information on the “Biogener Anteil am Gesamtkohlenstoffgehalt” (biomass fraction of the total carbon content) for biomethane from natural gas grids

Form field	Description
Vorgesehene Ebene (intended tier)	Tier “1” should be selected.
Wird von der Ebene nach Monitoring-Verordnung abgewichen? (Deviation from the tier according to Monitoring Regulation?)	Select reason “Ja, da unverhältnismäßig” (Yes, because unreasonable). Proof of disproportionality need not be provided.
Biogener Anteil (Biomass fraction)	<p>The percentage of natural gas extracted expected to be substituted with biomethane must be entered. The percentage is calculated from the ratio of the amount of heat quantity of the biomethane injected into the gas grid (without fossil admixtures for calorific value adjustment) to the heat quantity of the natural gas extracted during the reporting period<sup>7</sup>.</p> <p>Note: If the heat quantity of the biomethane injected into the gas grid refers to the gross calorific value, the gross calorific value based heat quantity of the natural gas must be used in the calculation of the biomass fraction.</p>
Beschreibung der Ermittlungsmethode (Description of the determination method)	<p>The calculation of the biomass fraction must be described (including the calculation of the heat quantity in terms of gross calorific value of the natural gas).</p> <p>If the extracted biomethane quantities are not proved with an extract from the German Biogas Registry or BiMaS, it must be shown in detail how the above mentioned requirements are implemented. Otherwise, a reference to the systems mentioned is sufficient.</p>

## 8.4 Sustainability of liquid biofuels

### 8.4.1 Requirement for sustainability evidence

According to § 3 EHV a zero emission factor may only be applied for liquid biofuels pursuant to Art. 3 (21) MRR used from 01.01.2014 if sustainability evidence has been provided in accordance with the Biomassestrom-Nachhaltigkeitsverordnung (Biomass Electricity Sustainability Regulation - BioSt NachV). The same is true for mixed liquid fuels and their biomass fractions. Sustainability must also be demonstrated for such liquid biogenic source streams that are used both as materials and for electricity or heat production according to MRR. If, for example, liquid biomass is used as a reducing or blowing agent in production processes and also generates heat, sustainability must be demonstrated in order to be able to apply a zero emission factor. However, if the biomass is exclusively used as a reducing or blowing agent and not for energy production, it is not necessary to demonstrate sustainability in order to be able to apply a zero emission factor.

Pursuant to § 2 (2) EHV, those biofuels are considered liquid which are pumpable when entering the burning or combustion chamber. The reference to pumpability follows from the law maker’s reasoning for § 3 (4) EHV. If biofuels are blended with other substances before entering the burning or combustion chamber and this mixture is not pumpable, the biofuel does not fall under EHV’s requirements and no sustainability evidence is required. If a potentially liquid biofuel is not classified as such by the operator, the monitoring plan must provide an explanation.

Sustainability evidence must also be produced for the use of liquid production wastes that are not subject to BioSt NachV and the Biofuel Sustainability Ordinance (BioKraft NachV) but to MRR when a zero emission factor is intended to be applied for the biomass fraction of carbon. These are in particular sewage sludges falling under the Recycling Management Act and meat pulps.

No sustainability evidence is required for waste lye from the pulp industry according to § 3 (6) EHV. Biogenic residues from alkaline processes in pulp production such as black liquor and tall oils and their derivatives (for example, tall oil pitch) fall in this category.

## 8.4.2 Providing evidence

Providing evidence of sustainability can be made via the Nabisy database at the Federal Office for Agriculture and Food (BLE). If the operator does not yet have an account at Nabisy, he has to apply for one using the role of "Anlagenbetreiber" („Operator“) at BLE.<sup>8</sup> The operator transfers the sustainability evidence or the partial sustainability evidence for the corresponding liquid biofuel at Nabisy from his account to DEHSt's account: DE-B-BLE-BM-NtzB-90000000.

For technical reasons, evidence/partial evidence can only be transferred to either the network operator's account (for evidence in the EEG's (renewable energy law) framework) or to DEHSt's account. EEG installations that are entitled to a reimbursement under § 27 EEG and can apply a zero emission factor in emissions trading, cannot therefore transfer evidence/partial evidence to DEHSt's account. They shall instead transfer the unique identifier (ID) of the sustainability evidence/partial sustainability evidence together with the emissions report in the relevant source stream form in the explanation field under "Angaben zu Datenlücken/Nichtkonformitäten oder nicht genehmigten Methoden (Information on data gaps/non-conformities or non-approved methods)".

When production wastes from an installation are re-used in the same installation, the installation needs both an account as a certified interface and an account as an operator in Nabisy.

If production wastes are not subject to BioSt-NachV's and BioKraft-NachV's scope (for example, sewage sludge, meat pulp), no evidence can currently be created within the recognised certification systems or within Nabisy. If evidence of sustainability must be provided for these substances according to the EHV (see Section Fehler! Verweisquelle konnte nicht gefunden werden.), it must be confirmed by a certification body approved according to BioSt-NachV or BioKraft-NachV, and submitted together with the emissions report. Such sustainability evidence for wastes must include the following items:

- ▶ Description of the calculation of greenhouse gas reduction potential according to § 8 and Annex 1 BioSt-NachV<sup>9</sup>. For example, the amount of greenhouse gas caused by its treatment after the sedimentation tank or digestion tower (i.e. for dewatering and drying and without credit for the production and use of sewage gas) and the transport to the combustion site should be taken into account in the calculation. Default values used here must be justified.
- ▶ Summary of the results with the following information:
  - ▶ greenhouse gas emissions (g +/MJ)
  - ▶ comparative value for fossil fuels (g CO<sub>2</sub>(e) /MJ)
  - ▶ greenhouse gas reduction in percent
  - ▶ meeting the greenhouse gas reduction when used (mark applicable usage)
    - ▶ for power generation
    - ▶ as fuel
    - ▶ in cogeneration
    - ▶ for heat production

## 9 Continuous CO<sub>2</sub> Emission Measurement System (CEMS)

Pursuant to Art. 40 MRR, operators are entitled to monitor all emissions from a facility for all emission sources by continuous emission monitoring systems (CEMS) if the tier requirements are met.

Pursuant to Art. 43 MRR, different methods are available for detecting emissions using CEMS. The concentration in the flue gas flow can be determined by direct measurement, and by indirect measurement in the cases of high concentration (calculation based on the measured concentrations of gas components other than CO<sub>2</sub>/N<sub>2</sub>O). Also, the flue gas flow rate can be determined by direct measurement or by indirect measurement using an appropriate mass balance approach.

<sup>8</sup> [https://www.ble.de/DE/Themen/Klima-Energie/Nachhaltige-Biomasseherstellung/Anerkennungen/aner kennungen\\_node.html](https://www.ble.de/DE/Themen/Klima-Energie/Nachhaltige-Biomasseherstellung/Anerkennungen/aner kennungen_node.html)

<sup>9</sup> <http://www.ble.de/SharedDocs/Downloads/DE/Klima-Energie/Nachhaltige-Biomasseherstellung/LeitfadenNachhaltigeBiomasseherstellung.pdf>, Kap. IX. Konkrete Berechnung der Treibhausgasmin derung

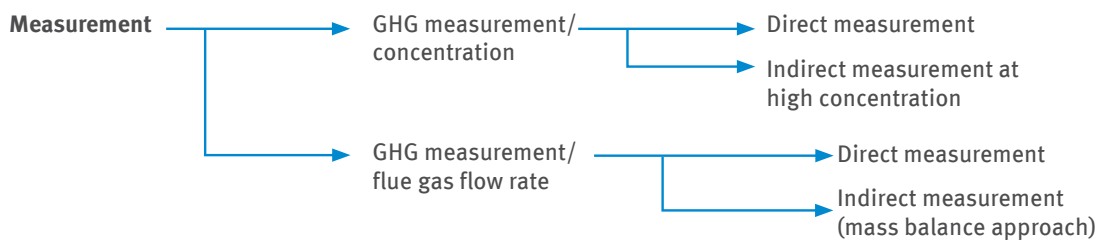


Figure 3: Variants of continuous emission measurement

## 9.1 Basic requirements

According to Art. 43(1) MRR, the annual CO<sub>2</sub> emission load as per equation 1, Annex VIII MRR should be determined based on the hourly CO<sub>2</sub> concentration and the hourly normalised flue gas flow rate. In addition, the direct CO emission in the atmosphere is to be treated as an equimolar CO<sub>2</sub> amount, that means CO emissions must also be determined, multiplied by a factor of 1.571 t CO<sub>2</sub>/t CO and added to the CO<sub>2</sub> emissions.

To determine the annual N<sub>2</sub>O emission load, the equation in Annex IV No. 16 B.1. MRR must be used pursuant to Art. 43(1) MRR. Again, the hourly N<sub>2</sub>O concentration and hourly normalised flue gas flow rate are used.

The highest levels must be met for all emission sources that contribute more than 5,000 t CO<sub>2</sub>(e) per year or more than 10% of the total annual emissions of an installation (the higher value is decisive) in accordance with Annex VIII MRR. This means that in these cases, CO<sub>2</sub> emissions must be determined with a maximum overall uncertainty of 2.5% (tier 4), and N<sub>2</sub>O emissions with a maximum overall uncertainty of 5% (tier 3).

If the operator can provide evidence that both the fulfillment of these tier requirements pursuant to Art. 41(1) MRR and monitoring using the calculation methodology according to the highest tiers is disproportionate, a lower tier can be applied for the emission source to be monitored by continuous measurement.

Emission measurement systems for determining the annual GHG emission loads must be operated under continuous application of quality assurance measures according to DIN EN 14181 (Stationary source emissions – Quality assurance of automated measuring systems) and DIN EN 15259 (Air quality – Measurement of stationary source emissions – Requirements for measurement sections and measurement task, measurement plan and measurement report). Calibration according to DIN EN 14181 and the selection of the measuring point (or measuring cross-section) pursuant to DIN EN 15259 must be performed in accordance with the requirements of Art. 42(2) MRR. This must be done by testing and calibration laboratories accredited for the relevant test and calibration methods in accordance with DIN EN ISO/IEC 17025, or can be considered equivalent in terms of Art. 32(2 and 3) MRR.

For the calibration of the CEMS for monitoring CO<sub>2</sub> emissions it is preferred that testing procedures in accordance with ISO 12039 (Stationary source emissions - Determination of carbon monoxide, carbon dioxide and oxygen - Performance characteristics and calibration of automated measuring systems) are used. For the calibration of the flue gas flow rate parameter, European Standard EN ISO 16911-1 and 16911-2 (Stationary source emissions - Manual and automatic determination of the velocity and volume flow rate in ducts, part 1 “manual reference procedure” and part 2 “continuous measurement”) must be applied.

Art. 45 MRR applies to emissions data within a reporting year in which reliable monitoring was not possible due to the failure of a measuring device that is part of CEMS. Depending on the case, various measures of creating substitute emissions data are described there.

Concerning failures of a measuring device that is part of CEMS for more than five consecutive days must be immediately reported to the competent authority (cf. Art. 45 (1) MRR). Thereby, it is ensured that applicable measures for improvement of the CEMS’ quality and a creation of reliable substitute data for failure periods are agreed upon.

In addition to continuous measurement, an corroborating calculation of the annual CO<sub>2</sub> emissions is required (exceptions apply to CO<sub>2</sub> emissions from catalytic cracker regeneration and transferred CO<sub>2</sub> to a transport network or to CO<sub>2</sub> forwarded to a storage site), but without the need of complying with specific tier requirements.

However, the corroborating calculation must be as accurate as it is possible without any additional effort. The corroborating calculation shall be performed according to the rules of the relevant section in Annex IV MRR applicable to the type of activity and must be included in the FMS source stream forms.

To determine the amount of CO<sub>2</sub> from biomass that was not determined from flue gas measurements according to DIN EN ISO 13833, the calculation-based methodology that includes the relevant tier requirements for the corresponding biomass source stream has to be applied.

Art. 5 MRR requires all greenhouse gas emissions to be fully reported. Status identifications, such as „Installation out of order (X)“, have no relevance for the reporting in emissions trading insofar greenhouse gases are emitted from the installation in this hour. A subtraction of measurement uncertainty is excluded. The uncertainty associated with the use of CEMS is merely authorised by the approval of the monitoring plan.

The evaluation of the emission data from KEMS according to the specifications of the MRR was not yet implemented in the specifications of the „Uniform nationwide practice for monitoring emissions“ (BEP). Reporting can be simplified provided that an evaluation instrument is used that was suitability-tested in accordance with the requirements of the BEP 2017 dated 23.01.2017<sup>10</sup> and that the computer unit was previously checked by the measurement institution according to § 29b BImSchG (appropriate implementation of the status identification, correct parameterization and data transmission, etc). The verifier then no longer has to comprehend the calculation of greenhouse gas emissions in detail, but only checks the quality assurance (QAL2, QAL3 and AST tests), the correct parameterization and the correct data transfer (from the evaluation computer to the FMS application).

First, for emission data evaluation according to Annex J of the BEP 2017, so-called short-term averages are determined in accordance with Annex B 1.3 of the BEP 2017. This means that only valid raw values during the installation's operation requiring monitoring are used for the short-term average values. According to point 4.7.3 of the BEP 2017, the competent authority determines the beginning and the end of the operation requiring monitoring as well as determines the individual operating modes of the installation in consultation with the operator. The respective criteria are to be determined by means of clear parameters collected by the evaluation system. DEHSt has published a working paper<sup>11</sup> on the KEMS emissions data evaluation in order to establish criteria for the beginning and end of the operation requiring monitoring.

## 9.2 Quality assurance and provision of evidence for CEMS

In order to approve the use of data from CEMS to monitoring emissions, evidence must be provided in the monitoring plan or in the accompanying documents for the following points:

- ▶ The CEMS was tested for suitability according to QAL 1 of DIN EN 14181.
- ▶ A calibration report with information on the QAL 2 test must be submitted as an evidence of the successful completion of calibration according to EN 14181.
- ▶ The uncertainty of the GHG mass flow measurement specified in the calibration report complies with the tier requirement applicable to the emission source according to Annex VIII MRR.
- ▶ The measurement institution according to §29b BImSchG confirms that the overall uncertainty of the GHG mass flow specified in the calibration report was determined based on the criteria described in Section 9.3 (e.g. in the calibration report). Alternatively, the operator may carry out his own individual uncertainty assessment.
- ▶ CO emitted to the atmosphere is treated as the molar equivalent amount of CO<sub>2</sub>. Here CO can be estimated based on reliable data and doesn't need to be measured directly. The estimation method is to be described in the monitoring plan.
- ▶ The method for creating substitution values according to Art. 45 MRR is to be described in the monitoring plan (see. Section 9.4.1). If an evaluation system tested for suitability according to the requirements of the BEP 2017 is used, reference can be made to this suitability test or the corresponding certificate.

<sup>10</sup> publication in the joint ministerial gazette 2017, Nr. 13/14, online: [http://www.verwaltungsvorschriften-im-internet.de/bsvwvbund\\_23012017\\_IGI2Azl-GI2450535.htm](http://www.verwaltungsvorschriften-im-internet.de/bsvwvbund_23012017_IGI2Azl-GI2450535.htm), download: 08.09.2017; draft for notification by European Commission in English: <http://ec.europa.eu/growth/tools-databases/tris/de/search/?trisaaction=search.detail&year=2016&num=459>

<sup>11</sup> Working paper is available for operators and manufacturers of computers for emissions data evaluation (only in German): [https://www.dehst.de/Shared-Docs/downloads/DE/stationaere\\_anlagen/Arbeitshilfe-KEMS.pdf](https://www.dehst.de/Shared-Docs/downloads/DE/stationaere_anlagen/Arbeitshilfe-KEMS.pdf)



The calibration report with information on QAL2 checks according to EN 14181 has to be submitted as an evidence for a successful calibration upon request of DEHSt. According to No. 6.1 of EN 14181 a QAL2 calibration has to be performed again for all measuring parameters, which are affected by

- ▶ significant changes of the installation's operation conditions (e.g. fuel switch) or
- ▶ significant changes or reparation of the AMS, which have a significant impact on the results

The calibration report for the affected measuring system has to be resubmitted after changes to DEHSt upon request.

Regular QAL 3 checks (drift and precision controls) must be performed for full compliance with the quality assurance measures for CEMS, both for the greenhouse gas concentration and the flue gas flow. EN 14181 and EN 16911 (with reference to specifications of EN 14181) require QAL 3 checks. The implementation of QAL 3 checks (at least once in the measuring equipment's maintenance interval) has to be provided in addition to specifying the interval in the monitoring plan (Note: this interval varies in length depending on the results of the qualifying test). The documentation of the implementation and evaluation of the results of the functional testing and calibration of continuous emission measurements by the inspection body according to §29b BImSchG is carried out uniformly in the report throughout Germany. QAL3 results (control charts) as well as the documentation by the measurement institution according to § 29b BImSchG have to be noticed and to be submitted on request to the DEHSt by the operator.

### 9.3 Determination of the total uncertainty of GHG mass flow

The conditions for determining the total uncertainty of GHG mass flow through direct measurement of the concentration and flow rate will be described below. These conditions must be fulfilled so that DEHSt can recognise the total uncertainty of GHG mass flow mentioned in the calibration report. In addition, the required tier as per Annex VIII MRR must of course be complied with.

- ▶ The measuring point/measuring cross-section has been specified for both the CEMS to be approved and for the comparative measurements performed by the accredited institution according to the criteria of EN 15259 so that the greenhouse gas load is determined reliably and representatively. The automatic measuring device (AMS) is installed correctly.
- ▶ The total uncertainty of GHG mass flow can be calculated by the following formula:

$$U_{\text{GHG-mass flow}} = \sqrt{U_{\text{GHG-concentration}}^2 + U_{\text{volume flow}}^2}$$

For both the GHG concentration and the volume flow,

- ▶ variability  $s_p$  (determined standard deviation) was determined according to the specifications of EN 14181,
- ▶ the  $k_v$  value (test value of variability) was specified according to the number of the comparison measurements and
- ▶ the 95% confidence interval is adhered to.
- ▶ The specified total uncertainty of the GHG mass flow is based on the operating point (that is, average annual concentration and flow rate/ flue gas velocity) and not on the measurement range end value of the respective measuring device for the component to be considered.
- ▶ The specified total uncertainty of the GHG mass flow refers to normalised values for both the GHG concentration and the volume flow rate according to the specification of No. 6.6 of EN 14181 and in accordance with Annex VIII MRR. If the concentration is determined based on dry flue gas and the volume flow is based on wet gas in standard cubic metres, the uncertainty of the correction parameter water vapor content in the flue gas must be included in the uncertainty analysis. It must be evident that the uncertainty contribution of this correction parameter was considered in the total uncertainty analysis of GHG mass flow.

Thus the following procedure is obtained:

$$U_{\text{GHG-mass flow}}[\%] = \sqrt{U_{\text{GHG-concentration}}^2[\%] + U_{\text{volume flow}}^2[\%]}$$

with

$$U_{\text{GHG-concentration}}[\%] = \frac{\frac{s_D * 2}{k_v}}{\text{average}_{\text{GHG-concentration}}} * 100$$

with  $s_D$ : standard deviation of the difference to the comparative measurement of the GHG-concentration

$$U_{\text{volume flow}} = \frac{\frac{s_D * 2}{k_v}}{\text{average}_{\text{volume flow}}} * 100$$

with  $s_D$ : standard deviation of the difference to the comparative measurement of the GHG-concentration

The respective average stems from all valid measurements (at the operating point) over the reporting year (without substitute values). If the installation is new and therefore no measurement values are available from the previous year, manufacturer design data of the facility or the process, or – if they are not available – the average of comparative measurements can be used as an indication. Measurement values can also be used for the parameter ‘volume flow’ if EN 16911 has previously not been met regarding the parameter ‘volume flow’.

In practice, the evaluation of the comparative measurements and the required offsetting (standardization) is carried out in the way that an identical reference state for the concentration and the volume flow is selected. This is necessary, inter alia, to carry out a direct mass flow calculation without further correction of the input parameters. The following section therefore describes a special case that should rarely occur in practice. It should be noted that deviating uncertainties may arise in the procedure described below, in contrast to direct determination.

If the normalised results of the comparative measurements relate to wet and dry conditions (eg dry GHG-concentration and wet volume flow), the uncertainty of the water vapor content correction parameter in the flue gas shall be included in the uncertainty assessment.

*Note: Another special case is the calibration of the flue gas velocity instead of the volume flow. In this case, the standard deviation refers to the operating state. In the uncertainty analysis, the uncertainties of the flue gas temperature and the pressure must be taken into account.*

The relation between wet and dry standard volume flow is as follows:

$$\text{volume flow}_{\text{normalised,dry}}[\text{m}^3/\text{h}] = \text{volume flow}_{\text{normalised,wet}}[\text{m}^3/\text{h}] * \text{correction parameter}$$

with

$$\text{correction parameter} = \frac{(100 [\text{Vol. \%}] - \text{water vapor concentration in the flue gas} [\text{Vol. \%}])}{100 [\text{Vol. \%}]}$$

The water vapor concentration has to be derived from the water vapor content.

The uncertainty of the volume flow at standard conditions dry is as follows:

$$U_{\text{volume flow,normalized dry}}[\%] = \sqrt{U_{\text{volume floww,normalized wet}}^2[\%] + U_{\text{correction parameter}}^2[\%]}$$

with

$$U_{\text{volume flow,normalized wet}} [\%] = \frac{s_D * 2}{k_v} / \text{average}_{\text{volume flow,normalized wet}} * 100$$

with  $S_D$ : standard deviation of the difference to the comparative measurement of the volume flow (normalized, wet).

For existing and calibrated AMS for the water vapor concentration in the flue gas, the standard deviation documented in the QAL2 report shall be used to calculate the uncertainty.

$$U_{\text{correction parameter}} [\%] = \frac{s_D [\text{Vol.}\%] * 2}{k_v} / (100 [\text{Vol.}\%] - \text{average}_{\text{water vapor concentration in the flue gas}} [\text{Vol.}\%]) * 100$$

with  $S_D$ : standard deviation of the difference to the comparative measurement of the water vapor concentration in the flue gas.

If there is no AMS for the determination of the water vapor concentration in the flue gas at the relevant emission source, the conversion of the reference state takes place on the basis of reliably estimated data. The estimation method has to be described in the monitoring plan.

*Note: Even if the results of the comparative measurements for non-existent AMS relate to the volume flow in the dry and standard state, the uncertainty for the water vapor concentration in the flue gas doesn't necessarily have to be taken into account. Whether the uncertainty associated with the determination of the water vapor concentration in the flue gas was taken into account in the evaluation of the comparative measurements by the measurement institution according to § 29b BImSchG depends on the procedure for the assignment of the measured values during standardization. If the non-existent AMS values for the water vapor concentration in the flue gas are replaced 1:1 by the measured values of the standard reference method (SRM), the uncertainty is not included in the determined standard deviation. If, on the other hand, the average of all SRM values is assigned to each value pair at AMS side and compared to the individual values of the SRM, the uncertainty in the calculated standard deviation is sufficiently taken into account.*

The uncertainty associated with determining the CO concentration needs not to be considered in the total uncertainty of the CO<sub>2</sub> mass flow if the ratio of CO concentration to the CO<sub>2</sub> concentration is less than 1%.

## 9.4 Ongoing monitoring

### 9.4.1 Need for and determination of substitution values

The result of QAL 2 according to Section 6.5 of DIN EN 14181 is a valid calibration range of AMS, which extends from zero to 1.1 times the calibration maximum. Moreover, Art. 44 (2) MRR defines “invalid hourly values” as values where less than 80% of the individual measurements in the respective hour in question are available and

- ▶ the measurement instrument was temporarily disturbed during that hour, or a shorter reference period or
- ▶ the measured values were out of range or
- ▶ the measurement instrument was out of order.

This enables the following „types“ of hourly values to be distinguished:

- a) hourly values that are valid according to Art. 44 (2) MRR and lie within the valid calibration range according to No. 6.5 of EN 14181
- b) hourly values that are valid according to Art. 44 (2) MRR, but do not lie within the valid calibration range according to DIN EN 14181. These values are associated with a higher but unspecified uncertainty than values within the valid calibration range.
- c) hourly values that are not valid according to Art. 44 (2) MRR.

The following options are available to installation operators for handling hourly values according to B):

- (1) Individual evidence by the end of the reporting year that the required tier has been met. If this is the case, no substitution values must be created. If the tier is not met, conservative substitution values are to be created (see procedure in items 2.a. and 2.b.).



- (2) Simplified procedure by implementing the algorithm of creating substitute values for each hourly average value in the evaluation computer (in this case no individual evidence is required (see item 1)): Hourly values are adjusted in accordance with Annex VIII No. 5 MRR.
- a) The substitution value for installations with constant parameters in the flue gas is created from the average of the values measured during the total reporting period plus 2 \* standard deviation. The standard deviation refers to all measured valid hourly values of the reporting period.
- b) The substitution value for installations with volatile parameters in the flue gas (e.g. due to a gradual increase in N<sub>2</sub>O concentration by catalyst ageing) is created from the average of the last 120 measured hourly values (including those values that are outside the calibration range without correction) plus 2 \* standard deviation. The standard deviation refers to the last 120 measured hourly values (including those values that are outside the calibration range without correction) which were used for creating the average.

Substitution values for dealing with hourly values according to C) must be formed pursuant to Art. 45 MRR. The procedure is as described above under items 2.a. and 2.b.

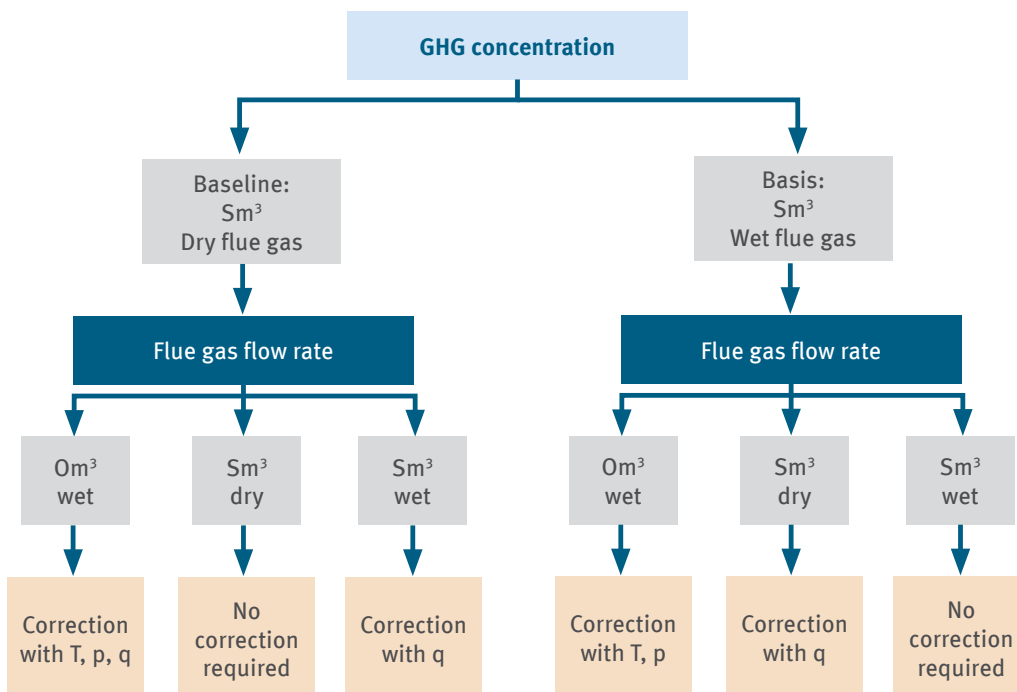
In addition to the procedure described above, the mass balance approach or an energy balance is also possible when creating the substitution values for the volume flow, see. Art. 45 (4) MRR.

### 9.4.2 Different reference quantities for calibration according to QAL2

Variability analysis according to EN 14181 must be carried out using measured values for concentration and flow rate converted to standard conditions. The operator must justify if he intends to use a different reference basis.

If GHG concentration and flue gas flow rate do not refer to the same conditions, additional correction parameters must be included in the GHG mass flow calculation. The uncertainty of these correction parameters must be considered in the total uncertainty analysis. In addition, the derivation of these uncertainties in the calibration report must show for which correction parameters comparison measurements were carried out.

The following figure indicates those cases where correction parameters are required:



**Legend:**

- T: temperature
- p: pressure
- q: humidity
- Sm<sup>3</sup>: standard cubic metre
- Om<sup>3</sup>: operational cubic metre

Figure 4: correction parameters

The use of constants for humidity and pressure is only permissible if it can be traceably justified that they are representative (e.g. derivation based on measured values of the monitoring point according to BImSchG, constant operation of the facility). The uncertainty of these constants must be estimated based on measurements and taken into account in the total uncertainty calculation.

## 10 Procedures

Wherever Annex I MRR refers to procedures, these must be established, documented and maintained by the operator outside of the monitoring plan. The monitoring plan itself must contain a brief summary of the procedures for the monitoring and reporting in the installation with the following information (Art. 12 (2) MRR):

- ▶ the title of the procedure,
- ▶ a traceable and verifiable reference for identification of the procedure,
- ▶ naming of the post or department responsible for implementing the procedure and for the data generated from or managed by the process,
- ▶ a brief description of the procedure allowing all participants to understand the essential parameters and operations performed,
- ▶ the location of relevant records and information,
- ▶ the name of the IT system used, where applicable,
- ▶ a list of EN standards or other standards applied, where relevant.

Table 2 shows an overview of the topics for which the FMS provides fields for documenting the company's existing procedures or procedures to be established. In addition, it also shows under which conditions documentation of these procedures is required in the monitoring plan.

**Table 2: Documentation of procedural instructions**

Form in FMS	Procedure	Information on the procedure must be documented in the monitoring plan, if...
Betriebsänderungen (Operational changes)	Information about the procedure used for establishing whether relevant operational changes have occurred and to ensure that DEHSt is informed.	... the installation receives an allocation under Allocation Ordinance 2020 (ZuV 2020).
If this is not the case, "entfällt" (not applicable) should be entered.	Angaben zum Verfahren zur Qualitätssicherung des Messgeräts. Zudem Erläuterung der Maßnahmen, wenn festgestellt wird, dass das Gerät nicht ordnungsgemäß arbeitet.	... Messgeräte – auch Lieferantenmessgeräte – verwendet werden.
Messgerät (Measuring instrument)	Details of the procedure for measuring instrument quality assurance. Explanation of the measures taken if it is determined that the device does not function properly.	... if measuring instruments – also those used by suppliers - are used.
Analyseverfahren (Analysis procedure)	Information on the analytical procedure, also if the procedure is performed by a third party (laboratory or supplier)	... analyses are performed.
Alle Stoffstromformulare (Source stream forms)	Information on sampling procedures and how it is ensured that the sampling plan is appropriate to the heterogeneity of the material.	... the question „Erfolgt eine Probenahme?“ (Are samples taken?) is answered with "Ja" (Yes).
Massenbilanz (Mass balance)	Details of the procedure for monitoring transferred source streams.	... the question "Handelt es sich um einen Stoff der weitergeleitet wird?" (Is this a source stream which will be transferred?) is answered with a "Ja" (Yes).
CO <sub>2</sub> -Messung (CO <sub>2</sub> measurement)	Details of the procedure of determining the flue gas flow, if the flue gas flow is determined by means of mass balance.	... "Massenbilanz" (Mass balance) was chosen as the method for determining flue gas flow.
	Details of the procedure for continuous CO <sub>2</sub> measurement.	... CO <sub>2</sub> measurement is used to determine the CO <sub>2</sub> emissions of the installation.

Form in FMS	Procedure	Information on the procedure must be documented in the monitoring plan, if...
	Information on the procedure for the corroborating calculation	... CO <sub>2</sub> measurement is used to determine the CO <sub>2</sub> emissions of the installation (unless they are emissions of a catalytic cracker in a refinery).
N <sub>2</sub> O-Messung (N <sub>2</sub> O measurement)	Details of the procedure of determining the flue gas flow if the flue gas flow is determined by means of mass balance.	... "Massenbilanz" (Mass balance) was chosen as the method for determining flue gas flow.
	Details of the procedure for continuous N <sub>2</sub> O measurement.	... the installation emits N <sub>2</sub> O
N <sub>2</sub> O-Weiterleitung (N <sub>2</sub> O transfers)	Information on sampling procedures.	... N <sub>2</sub> O is transferred and the question "Erfolgt eine Probenahme?" (Are samples taken) is answered with a "Ja" (Yes).
	Details of the procedure for monitoring transferred N <sub>2</sub> O.	... N <sub>2</sub> O is transferred.
Zelltyp (PFC Emissionen) (Type of cell (PFC emissions))	Details of the procedure for determining the weight fraction and coefficient.	... there is a procedure for determining the weight fraction factor and coefficient.
	Details of the procedure for determining emissions from diffuse sources.	... there is a procedure for determining emissions from diffuse sources.
	Information on the scheduling process for determining relevant parameters.	... there is a scheduling procedure for determining relevant parameters.
Datenmanagement (data management)	Details of the procedure on which the data management activities are based.	In each case
	Details of the procedure on which control activities are based.	In each case

The procedures themselves are not to be attached to the monitoring plan. DEHSt will request this, if necessary in an individual case. If determination methods or procedures have already been described in other fields of FMS, a reference/link can be made to them in connection with procedure instructions in the field "Verfahrensanweisung" (Procedure).

## 11 Risk Assessment

Based on the results of a risk assessment, operators must demonstrate to DEHSt that the control activities established in the monitoring plan are suitable for the risks identified, see Art. 12 (1) b) MRR. Installations with low emissions, i.e. installations that emit less than 25,000 tonnes of CO<sub>2</sub>e per year are exempt from this obligation, according to Art. 47 (3) MRR.

## 11.1 Results of the Risk assessment: Proof according to Art. 12 (1) b) MRR

The content of the proof is not defined in the MRR. It follows from its purpose, i.e. the proof must enable DEHSt to assess the adequacy of the controls provided. Pursuant to Art. 12 (1) b) MRR, in order to make such an assessment possible, the proof must include at least the following:

- ▶ Designation of the most relevant causes for potential reporting errors and deviations from the monitoring plan (see fields “Erläuterung der Risiken” (Explanation of risks) and “Erläuterung der Kontrollrisiken” (Explanation of control risks) on the “Datenmanagement und Kontrollrisiken” (Data management and control system) form)
- ▶ Description of the method used for identifying and evaluating error and deviation risks (there is no explicit query in the FMS - therefore the field “Ergebnisse der Risikoanalyse” (Risk analysis results) on the “Datenmanagement und Kontrollsysteme” (Data management and control system) form should be used, or the method must be explained in a document attached to the monitoring plan.
- ▶ Outline of the reasons why the proposed control measures are sufficient to counter the risks identified and to prevent errors and deviations from the monitoring plan (cf. field “Ergebnisse der Risikoanalyse” (Risk analysis results) on the “Datenmanagement und Kontrollsystem” (Data management and control system” form).

## 11.2 Recommendations for the content of an internal Risk assessment

The following explanations serve as a recommendation for dealing with the collection and assessment of error risks. Particularly the thresholds noted for the classification of the relevance of an error risk should be established by the operators themselves, and, primarily for emissions-intensive installations, replaced by stricter approaches as proposed.

Table 3: Overview of the individual steps of a risk assessment

Step	Type	Issues to be addressed
Inherent risk		
1	Identification of inherent risks	At what points in the emission control system could errors or deviations from the monitoring plan occur (taking into account all data collection, processing and management steps)?
2	Evaluation of inherent risks	How likely and severe are the risks identified, relative to the annual emissions volume?
3	Minimisation of inherent risks	Which prevention and control measures must be implemented in order to minimise inherent risks?
Control risk		
4	Identification of control risks	To what degree are the prevention and control measures established in step 3 themselves prone to risk?
5	Minimisation of control risks	Which measures are required in order to minimise the risks identified in step 4?
Summary as an attachment to the monitoring plan		
6	Results of the risk assessment	<ul style="list-style-type: none"> <li>▶ Listing of the most relevant causes of reporting errors and deviations from the monitoring plan</li> <li>▶ Description of the method used to determine and evaluate the error and deviation risks</li> <li>▶ Reasons why the control measures provided are sufficient for countering the risks identified, and for preventing errors and deviations from the monitoring plan</li> </ul>

### Step 1: Identification of inherent risks

Under Art. 57 (2) MRR and Annex I (1) No 1 d) MRR, the operator is obligated to fully explain its data management. Data management begins with capturing all emission-related processes, sources and source streams of an installation. In the monitoring plan, it must show each step of the data stream and data processing, from data capture at the primary source up to the emissions report. The operator must graphically represent the data stream in a flow chart. The flow chart must be enclosed as an attachment to the monitoring plan.

The data management documentation is also the basis for the risk assessment under Art. 12 (1) b) MRR. For each parameter (consumption rates, calculation factors, etc.) questions must be asked as to which events or conditions (e.g. equipment failure, organisational risks) may lead to errors or deviations from the requirements for data management in the monitoring plan. Each of the error sources identified in this way is an inherent risk that must be assessed

## Step 2: Assessment of inherent risks

In order to assess the relevance of error sources, it is advisable to proceed in three steps:

- (1) How probable is it that the risk materialises?
- (2) What is the maximum impact of the error/deviation from the monitoring plan if it occurs?
- (3) How severe is the risk with regard to the probability of its occurrence and its impact on total emissions volume?

A five-stage classification can serve as a benchmark for answering the first two questions

For question 1, the probability of the event, e.g.:

Rating	Frequency of the event in a calendar year
Very low	Not more than 1x
Low	Not more than 6x
Moderate	Not more than 12x
High	Not more than 24x
Very High	Not more than 24x

For question 2, the impact of the event on emissions volume, e.g.:

Rating	Impact on the calculated emissions volume
Not relevant	None
Low	Up to 0.1 % (C-installations) / 0.25 % (A- and B-installations)
Moderate	Up to 0.4 % (C-installations) / 1 % (A- and B-installations)
High	Up to 1 % (C-installations) / 2.5 % (A- and B-installations)
Very high	> 1 % (C-installations) / 2.5 % (A- and B-installations)

For answering Question 3, the final assessment of the severity of a risk, a grid might be useful:

<b>Probability</b>	very high					
	high					
	moderate					
	low					
	very low					
		none	low	moderate	high	very high
<b>Impact on annual emissions volume</b>						

	High
	Moderate
	Low

**Figure 5: evaluation pattern for error risks**

The categorisation selected in the grid is meant to illustrate that the error risks must also be considered high even if they only have a relevant impact on the accuracy of the emissions volume because of their multitude. The same applies in reverse to errors that may be rare, but taken individually, have great impact on the emission volume.

### Step 3: Minimisation of inherent risks

According to Annex I (1) No 1 e) MRR, in their monitoring plan, operators must at least address the control measures referred to in Art. 58 MRR, and describe the procedures implemented in that regard. The information on quality assurance of the measurement devices in accordance with Art. 58 (3) a) MRR is required in the “Messgerät” (Measuring instrument) form. The information on control measures referred to in Art. 58 (3) b) to g) is required in the “Datenmanagement” (Data management) form. Therefore, please refer to Chapters 6.1 and 12.5 regarding the individual requirements for the content of the monitoring plan.

Steps 4 and 5: Identification and minimisation of control risks

Control measures can also fail. Therefore Art. 58 (4) MRR requires operators to continuously test the effectiveness of the proposed control measures and to improve them, if necessary. Such improvements can lead to changes in data management and control, which may necessitate changes in the monitoring plan.

## 12 Information on the Installation and Higher Level Issues

### 12.1 Designation and description of the installation (“Anlage” (Installation) form))

The operator will describe his installation in the “installation” form, if applicable, incl. specific installation units (“Anlagenteil” (Installation unit) form). Table 4 lists some of the information required in the FMS.



**Table 4: “Anlage” (Installation) form, pages 2 and 3, characteristics of the installation, designation of the installation**

Form field	Description
Beschreibung der Anlage (Description of the installation)	Explanation of the purpose of the installation, including the various installation units and ancillary equipment.
Verfahrensbeschreibung (Process description)	Outline of the installation's processes, as relevant to emissions.
In der Anlage ausgeübte Tätigkeiten nach Anhang 1 Teil 2 TEHG (Installation activities pursuant to Annex 1 Part 2 TEHG)	All activities of the installation referred to in Annex 1 Part 2 TEHG
Feuerungswärmeleistung (Rated thermal input)	As evidenced by the Federal Immission Control Act or TEHG approval; for derivation also see Chapter 4 in <a href="#">“TEHG-Anwendungsbereich für die Zuteilungsperiode 2013-2020: Hinweise der DEHSt”</a> (TEHG scope for the 2013-2020 allocation period: Notes from DEHSt).
Handelt es sich um eine Anlage mit geringen Emissionen? (Is it an installation with low emissions?)	The question can only be answered if the installation has been designated a Category A installation and if there are no N <sub>2</sub> O emissions
Benennung der Dokumente zur Erläuterung des Fall-Back-Ansatzes (Listing of documents explaining the fall-back approach)	If previously the question “Fall-Back-Konzept wird angewendet?” (Fall-back concept applied?) was answered “Ja” (Yes) (see Chapter 4.3.3). The document must be attached to the form “Anlage” (Installation). The results of the uncertainty assessment pursuant to Art. 22 MRR must also be outlined in these documents.
NACE code	Industry classification of the installation according to Regulation 1893/2006/EC, see Federal Statistical Office ( <a href="#">Statistisches Bundesamt</a> ). It is to be based on the economic focus of the operator, which itself may not necessarily be an activity subject to emissions trading. For example, a car manufacturer who operates his own power plant would select NACE code 29.10 for the production of motor vehicles and motor vehicle engines, but not NACE code 35.3 for the heat supply, which is the purpose of the power plant.
4. BImSchV-No	For installations approved under BImSchG (Federal Immission Control Act), selection of the activity approved under 4 <sup>th</sup> BImSchV (Federal Immission Control Ordinance). For installations not approved under BImSchG, indicate “entfällt” (Not applicable).
EPRTT-Tätigkeit (EPRTT activity)	The activity listed in Annex I to Regulation 2006/166/EC (European Pollutant Release and Transfer Registry) to which the installation is assigned.
EPRTT-Kennnummer (EPRTT identification number)	Identification number of the installation in the European Pollutant Release and Transfer Registry under Regulation 2006/166/EC.
CRF-Kategorie nach IPCC (CRF category according to IPCC)	Selection of the categories to which the installation is assigned under the "Common Reporting Format" for national greenhouse gas inventories of the UNFCCC.

## 12.2 Information on installation capacity, production and installation units (“Produktion” (production), “Anlagenteil” (installation unit), “Produktion (Anlagenteil)” (Production (installation unit)) forms)

Under Annex I (1) No 1 MRR, installations and their activities which are subject to monitoring must be described in the monitoring plan. Therefore, for every form “Anlage” (Installation) a form “Produktion” (Production) is automatically created, on which the product category of the final product of the installation must be selected from the catalogue stored there, and the net output of the installation must be specified according to § 3 No 11 TEHG (i.e., if applicable, deducting wastes and return heat). If an installation produces several products, it is sufficient to indicate only that product on the “Produktion” (Production) form that is economically most significant for the installation.

If it is a power plant, which generates both thermal energy and electrical energy, a second “Produktion” (Production) form must be created to document both products.

If the installation consists of several installation units, a separate “Anlagenteil” (Installation unit) form has to be created for each. Installation units are individual units, such as individual boilers or individual production lines. However, individual units that have similar functions can be also described as one installation unit, such as five steam boilers as a steam boiler installation unit. For “Einheitliche Anlagen” (Single installations) under § 24 TEHG and integrated steel mills, this means that a combination of different units such as coke oven, sinter plant, blast furnace and converter are not allowed as one installation unit. The installation unit must be named and described on the form. In addition, it must be indicated whether CO<sub>2</sub> is measured using a continuous emission measurement system in this installation unit. In turn, for each installation unit, a “Produktion (Anlagenteil)” (Production (installation unit)) form must be created, which must also include the product category and the production capacity of the installation unit.

Example: If an installation operator combined a coke oven, sinter plant, blast furnace, converters, and various hot and cold rolling mills into a “Single installation” pursuant to § 24 TEHG, the most economically significant product of this installation is the crude steel it produces. Under the “Anlage” (Installation) form, in the “Produktion” (Production) form, the operator will specify the actual and legal maximum annual production volume for crude steel according to § 3 No 11 TEHG. For the various “Anlagenteile” (Installation units) of coke oven, sinter plant, blast furnace and converter as well as the respective hot and cold rolling mills, an “Anlagenteil” (Installation unit) form must be created. For every “Anlagenteil” (Installation unit) form, a new “Produktion (Anlagenteil)” (Production (Installation unit)) form is required, in which the production volume according to § 3 No 11 TEHG must be indicated for each installation unit (both the actual or the maximum legal annual production volume of coke, sinter, pig iron, crude steel, etc. - if the two values are different, the smaller value must be indicated).

### 12.3 Activity information (“Berichtsanlagenteil” (Activity specific reporting form))

For each activity under Annex 1 Part 2 TEHG that takes place in the installation, a “Berichtsanlagenteil” (Activity specific reporting) form must be created. If several greenhouse gases which are subject to emissions trading are emitted, one “Berichtsanlagenteil” (Activity specific reporting) form needs to be created for each (e.g. “Berichtsanlagenteil CO<sub>2</sub>” (CO<sub>2</sub> activity specific reporting), “Berichtsanlagenteil N<sub>2</sub>O” (N<sub>2</sub>O activity specific reporting)). The source streams of the installation are then mapped to the respective activity specific reporting. With regard to the term “activities” it must be differentiated between the activities listed in Annex 1 Part 2 TEHG (corresponding entries on the “Anlage” (Installation) and “Berichtsanlagenteil” (Activity specific reporting) forms) and activities of the MRR (e.g. “Materialstrom” (Material stream) form - also see Chapter 13.1.2.). Table 5 maps activities 1 to 20 of Annex IV MRR to the activities listed in Annex 1 Part 2 TEHG.

Table 5: Activities under Annex 1 Part 2 TEHG and Annex IV MRR

Activity	Annex 1 Part 2 TEHG	Activities listed in Annex IV MRR
Combustion	1 to 6	1
Refineries	7	2
Coke ovens	8	3
Sinter plants	9	4
Iron/steel	10	5
Ferrous metals and alloys, non-ferrous metals	11, 13	6
Primary aluminium	12	7 to 8
Cement	14	9
Lime	15	10

Activity	Annex 1 Part 2 TEHG	Activities listed in Annex IV MRR
Glass, mineral substances	16, 18	11
Ceramics	17	12
Gypsum products and plaster boards	19	13
Pulp, paper	20, 21	14
Carbon black	22	15
Nitric acid, adipic acid, glyoxal or glyoxylic acid	23, 24, 25	16
Ammonia	26	17
Bulk organic chemicals	27	18
Hydrogen and syntheses gas	28	19
Sodium carbonate and sodium bicarbonate	29	20

The MRR requires that an installation's emissions are reported activity specific. It means that if more than one activity under Annex I ETD is performed in an installation subject to emissions trading, the emissions are determined separately according to the activities referred to in Annex 1 TEHG, and then indicated in the monitoring plan. This also means that emissions resulting from different sources within an installation, but are assigned to one and the same activity listed in Annex 1 Part 2 TEHG, may be reported in aggregate form for each activity.

An exception to the above procedure is for coke ovens, sinter plants and installations for the production and smelting of pig iron and steel as part of integrated mills. If the permit according to BImSchG is for an entire steel mill, the CO<sub>2</sub> emissions can also be observed for the entire mill in monitoring and reporting if a mass balance approach is used. This also applies if it is a "Single installation" under § 24 TEHG. For integrated mills and "Single installations" under § 24 TEHG, a "Berichtsanlagenteil CO<sub>2</sub>" (CO<sub>2</sub> activity specific reporting) form can be created, to which the activity most characteristic for this installation is then assigned according to Annex 1 Part 2 TEHG. The other activities of the integrated mills or "Single installations" must be indicated on the "Berichtsanlagenteil CO<sub>2</sub>" (CO<sub>2</sub> activity specific reporting) form in the field "Beschreibung des Berichtsanlagenteils" (Description of the activity specific reporting). In addition, one or more CRF category must be specified from the selection list for each activity specific report.

## 12.4 Information on changes to the operation according to § 22 ZuV 2020 ("Betriebsänderungen" (operational changes) form)

According to § 22 ZuV 2020 operators who receive a free allocation for the third trading period, are obligated to monitor and report actual and planned changes in capacity, the activity rate and the operation of the installation. Under Art. 12 (3) MRR it may be required to specify provisions in the monitoring plans to ensure that the reporting and notification obligations already imposed by Art. 24 of Decision 2011/278/EU on EU-wide uniform allocation rules are met. Therefore, the monitoring methods and procedures to ensure proper reporting according to § 22 ZuV 2020 must be explained in the monitoring plan. Chapter 12.4.1 provides an overview of content, timing and recipient list of the reporting requirements. Chapter 12.4.2 then outlines the purpose of the reporting requirements. Chapter 12.4.3 contains the requirements for the methods and procedures designed to ensure compliance with the monitoring and reporting requirements, which must be described in the monitoring plan.

### 12.4.1 Content, timing and recipient list of the reporting obligation

According to § 22 ZuV 2020 (Allocation Ordinance) the following reporting obligations exist:

- ▶ in the event of a substantial capacity reduction under § 19 ZuV 2020 the operator shall immediately notify DEHSt of the decommissioned capacity and the installed capacity of the sub-installation after the reduction,
- ▶ in the case of shutdown of operation in accordance with § 20 (1) ZuV 2020 the operator must immediately notify DEHSt with the date of shutdown,

- ▶ each year, by 31 January of the following year at the latest, and beginning on 31 January 2013, the operator must submit a report to DEHSt on the operation for the previous year and planned changes for the current year. Besides activity rates, all physical changes, changes in capacity and other changes in operation within the installation compared to the allocation application have to be indicated. In general, it is the operator's responsibility to submit a report on operation, even, if there were no changes in operation.

The details on form and content of this report are described in the Guidance document „[Zuteilungsverfahren 2013-2020 – Teil 6, Kapazitätsverringierungen und Betriebseinstellungen](#)“ („Allocation procedure 2013-2020 – Part 6, reductions in capacity and shutdowns).

The reporting obligation also applies to small emitters who are exempt under § 27 TEHG, because the compensation payment taking into account the allocation for the respective year is determined according to § 26 ZuV 2020.

## 12.4.2 Purpose of the reporting obligation

The monitoring and reporting on the installation's operation serves to implementation of §§ 19 to 22 ZuV 2020. According to these, DEHSt is obligated to adjust allocation decisions in the following cases wherein all adjustments to allocation decisions may be reversed if the European Commission refuses them.

### ▶ Significant capacity reduction

In the case of a significant reduction in capacity of a sub-installation after 30.06.2011 the free allocation will be reduced by the corresponding amount of the reduction in capacity. The allocation decision will be adjusted starting with the year following the year of the capacity reduction (see § 19 ZuV 2020).

For determining the start date of a modified operation as well as the capacity after the capacity reduction, detailed explanations in Part 6, Chapter 4 of the Guidance „[Leitfaden für das Zuteilungsverfahren 2013-2020](#)“ (Allocation procedure 2013-2020), especially Chapter 4.2 and 4.3, have to be applied.

### ▶ Cessation of operations

According to § 20 (1) ZuV 2020, the operation of an installation is deemed to have ceased, if

- ▶ the emissions permit has expired or been withdrawn,
- ▶ operation is not possible for technical reasons or
- ▶ the resumption of operation within maximum of six months after cessation cannot be guaranteed.

According to § 20 (1) No 5 ZuV 2020, DEHSt can, upon request, extend the aforementioned six months up to 18 months if the resumption of operation is not possible due to force majeure.

The rule according to § 20 (1) No 5 ZuV 2020 does not apply to reserve, standby, and seasonal installations, if they have a valid emissions permit and all other required operating licenses, are regularly serviced and can be put back into service on short notice without any physical modifications.

In the case of a cessation, DEHSt will withdraw the allocation decision for the following year and stops issuing allowances to that installation. It is important to note that in the case of cessations according to § 20 (1) No 3 to 5 ZuV 2020, the obligation to participate in emissions trading and the resulting reporting and surrender obligations persist, unless the emissions permit has expired or has been withdrawn.

### ▶ Partial cessation

A partial cessation in accordance with § 21 (1) ZuV 2020 exists when the activity rate of an sub-installation,

- ▶ which receives a free allocation in the amount of at least 50,000 allowances/year or
- ▶ which accounts for at least 30 % of the annual allocation of the installation,

is reduced by 50 % or more compared to the activity rate, which was used as the basis of the allocation. The adjustment will be made gradually according to the degree of reduction in activity rate. The allocation can also be gradually increased later if the previously decreased activity rate of the sub-installation increases again in future years, see § 21 (2) to (4) ZuV 2020.

### 12.4.3 Requirements for monitoring operational changes

In the monitoring plan for the 3<sup>rd</sup> trading period (2013 – 2020) the method for monitoring the activity rates of every sub-installation has to be indicated (see FAQ Nr. MVO 006). Additionally, must be described how data resulting from physical changes is collected in order to identify relevant changes in capacity, how shutdowns are monitored, and how the corresponding immediate announcement to DEHSt is guaranteed (see FAQ Nr. MVO 008). To determine operational changes, the relevant specifications made in the Guidance „Allocation procedure 2013-2020” (Leitfaden für das Zuteilungsverfahren 2013-2020) – especially part 6 – as well as [DEHSt FAQs](#) must be applied.

Fundamentally, the following principle applies: The monitoring methodology for operational changes must be consistent with the methodology for collecting the data for the allocation decision. This means that monitoring of operational changes may not be based on a data estimate, if measured data were used for the allocation and more accurate and measured data continue to be available and can be used. Deviations from this are acceptable, if, for instance, data for the allocation process could only be estimated, but now measured, and thus more accurate data are available. Moreover, deviations are also acceptable as a result of a revised measuring technique. The same applies if the capacity for the allocation process was determined experimentally according to § 4 (2) ZuV 2020, but the determination of a decommissioned capacity in the context of monitoring must comply with the requirements of § 2 No 5 and 20 ZuV 2020.

If the activity rate in the allocation process was determined based on capacity data (see § 8 (7) to (9) ZuV 2020), the methods of capacity and capacity utilisation factor determination must not be used to identify operational changes. But, the method used to determine the monthly values, must be applied analogous to the determination of the annual values. In terms of consistent monitoring, this is not to be evaluated as a deviation.

When activity rates are monitored, the actual installation composition has to be considered within the reporting year. After changes in composition (e.g. after starting operation of a new sub-installation or additional electricity generation) the hierarchy of allocation methods as well as double counting has to be reviewed. If necessary, the methods within the monitoring plan have to be adjusted (see examples in FAQ Nr. MVO 006).

When monitoring operational changes it must be taken into account that, e.g.

- ▶ the monitoring of the annual activity rate of sub-installations using the fall-back methodology must also be performed differentiated by carbon leakage status if this is also decisive for the allocation,
- ▶ heat export to distribution networks or non-ETS installations in the case of sub-installations with heat emission factor and carbon leakage threat have to be monitored in case of a change in carbon leakage status (e.g. due to a changed consumption structure) (see document “Nachweis zur Verwendung exportierter Wärme” for methodological hints),
- ▶ for sub-installations with “type c” process emissions, the residual gases must be accounted for according to the instructions in the Guidance “[Leitfaden für das Zuteilungsverfahren 2013-2020](#)” Part3 b (“Allocation procedure 2013-2020”),
- ▶ the thermal energy must be accounted for in sub-installations with a heat benchmark whereas, for the accurate determination of the activity rate, it must be differentiated between carbon leakage and non-carbon leakage, ETS and non-ETS heat, and if combined heat is generated according to Annex 3 No. VI EEG (German Renewable Energy Act). the special instructions for the determination of activity rates for certain product benchmark e.g. lime, CWT, steam cracking (see “Excel-Tools zur Berechnung zusätzlicher Daten für spezielle Produkt-Emissionswerte” (Excel tools for calculating additional data for specific product benchmarks”)) must be considered.

The form “Betriebsänderungen” (Operational changes) in FMS is automatically created under the form “Deckblatt” (Covering page).



**Table 6: Form „Betriebsänderungen“ (Operational changes)**

Form field	Description
Vorgesehene Methoden zur Ermittlung der Betriebsänderungen (Methods intended for determining operational changes)	The following changes must be monitored: changes in capacity (physical changes and their effect on the capacity of the sub-installations), activity rates of all sub-installations (production quantities, heat imports and exports, fuel energy used and process emissions under § 2 (29) ZuV 2020) and other relevant changes to the operation of an installation (such as changes in the interaction with other facilities or installations, customer structure for heat exports, changes from „non-power producer to power producer within the meaning of § 2 No 21 ZuV 2020, changes in (intermediate) products). Generally, the monitoring methodology must be consistent with the methodology used for the collection of data for the allocation decision. It must be explained in this form, as it was described in the allocation application.
Datenquellen (Data sources)	Specification of the sources used for determining operational changes.
Erläuterung der Abweichungen (Explanation of deviations)	If there is to be a justified deviation from the data collection methodology used in the allocation process, this must be explained. Deviations are appropriate when data for the allocation process for existing installations could only be estimated, but now measured, and therefore more accurate data are available. Deviations may also be acceptable as a result of revised measuring techniques.
Angaben zur Verfahrensanweisung (Information on procedural instructions)	See general information in Chapter 10.
Beschreibung des Verfahrens	It must be specified where, how and what data and documents as proof for the details of operational changes are kept. The data must be kept for at least ten years and must be provided to DEHSt on request (see Art. 66 in conjunction with Art. 12 (3) MRR and §§ 19 to 22 ZuV 2020).

The annual report on operational changes according to § 22 ZuV 2020 and the immediate notification of significant capacity reductions and cessation of operations need not be verified separately. Under Art. 17 (4) and Art. 27 (3) o) of the Accreditation and Verification Regulation (AVR) the verifier will examine whether procedures established in the monitoring plan were properly applied in connection with the reporting of emissions. In addition, the verifier will examine whether the operator has provided all information to DEHSt. If this is not the case, or if incorrect data has been provided, the verifier will point this out in his verification report of the emissions report.

## 12.5 Information on measuring instruments (“Messgerät” (measuring instrument) form)

For the requirements for determining source stream quantities, the specifications in Chapter 0 must be observed.

As in the first and second trading periods, operators can determine source stream quantities by either using their own instruments or on the basis of invoiced fuel or material quantities. In any case, that is also for an instrument that is outside the control of the installation operator, a form “Messgerät” (Measuring instrument) must be created. The form “Messgerät” (measuring instrument) must be created for the determination of source stream quantities (for both standard method and mass balance method, see Chapter 4.1), and for measuring instruments used for determining continuous emissions (CEMS). Flow meters for CEMS used to determine the flue gas flow must be also identified as instruments “zur kontinuierlichen Emissionsmessung” (for continuous emissions measurement). In contrast, analysis instruments (such as bomb calorimeters) are not to be included in the form “Messgerät” (Measuring instruments). Information on analyses is recorded on the form “Analyseverfahren” (Analysis procedure) (see Chapter 12.6).

In general, similar measuring instruments can be summarised in one FMS form. In the corresponding text fields, the quantity of similar instruments that are installed has to be defined as well as where they can be found in the flow chart (different ID numbers of measuring instruments).



Furthermore, differences in the quality assurance of measuring devices have to be described transparently (e.g. differences in data for the last date of verification or calibration).

Table 7. explains some of the information required about measuring instruments.

**Table 7: Form “Messgerät” (Measuring instrument), page 1, Information about the measuring instrument**

Form field	Description
Messgerät zur (Measuring instrument for)	Information on whether this is a measuring instrument for determining quantity (calculation method) or for monitoring continuous emissions. If CO <sub>2</sub> is transferred, it may be necessary to create an entry for the instrument in the receiving installation.
Nr. der Messeinrichtung (The measuring instrument No.)	Entry of the number used by the installation operator for the measuring instrument. This must be the same number, which is used in the flow diagram of the installation.
Standort des Messgeräts (Location of the measuring instrument)	Information on location of measuring instrument in order to find it on the flow diagram as well as during on-site verification.
Messgerät ist (Measuring instrument is)	Specifies whether it is an internal instrument or one outside the operator's control (e.g. a supplier's instrument).
Bezeichnung des Messgeräts (Name of the instrument)	Brand and type of the instrument must be entered.
Messmethode (Measurement method)	Select the right measurement methods from the list in the FMS catalogue. For methods not listed, choose “Sonstige Messmethode” (Other measurement method).
Beschreibung “Sonstige Messmethode” (Description of “Other methods”)	This field must be completed if “Sonstige Messmethode” (Other measurement method) was selected under “Messmethode” (Measurement method). The operator has to describe the measurement method used in an understandable manner.
Messbereich (Measuring range)	Provide the measuring range as specified by the manufacturer of the instrument.
Typischer Arbeitsbereich (Typical operating range)	Details of the actual operating range in the installation in which the instrument is used.
Messfrequenz (Measuring frequency)	The MRR requires that for instruments for "continuous emissions measurement" the associated measurement frequency is indicated.

In addition to information on the instrument itself, further information on quality assurance must be provided on the form “Messgerät” (Measuring instrument).

**Table 8: Form “Messgerät” (Measuring instrument), page 1, Details on quality assurance**

Form field	Description
Eichung oder Kalibrierung? (Verification or calibration?)	If the instrument is neither verified (select “Eichung” (Verification)) nor calibrated (select “Kalibrierung” (Calibration)), “Andere Methode” (Other method) must be selected, which must then be described further in the “Beschreibung der Qualitätssicherung” (Quality assurance description) field.
Angaben zur Art der Messunsicherheit (Information on types of measurement uncertainty)	The choices in this field depend on what was selected under “Eichung oder Kalibrierung?” (Verification or calibration?) “Eichung” (Verification): If the instrument has been verified, please indicate whether the uncertainty indicated under “Wert der Unsicherheit” (Uncertainty value [%]) is the “Verkehrsfehlergrenze” (Maximum permissible error in service) or “Eichfehlergrenze” (Maximum permissible error) (see Chapter 6.1.1). „Kalibrierung” (Calibration): If the device is not verified, but is regularly calibrated, indicate whether the uncertainty in the field „Wert der Unsicherheit” (Uncertainty value [%]) refers to „Erweiterte Messunsicherheit” (Expanded measurement uncertainty) or the „einfache Messunsicherheit” (Standard measurement uncertainty) (see Chapter 6.1.2). “Andere Methode” (Other method): If the device is neither verified nor calibrated, indicate whether the uncertainty in the field “Wert der Unsicherheit [%]” (Uncertainty value [%]) refers to „Messunsicherheit nach Herstellerangaben” (Measurement uncertainty according to manufacturer’s) or “Sonstiges” (Others) (see Chapter 6.1.3).

Form field	Description
Wert der Unsicherheit [%] (Value of the uncertainty [%])	Quantification of the level of uncertainty of the instruments as a percentage.
Intervall (Interval)	Interval of the verification or calibration (e.g. "Every two years").
Letzter Termin (Last date)	Date of last verification or calibration.
Beschreibung der Qualitätssicherung (Quality assurance description)	Quality assurance for the instrument must be described if the device is not verified, i.e., if in the "Eichung oder Kalibrierung?" (Verification or calibration?) field "Kalibrierung" (Calibration) or "Andere Methode" (Other method) was selected. See Chapter 6.1.2 and 6.1.3.

Apart from the above information about quality assurance, in Annex I (1) No 1 e) in conjunction with Art. 58 (3) a) and Art. 59 (1), the MRR requires that all measuring equipment is regularly calibrated, adjusted and checked based on internationally accepted standards (if available) in respect to the risks of data collection and data management. In the field "Beschreibung des Verfahrens" (Description of the procedure) under "Angaben zur Verfahrensanweisung" (Details of the procedure) on the form "Messgerät" (Measuring instrument), the quality assurance of the instrument must be addressed (see Chapter 6.1.2).

Analogous to the information about the measuring instrument, information to the volume conversion device may have to be provided, if for example, the volume of natural gas consumed must be converted to standard volume using temperature and pressure measurements.

## 12.6 Information on the analysis procedure ("Analyseverfahren" (Analysis procedure) form)

For each analysis process (e.g. analysis of the biomass carbon content, calorific value analysis, etc.), a separate form "Analyseverfahren" (Analysis procedure) needs to be created. On this form, the method of the analysis procedure (e.g. bomb calorimeter, gas chromatography etc.) and the relevant CEN, ISO or other standards must be indicated which are used in the respective analysis method. Additional information on the analysis process must be provided under "Angaben zur Verfahrensanweisung" (Information on procedural instructions). For any deviation from the requirements in the relevant standards (e.g. simplified conversion of gross calorific value to net calorific value with a fixed factor), the main steps need to be summarised in the field "Beschreibung des Verfahrens" (Description of the procedure).

If, for example, multiple analyses according to CEN, ISO or other standards are required for determining the emissions factor or the calorific value because several methods have to be combined, still only one form "Analyseverfahren" (Analysis procedure) needs to be created in the FMS. On it, the various procedures for determining the factor must be summarised. If, for example, for determining the emission factor, in addition to carbon content, water content is also determined, "Analyse nach Radmacher-Hoverath, Bestimmung des Wassergehalts" (Analysis after Radmacher-Hoverath, determination of water content) must be noted in the field "Methode des Analyseverfahren" (Method of the analysis procedure), and "DIN 51721, DIN 51718" in the field "Nennung des Standards" (Identification of standards).

As long as the specific branches analysis are possible according to industry best practice guidelines as per Annex IV MRR, this shall be described on the form "Analyseverfahren" (Analysis procedure) and presented in the text fields "Angaben zur Verfahrensanweisung" (Information on procedural instruction) that the method used actually adheres to the proven industry practice formulated in a guideline.

## 12.7 Information on laboratories ("Labor" (Laboratory) form)

For the suitability of analytical laboratories the requirements in Chapter 7.2.4 should be observed.

A "Labor" (Laboratory) form should be created for each in-house and third-party laboratory that analyses source streams. On this form the operator shall note the name of the laboratory and whether the laboratory has an EN ISO 17025 accreditation. In addition, test procedure and test scopes for which the laboratory is accredited and which are relevant to emission control under the emissions trading scheme must be specified.

If similar accredited laboratories are commissioned for the same test procedure and test scope to analyse a source stream, it is sufficient to create only one form “Labor” – choosing one laboratory, representing all identical laboratories. The description of quality assurance – in the field „Angabe der akkreditierten Labor-Prüfverfahren und -Prüfbereiche“ (Description of the accredited laboratory test procedure and test scope) on the form „Labor“, incl. a reference to an additional document if necessary – should include the information describing how it is ensured that the laboratories for identical test procedure and test scope are accredited.

If laboratories do not have identical specifications, a form “Labor” has to be created for every laboratory separately.

If the laboratory is not EN ISO 17025 accredited, its equivalence in terms of quality management and technical competence must be demonstrated. The documents in which the evidence are recorded must be identified in the field “Nachweis der Gleichwertigkeit bzgl. Qualitätsmanagement und fachlicher Kompetenz” (Evidence of equivalence in terms of quality management and technical competence). Reference documents (e.g. further education certificates, etc.) referred to need not be attached to the monitoring plan. It suffices for the verifiers and DEHSt to have access to them if necessary.

If the evidence of equivalence has been provided, “nicht erforderlich” (Not required) should be entered into “Nachweis der Unverhältnismäßigkeit” (Evidence of disproportion) (see Chapter 7.2.4). Disproportion only needs to be demonstrated (see “Nachweise der Unverhältnismäßigkeit” (Evidence of disproportion)) if the operator neither uses an accredited laboratory nor can provide suitable equivalent evidence for the non-accredited laboratory (see Chapter 7.2.4). In this case, evidence of disproportion must be attached as an attachment to the form „Labor” (Laboratory).

## 12.8 Information on data management and control system (form “Datenmanagement” (Data management))

In Annex I (1) No 1 d) and e) MRR requires information on procedures in terms of data management and control system (see Chapter 10). The following tables and explanations describe the monitoring plan information expected that will explain the procedure in terms of data management and the control system in a company.

### Data Flow

Table 9: “Datenmanagement” (Data management), page 1, Data flow

Form field	Description
Beschreibung des Datenflusses (Description of data flow)	The data flow diagram is to be entitled and to be attached to the “Datenmanagement” (Data management) form. Additional explanation in this field complements the data flow diagram. Facts that are not readily apparent from this diagram must be presented here. This may in particular concern the way of data processing (manual, automated) and data transfer.
Erläuterung von Risiken (Risk explanation)	Where and how errors can occur in the collection and management of emission data are to be explained. If it is discernible from the description of the data flow, the relevant risks, e.g. all manual steps and failure of IT systems (see Chapter 11) may be combined.

### Control activities

Table 10: “Datenmanagement” (Data management), page 2, Control activities

Form field	Description
Beschreibung von Qualitätssicherungsverfahren von Daten (Description of quality assurance procedures for data)	Explanation of the methods implemented to ensure data quality compliance with the monitoring plan (e.g. plausibility test of analysis results). <b>Note:</b> Quality assurance for measuring instruments to determine input or production quantities shall be entered on the “Messgerät” (Measuring instrument) form, for non-accredited laboratories on the form “Labor” and on additional attached documents if necessary.

Form field	Description
Beschreibung des gesamten Kontrollverfahrens (Description of the entire checking procedure)	Explanation of the measures, which will prove, whether released data – if necessary after a quality assurance – were completed properly and fully (e.g. review of sampling procedures or of completeness of data processing and data transfer).
Erläuterung der Kontrollrisiken (Explanation of control risks)	Where and how controls can fail or an error cannot be identified (see Chapter 11)?
Beschreibung des Korrekturverfahrens (Description of correction method)	How errors are detected and corrected in the monitoring system as a whole and in data management in particular? Unless done elsewhere: Where can errors requiring such correction occur?

### Risk analysis

At this point, the results of risk analysis must be recorded. It is clearly to explain why control measures laid down are sufficient to avoid identified risks of reporting errors and deviations from the monitoring plan. Unless done elsewhere, it must be clarified which methods will be used to assess and evaluate risks.

### Data gaps

It may also happen in very good monitoring systems that primary data acquisition sources established in the monitoring plan fail (instrument failure) or are not available on time (supplier's calculation arrives late). Nevertheless, to be able to report in accordance with the MRR, operators should provide – if possible – an alternative data acquisition method in the monitoring plan. Where this has not been done, and if data gaps occur, operators must adapt their monitoring plan immediately and have it approved by DEHSt according to Art. 12 (2) b) and c) and 65 (1) MRR.

Possible methods for closing data gaps are explained in chapter Fehler! Verweisquelle konnte nicht gefunden werden.

**Table 11: “Datenmanagement” (Data management) form, page 1, Data gaps**

Form fields	Description
Sekundärdatenquellen (Secondary data sources)	Specification of sources to be used instead when primary sources, specified in the monitoring plan, fail (e.g. use of supplier's bill in the event of own instrument's failure). Information on uncertainty should be provided for secondary sources for consumption or production data.
Datenrekonstruktion (Data reconstruction)	Explanation of the processes which can be used to reconstruct emission data in the case of failure of primary sources. For the reconstruction of consumption or production quantities, data on uncertainty should be provided.
Schätzmethode (Estimation method)	Description of estimation methods for closure of “real” data gaps (the use of secondary sources or other data reconstruction is not possible).

### Environmental management systems

If relevant, the installed environmental management systems within the installation to which the emission monitoring is linked shall be specified according to Annex I (1) No 1 f) MRR.

## 13 Monitoring of CO<sub>2</sub> Emissions

### 13.1 Fuel and material streams („Stoffstrom“ (source stream) forms “Brennstoffstrom\_HW” (fuel stream\_CV), “Brennstoffstrom\_MV” (fuel stream\_MV), “Materials trom” (material stream)

With regard to the intended transparency and accuracy of monitoring and reporting, source streams must generally be determined separately and a separate FMS form completed for each source.

When monitoring CO<sub>2</sub> emissions from combustion activities, a “Brennstoffstrom\_HW” (Fuel stream\_CV) form must normally be created because the emission factor must be given based on the calorific value. According to Art. 36 MRR, reporting may alternatively be performed using either a mass or volume based emission factor if any of the following conditions are met:

- ▶ the determination of a calorific value-based emission factor causes unreasonable costs or
- ▶ the determination of a mass or volume based emission factor can provide at least the same accuracy as the determination of emission factor based on a calorific value.

If the operator would like to use a mass or volume based emission factor for a source stream for combustion, the “Brennstoffstrom\_MV” (Fuel stream\_MV) form should be created and one of the above required evidences provided.

Identical source streams within an installation and an activity may be aggregated. For example, the aggregation of the same types of coal in the categories specified in the DEHSt list that are used in different parts of a power plant is permitted. Source streams with distinct compositions due to their specific origins must not be combined. This applies both for fuels and materials which are sourced from outside the installation as well as (production) residues produced by the installation itself. Fuels and material streams to be mixed just prior to combustion or processing must separately be calculated for each of the components prior to mixing (e.g. separate source stream forms for waste and coal).

If the exact origin of the materials is not yet known when the monitoring plan is being created, a source stream form can be created for the category relevant to the material (for example creating a source stream form for “Hard coal import Canada” instead of “Hard coal import Australia” to be actually acquired later).

It should be noted that additional source stream forms must be created in the emissions report when more source streams are actually used in the reporting year than scheduled in the monitoring plan (e.g. “Hard coal import Australia”, “Hard coal import South Africa” and “Hard coal import Russia”).

#### 13.1.1 Mapping of fuel and material streams to activity specific reporting

With several activities listed in Annex 1 Part 2 TEHG, it must be ensured that the mapping of fuel and material streams for each activity is accurately shown in the monitoring plan. In FMS, the source streams must be allocated to that activity specific reporting which maps the relevant activity according to Annex 1 Part 2 TEHG (also see Chapter 12.3).

If both, activities subject to emissions trading and those not subject to emissions trading, are carried out at a single location (e.g. food industry), sources or source streams must be carefully identified and correctly assigned to the activity subject to emissions trading.

#### 13.1.2 Description of fuel and material streams

In addition to the activities listed in Annex IV MRR, Table 1 of Annex V MRR also distinguishes certain processes and/or determination methods within the activities of Annex IV MRR, e.g. Annex IV No 1: “Combustion - (Solid fuels)”. The relevant activity should be indicated for each source stream (see selection box “Tätigkeit nach Anhang IV Monitoring-Verordnung” (Activity according to Annex IV Monitoring Regulation). Depending on the activity selected according to Annex 1 Part 2 TEHG on the parent activity specific reporting, those activities can only be selected according to Annex IV MRR on the source stream forms that correspond to the activity as per TEHG. For this purpose the appropriate mappings were laid out in FMS.

For example, if a CO<sub>2</sub> activity specific reporting has been created for activity No. 15 according to Annex 1 Part 2 TEHG (Installations for burning limestone or dolomite with a production capacity > 50 t lime, calcined magnesite or calcined dolomite per day), activity “10 - Kalk – Karbonate“ (10 – Lime - Carbonates) can be selected according to Annex IV MRR on the “Materialstrom” (Material stream) source stream form, but not activity “11 - Glas – Karbonate” (11 – Glass - Carbonates) according to Annex IV MRR.

The transparent and understandable description of the substance must be ensured. This is especially true when unlisted materials are selected in the field “Name des Stoffes” (Name of the substance) (see source stream forms, “Ersatzwert für feste Stoffe” (Substitution value for solid substances) is entered into selection box “Name des Stoffes” (Name of the substance)). If the substance can be allocated to a category contained in the FMS list, it must be done. “Ersatzwerte” (Substitution values) must not be selected in this case (for example, no mapping of coal or recycled municipal waste using “Ersatzwert für feste Stoffe” (Substitution value for solid substances)). If a substance cannot be allocated to any category from the FMS selection list, the term “Ersatzwert...” (Substitution value...) must be selected. In this case, information about an accurate characterisation of the substance must be provided in the field “Beschreibung des Stoffes” (Description of the substance), e.g. a relevant specification must be made and – where relevant – the origin or composition must be described.

In addition, it must be shown whether the source stream represents an acquisition of transferred (inherent) CO<sub>2</sub>. For instance, this is the case when blast furnace gas obtained from a steel mill is used in the site’s own power plant. If (inherent) CO<sub>2</sub> has been transferred, the question “Handelt es sich um einen weitergeleiteten Stoff” (Is this a transferred substance?) must be answered with “Ja” (Yes). For transferring substances to other installations, see Chapter 13.4.

If the source stream is used as a fuel in the installation, this must also be noted for material streams (see “Materialstrom” (Material stream) form).

### 13.1.3 Information on Continuous emission measurement

If continuous emission measurement is used in the installation instead of or in addition to calculation, the requirements in Chapter 9 must be followed. The operator must create the “CO<sub>2</sub>-Messung” (CO<sub>2</sub> measurement) form in the FMS (see Chapter 13.3). Since MRR envisages that a corroborating calculation for continuous emission measurement is obligatory, source stream forms must be created for those substances whose emissions are included in the continuous emission measurement.

On the relevant forms, the question “Wird CO<sub>2</sub> aus diesem Stoff durch kontinuierliche Messung erfasst?” (Has CO<sub>2</sub> from this source stream been determined by continuous measurement?) must be answered with “Ja” (Yes) and the relevant number of the source (see selection box “Nummer der Quelle” (Source number)) previously assigned on the “CO<sub>2</sub>-Messung” (CO<sub>2</sub> measurement) form (see Chapter 13.3) must be indicated. If emissions resulting from a source stream are determined via more than one source, all sources have to be filled in on the source stream form.

Only emissions determined by a continuous emission measurement system shall be taken into account in the corroborating calculation. If a source stream is to be determined both by the calculation method and by the continuous emission measurement systems, two source stream forms must be created in the FMS: one for the corroborating calculation and one for the calculation method.

Unlike all the other values that can be estimated in the corroborating calculation independently of the tiers, the biomass fraction in a continuous emission measurement must still be determined by calculation based on the tiers required by MRR. Therefore it must be specified on the source stream form whether a source stream with biomass carbon content has been detected (see selection box “Handelt es sich um einen Stoffstrom mit biogenem Anteil?” (Is this a source stream with biomass fraction?)). If the operator would like to subtract the emissions of biogenic origin from his total emissions, he must fill in the information on the source stream form and mass balance form about “Biogener Anteil am Gesamtkohlenstoffgehalt” (Biomass fraction of total carbon content) and consider the requirements in Chapter 8.2.

### 13.1.4 Information on sampling

If the operator does not determine calculation factors individually but the use of standard factors is allowed, the operator shall answer the question “Erfolgt eine Probenahme?” (Is a sampling being performed?) with “Nein” (No) on the source stream form.



In all other cases, the question must be answered with “Ja” (Yes), indicating the name of the sampling plan (see text field “Bezeichnung des Probenahmeplans” (Description of the sampling plan)) which will then be attached to the associated source stream form (see also Chapter 7.2.2). In addition, information must be provided on the sampling procedure under an identical heading and a check-up on the sampling plan’s up-to-datedness should also be addressed. If this information is clear in the sampling plan, a reference can be made to it.

### 13.1.5 Information on quantities

The requirements specified in Chapter 0 are valid for determining source stream quantities.

The field “Ebene nach Monitoring-Verordnung (Soll-Ebene)” (Monitoring Regulation tier (required tier)) is automatically filled in. The operator specifies the “Vorgesehene Ebene” (Intended tier) with which he plans to determine the quantity of the source stream. The following table describes other necessary information about the quantity of the source stream:

**Table 12: “Stoffstrom” (Source stream) forms, page 3, Consumption or input quantities**

Form field	Description
Wird von der Ebene nach Monitoring-Verordnung abgewichen? (Is there a deviation from the Monitoring Regulation tier?)	<p>If the “Vorgesehene Ebene” (Intended tier) at least meets the “Ebene nach Monitoring-Verordnung (Soll-Ebene) (Monitoring Regulation tier (required tier)), the answer “Nein” (No) has to be chosen from the selection list.</p> <p>If the “Vorgesehene Ebene” (Intended tier) deviates down from the “Ebene nach Monitoring-Verordnung (Soll-Ebene)” (Monitoring Regulation tier (required tier)), an explanation has to be chosen in this field from the selection list:</p> <ul style="list-style-type: none"> <li>▶ “Ja, da emissionssschwach und unverhältnismäßig” (Yes because minor source stream and unreasonable“ if the criteria in Art. 19 (3) a) MRR is met (see Chapter 4.2).</li> <li>▶ “Ja, da de-minimis” (Yes as de-minimis) if the criteria in Art. 19 (3) b) MRR is met (see Chapter 4.2).</li> </ul> <ul style="list-style-type: none"> <li>▶ “Ja, da biogener Kohlenstoffgehalt <math>\geq 97\%</math>” (Yes because biomass carbon content <math>\geq 97\%</math>) if the biomass fraction of a fuel or material mixture is 97 % or more. A no-tier method may be applied. In this case, “Schätzung” (Estimate) has to be selected under “Vorgesehener Ebene” (Intended tier) (see Chapter 8.1).</li> <li>▶ “Ja, da reine Biomasse” (Yes as pure biomass) if the source stream is composed exclusively from biomass (i.e. biomass fraction = 100 %, see Chapter 8.1). Evidence (e.g. one-time analysis or proof of origin) is to be provided in the field “Beschreibung der Ermittlungsmethode” (Description of the determination method). A no-tier method may be applied. In this case, “Schätzung” (Estimate) has to be selected under “Vorgesehene Ebene” (Intended tier).</li> <li>▶ “Ja, da unverhältnismäßig” (Yes because unreasonable) if the required Monitoring Regulation tier (required tier) is unreasonable (see Chapter 4.3.1). The document, which contains the evidence of disproportion, has to be specified in the field “Beschreibung der Ermittlungsmethode” (Description of the determination method) and attached to the source stream form.</li> </ul>
Messgerät (Measuring instrument)	That measuring instrument for which a “Messgerät” (Measuring instrument) form has been previously created and which is used to determine the substance quantity of the source stream has to be selected from the list (see Chapter 12.5). Also, several instruments can be arranged for determining the source stream quantity by pressing the “+” button on the left edge of the form.
Beschreibung der Ermittlungsmethode (Description of the determination method)	<p>If the source stream quantity has been estimated (“Schätzung” (Estimate) in the field “Vorgesehene Ebene” (Intended tier)), the estimation method has to be described. If no instrument has been selected (“kein Messgerät” (No instrument) in the form “Messgerät” (Measuring instrument)), it must be explained how the source stream quantity has been determined.</p> <p>Moreover, the evidence of compliance with the overall uncertainty in determining the annual quantity used must be described here when, in addition to the instrument’s uncertainty, further uncertainty components need to be considered (see Chapter 6).</p>

### 13.1.6 Information on the calculation factors

Similar to determining the source stream quantity (see Chapter 13.1.5), the field “Ebene nach Monitoring-Verordnung (Soll-Ebene)” (Monitoring Regulation tier (required tier)) is automatically filled for the calculation factors (emission factor, carbon content, net calorific value, biomass fraction of total carbon content, conversion factor), which are different depending on the monitoring method (see Chapter 4.1).

The operator specifies the “Vorgesehene Ebene” (Intended tier) which he wants to use for determining the calculation factor. Depending on the selected tier or method, all other fields must be completed.

With regard to the field “Wird von der Ebene nach Monitoring-Verordnung (Soll-Ebene) abgewichen?” (Is there a deviation from the Monitoring Regulation tier (required tier)?) see explanations in Chapter 13.1.5.

For the calculation factors emission factor, net calorific value and carbon content, it must be shown in the field “Ermittlungsmethode” (Determination method) whether the determination takes place by “Analyse” (Analysis) (see Chapter 7.2) or if a “Standardwert” (Standard factor) is used (see Chapter 7.1). This field is disabled if the operator has previously set “Schätzwert” (Estimate) in the “Vorgesehene Ebene” (Intended tier).

- ▶ If the determination method “Standardwert” (Standard factor) has been chosen, the field “Datenquelle” (Data source) is automatically assigned to the source of the relevant substance for which the source stream form has been created (see Chapter 13.1.2). For material streams (see source stream form “Materialstrom” / Material stream) a different data source can be manually selected for the emission factor, net calorific value and carbon content from the list by first enabling the “vom Standardwert abweichen” (deviate from standard factor) checkbox. Then under “Datenquelle (Data source) the actual source used for determining the calculation factor must be selected from the selection list. If “Sonstiges” (Other) has been selected as a data source in the field “Beschreibung der Datenquelle oder Ermittlungsmethode” (Description of data source or determination method), the data source used shall be explained in more detail.
- ▶ If “Analyse” (Analysis) has been specified as the determination method, in the next step the operator shall select the previously created analysis method on the respective source stream form (see Chapter 12.6) which will be used for determining the calculation factor (see selection box “Analyseverfahren” (Analysis procedure)) and will need to show the analysis frequency in the field of the same name. He must also select the previously created laboratory that will determine the relevant calculation factor (see Chapter 12.7).

If the field “Vorgesehene Ebene” (tier to be applied) is filled with “Schätzwert” (estimated value), the estimation method for determining the calculation factor has to be explained in the corresponding field “Beschreibung der Datenquelle oder Ermittlungsmethode” (description of source or determination method) (for emission factor, net calorific value and carbon content) or in field “Beschreibung der Ermittlungsmethode” (description of determination method) (for conversion factor, biomass fraction of carbon content).

**Note on calorific value:** Since only “Proxy data” are required for the net calorific value in emission reports according to Annex X (1) No 6 g) MRR (see Chapter 7.3.2) when fuel emission factors relate to mass or volume rather than energy, “Schätzung” (Estimate) is preset in the “Ebene nach Monitoring-Verordnung (Soll-Ebene)” (Monitoring Regulation tier (required tier)) on all source stream forms except for the source stream form “Brennstoffstrom\_HW (Brennstoffstrom, Emissionsfaktor heizwertbezogen)” (Fuel stream\_CV (fuel stream, calorific-value-based emission factor)). However, the operator must specify in the “Vorgesehene Ebene” (Intended tier) how such a “Proxy value” is determined. If it is not based on the tier, but on the recognised sources, the “Vorgesehene Ebene” (tier to be applied) is to be filled in with “Schätzwert” (estimated value) and the determining information is to be described in the field “Beschreibung der Datenquelle oder Ermittlungsmethode” (Description of the data source or determining methods).

### 13.1.7 Information on receiving transferred gases

If the question “Handelt es sich um den Bezug von weitergeleitetem (inhärentem) CO<sub>2</sub>?” (Has transferred (inherent) CO<sub>2</sub> been received?) on page 1 of the relevant source stream form has been answered with “Ja” (Yes), more information on the transferring installation<sup>12</sup> (including the operator, obligation to emissions trading and the measuring instrument(s) of the delivering installation) must be provided and the supplier’s determination method must be described on page 6 (see “Beschreibung der Ermittlungsmethode” (Description of the determi-

<sup>12</sup> In the FMS, the installation’s file number in the EU registry is queried. In the EU registry there is an “Anlagen Nr.” (Installation ID) field and a „Genehmigungskennung” (Permit ID) field. In the monitoring plan, the “Anlagen Nr.” (Installation ID) must be entered.

nation method). Moreover, it may require the “Erläuterung bei Abweichung der Messergebnisse” (Explanation on deviation of measurement results) and how adjustments shall be made in the case of disagreements between your own measurement result and that of the supplier to be described if the deviation of the measurement results cannot be explained by the two measurement systems’ uncertainties. If the supplier has not measured the source stream, these fields can be left blank.

## 13.2 Carbon balances (“Massenbilanz” (Mass balance) form)

If CO<sub>2</sub> emissions are calculated based on mass balance in whole or in part, analogous to the procedure used for fuel and material streams (see Chapter 13.1.1), mass balance elements (“Massenbilanz” (Mass balance) forms) should be created and allocated to the corresponding “Berichtsanlagenteil CO<sub>2</sub>” (CO<sub>2</sub> activity specific reporting) which maps the relevant activity according to Annex 1 Part 2 TEHG (also see Chapter 12.3).

Provisions in Chapter 13.1.2 apply analogous to the description of mass balance elements. The classification of mass balance elements into major, minor and de-minimis source streams is explained in Chapter 4.3.2. The provisions in Chapter 13.1.3 to 13.1.7 apply to information on continuous emission measurement, sampling, substance quantities, calculation factors and receiving transferred gases.

It must also be shown whether the substance for which the “Massenbilanz” (Mass balance) form has been created, is transferred (see field “Handelt es sich um einen Stoff, der weitergeleitet wird?” (Is it a substance that is transferred?), page 1). The transfer of residual gases from a mass balance is described in Chapter 13.4.1.

The source streams must be marked as balance elements – input, products, export – (cf. “Massenbilanz” (Mass balance) form, page 3). When importing data/source streams from the 2011 emissions report or 2020 data notice, the balance element “Lagerbestandsänderung” (Storage change) is not carried over. It is therefore particularly important to ensure that all source streams are included in the monitoring plan after data imports.

Similar to material streams (see “Materialstrom” (Material stream) form, page 3), it must be additionally shown for mass balance elements marked as “Input” (cf. “Massenbilanz” (Mass balance) form, page 3), whether the source stream is also used as fuel in the installation (example: natural gas for synthesis gas production). If this is the case, the determination method for the calorific value must be specified. The provisions in Chapter 7.3.2 apply.

## 13.3 Continuous CO<sub>2</sub> measurement (“CO<sub>2</sub>-Messung” (CO<sub>2</sub> measurement) form)

For each CO<sub>2</sub> source which is monitored by continuous emission measurement, a “CO<sub>2</sub>-Messung” (CO<sub>2</sub> measurement) form has to be created and allocated to the CO<sub>2</sub> activity specific reporting, for which the relevant activity has been selected in accordance with Annex 1 Part 2 TEHG (also see Chapter 12.3). A number should be allocated to the source (see field “Nummer der Quelle” (Source number)). In addition, a transparent description must be provided in the field “Beschreibung der Quelle” (Source description) as to where the continuous CO<sub>2</sub> measurement is performed, and how the measurement is technically related to the installation units (e.g. when flue gas flows are discharged from a number of installation units via a common flue pipe).

The question on page 1 of the form whether the CO<sub>2</sub> measurement determines “Emissionen aus Regenerationsvorgängen nach Anhang IV Nr. 2 MVO?” (Emissions from regeneration processes according to Annex IV No 2 MRR?) must be answered with “Ja” (Yes) when the form describes emission determination methods from the regeneration activities of catalytic crackers, regeneration of other catalytic converters and flexi-coking or from Claus plants according to Annex IV No 2 MRR (Mineral oil refineries).

For determining the CO<sub>2</sub>-concentration, further data has to be entered on page 1.

Table 13: “CO<sub>2</sub>-Messung” (CO<sub>2</sub> measurement) form, page 1, Information on determining CO<sub>2</sub> concentration

Form field	Detailed description
Methode (Method)	If the CO <sub>2</sub> concentration is not determined by direct measurement, “Berechnung” (Calculation) has to be selected.

Form field	Detailed description
Parameter/Messgerät (Parameter/measuring instrument)	Depending on the choice of the method for determining the CO <sub>2</sub> concentration, measurement instruments shall be chosen from the list of instruments for which “Measuring instrument” forms have been previously created (see Chapter 12.5) to determine the relevant parameters. When calculating the CO <sub>2</sub> concentration, the CO <sub>2</sub> field is disabled, but other segments can be created for the parameters O <sub>2</sub> , N <sub>2</sub> , SO <sub>2</sub> and NO <sub>x</sub> by pressing the “+” button on the left edge of the form and the related instruments can be selected.

To determine the flue gas flow, the following information should be provided on page 2:

**Table 14: “CO<sub>2</sub>-Messung” (CO<sub>2</sub> measurement), page 2, Information on determining flue gas flows**

Form field	Detailed description
Methode (Method)	If the flue gas flow is not determined by direct measurement, “Massenbilanz” (Mass balance) has to be selected.
Messgerät zur Bestimmung des Abgasvolumens (Instrument for determining the flue gas volume)	Both with “Massenbilanz” (Mass balance) and “Messung” (Measurement) to determine the flue gas flow, the measuring instrument has to be selected from the list of measuring instruments for which an “Messgerät” (Measuring instrument) form has previously been created (see Chapter 12.5). If the flue gas volume was determined using multiple instruments, an instrument can be added by pressing the “+” button on the left edge of the form.
Parameter/Messgerät (Parameter/measuring instrument)	If the flue gas flow was determined by a mass balance, the fields to CO <sub>2</sub> and CO are automatically filled with the data that has been entered under “Angaben zur Bestimmung der CO <sub>2</sub> -Konzentration” (Information to determine CO <sub>2</sub> concentration). For the parameters O <sub>2</sub> , SO <sub>2</sub> and NO <sub>x</sub> the appropriate instruments have to be chosen for which a “Messgerät” (Measuring instrument) form must have been created previously (see Chapter 12.5). Moreover, further segments may be created for additional parameters and associated instruments by pressing the “+” button on the left edge of the form.

To calculate the flue gas flow by mass balance, information on procedures must be provided, see Chapter 10.

The following table explains some of the required information in the determination of CO<sub>2</sub> emissions on page 3 of the “CO<sub>2</sub>-Messung” (CO<sub>2</sub> measurement) form:

**Table 15: “CO<sub>2</sub>-Messung” (CO<sub>2</sub> measurement), page 3, Information on determining CO<sub>2</sub> emissions**

Form field	Detailed description
Wird von der Ebene nach Monitoring-Verordnung abgewichen? (Is there a deviation from the Monitoring Regulation tier?)	<p>If the “Vorgesehene Ebene” (Intended tier) at least meets the “Ebene nach Monitoring-Verordnung (Soll-Ebene)” (Monitoring Regulation tier (required tier)), the answer “Nein” (No) has to be chosen from the selection list.</p> <p>If the “Vorgesehene Ebene” (Intended tier) deviates down from the “Ebene nach Monitoring-Verordnung (Soll-Ebene)” (Monitoring Regulation tier (required tier)), an explanation has to be chosen in this field from the selection list:</p> <ul style="list-style-type: none"> <li>▶ “Ja, da <math>\leq 5.000 \text{ t CO}_2\text{e/a}</math> oder <math>\leq 10 \%</math> der jährl. Gesamtemissionen” (Yes because <math>\leq 5,000 \text{ t CO}_2\text{(e)}</math> p.a. or <math>\leq 10 \%</math> of the annual total emissions) if the criterion in Art. 41 (1) MRR is satisfied (see Chapter 9). At least the tier one step below the highest tier should be applied.</li> <li>▶ “Ja, da unverhältnismäßig” (Yes because unreasonable) if the required Monitoring Regulation tier (required tier) is unreasonable (see Chapter 4.3.1). The document which contains the evidence of disproportion has to be specified in the field “Beschreibung der Ermittlungsmethode inkl. Unsicherheitsbewertung” (Description of the determination method including uncertainty analysis) and attached to the CO<sub>2</sub> measurement form.</li> </ul>
Beschreibung der Ermittlungsmethode inkl. Unsicherheitsbetrachtung (Description of determination method including uncertainty analysis)	Here has to be described how the overall uncertainty in determining the annual CO <sub>2</sub> emissions from the emission source is determined and what is the value of this overall uncertainty.

Form field	Detailed description
Beschreibung der Methode zur Bestimmung fehlender Daten (Description of determination method for missing data)	If e.g. hourly values of the measured concentrations (e.g. due to temporary problems with the measuring instrument) are missing, the determination method for the missing data is to be described. The provisions in Art. 44 (2) and Art. 45 MRR must be taken into account.
Nennung der verwendeten Standards (Specifying the standards used)	Listing the standards to be used for continuous CO <sub>2</sub> measurement.
Beschreibung der Abweichungen von den Standards (Description of deviations from the standards)	Any deviations from the specifications in the used standards shall be described.

On page 4 of the form the procedural instructions for the continuous CO<sub>2</sub> measurement shall be described.

Besides specifying and appending a process diagram for continuous CO<sub>2</sub> measurement, information on other emission sources which may occur in exceptional and transitional phases (e.g. emergency flaring, diffuse sources) shall be provided on page 5 of the form.

In the FMS, source stream forms or mass balance forms for performing the corroborating calculation for the source streams shall be created (see Chapter 13.1.3).

## 13.4 Transfer of inherent CO<sub>2</sub>

Where CO<sub>2</sub> is transferred between two installations subject to emissions trading, the following applies as to which installation is obliged to surrender:

- ▶ An installation that transfers (inherent) CO<sub>2</sub> is not then obliged to surrender for this only if the substance in the receiving installation is used as a fuel, or when the transfer takes place to a so-called CCS facility in terms of Art. 49 (1) MRR for permanent geological storage. In this context, specific regulations must always be considered: Annex IV No. 10 (lime), No. 14 (pulp and paper), No. 17 (ammonia) or No. 20 (soda and sodium bicarbonate) MRR. If the transferring installation belongs to one of these sectors, it may be obliged to surrender for the transferred CO<sub>2</sub> in any case, regardless of the further use of the material stream.
- ▶ Recipients of transferred CO<sub>2</sub> need in principle to surrender allowances for this. Then, in exceptional cases, they are only exempt from surrendering if the transferring installation is already obliged to surrender due to special regulations as in the above-mentioned sector-specific special cases, or when it uses the transferred substance as a material and not as a fuel.

Whether the monitoring method for transferred CO<sub>2</sub> is presented on the “Massenbilanz” (Mass balance) form or on the “CO<sub>2</sub>-Messung” (CO<sub>2</sub> measurement) form, depends on the (permitted) selection of the monitoring approach.

- ▶ Transferred CO<sub>2</sub> which is not measured directly and continuously, should be presented as a “Massenbilanzglied” (Mass balance element). This applies even when operators have chosen the standard methodology.
- ▶ If an operator measures transferred CO<sub>2</sub> directly, he shall describe the monitoring in the “CO<sub>2</sub>-Messung” (CO<sub>2</sub> measurement) form.

If the source stream is also measured at the recipient installation, the operator shall describe the recipient installation’s determination method (see the field “Beschreibung der Ermittlungsmethode zur Bestimmung der weitergeleiteten Menge bei der aufnehmenden Anlage” (Description of the method for determining the transferred quantity at the recipient installation)). Moreover, in the field “Erläuterung des Vorgehens bei Abweichung der Messergebnisse” (Explanation of the procedure for deviations in measurement results) must be described, how the results are adjusted if they differ, and this difference cannot be explained by the approved uncertainties of the two measuring systems. If the deviating measurement results can be explained by the measurement systems’ uncertainties, the arithmetic mean of the two measured values must always be used for the emissions reports of both installations according to Art. 48 (3) MRR.



### 13.4.1 Transfer of CO<sub>2</sub> as mass balance element

The monitoring of transfer requires all data necessary for mass balance elements, see Chapter 13.2. Transfers have to be marked as an Output of a mass balance („Export“ oder „Produkte“).

In addition, information is needed on the installation to which CO<sub>2</sub> is transferred<sup>13</sup>. If CO<sub>2</sub> is transferred to several installations, corresponding query fields must be created by pressing the “+” button for each additional installation.

**Note:** If, as the basis for the monitoring plan, an xml document (e.g. a 2011 emissions report) is imported, in which several mass balance elements have been created for a source stream, to map for example several customers of a transferred residual gas in the emissions report, several mass balance elements will also be created for this source stream in the working version of the monitoring plan. On page 8, the “Massenbilanz” (Mass balance) form enables the specification of a number of recipient installations to which a source stream can be transferred. Thus, it is not necessary to create several mass balance elements for a source stream when substances are transferred from the mass balance. Both variants are however allowed, provided that, when a source stream is divided into several mass balance elements, adherence to the tier requirements is ensured pursuant to Annex II MRR which applies in total to the source stream.

### 13.4.2 Monitoring of transferred CO<sub>2</sub> emissions by continuous emission measurement

If transferred CO<sub>2</sub> is continuously measured, a “CO<sub>2</sub>-Messung” (CO<sub>2</sub> measurement) form has to be created. The question “Dient diese kontinuierliche Emissionsmessung der Erfassung von weitergeleitetem CO<sub>2</sub> an andere Anlagen?” (Does this continuous emission measurement serve for determination of transferred CO<sub>2</sub> to other installations?) must be answered with “Ja” (yes) and the monitoring method must be described. In addition to the necessary methodological information needed for each continuous emission measurement (cf. Chapter 13.3), information must be provided about the installation(s) to which CO<sub>2</sub> has been transferred. In this respect, reference is made to the descriptions in Chapter 13.4.1.

## 14 N<sub>2</sub>O Emission Monitoring

### 14.1 Continuous N<sub>2</sub>O measurement (“N<sub>2</sub>O-Messung” (N<sub>2</sub>O measurement) form)

In addition to reporting on CO<sub>2</sub> emissions, those installations that produce nitric acid, adipic acid and glyoxal or glyoxylic acid must also report on N<sub>2</sub>O emissions in accordance with of Annex IV No 16 MRR. A “Berichtsanlagenteil N<sub>2</sub>O” (N<sub>2</sub>O activity specific reporting) must be created in FMS for each activity as per TEHG where N<sub>2</sub>O emissions are released. Precisely one “N<sub>2</sub>O-Messung” (N<sub>2</sub>O measurement) form must be mapped to this activity specific reporting. This means that a separate “Berichtsanlagenteil N<sub>2</sub>O” (N<sub>2</sub>O activity specific reporting) with precisely one “N<sub>2</sub>O-Messung” (N<sub>2</sub>O measurement) form must be created for each of the products linked to the N<sub>2</sub>O emissions produced by the installation (nitric acid, adipic acid, glyoxal or glyoxylic acid). Regarding the description of the source on page 1 of the “N<sub>2</sub>O-Messung” (N<sub>2</sub>O measurement) form, the provisions in Chapter 13.3 apply.

The activity as per Annex IV MRR is automatically entered in the “Berichtsanlagenteil N<sub>2</sub>O“ (N<sub>2</sub>O activity specific reporting) form depending on the data in “Tätigkeit nach Anhang 1 Teil 2 TEHG” (Activity according to Annex 1 Part 2 TEHG) (24 - Nitric acid producing installations, 25 - Adipic acid producing installations or 26 - Glyoxal or glyoxylic acid producing installations).

In addition to the hourly production quantity for the product concerned, the method for determining the hourly production quantity and product concentration must be described in the field “Methode zur Bestimmung der Produktionsmenge und Produktkonzentration” (Method for determining the production quantity and product concentration) field.

<sup>13</sup> In the FMS, the installation’s file number in the EU registry is queried. In the EU registry there is an “Anlagen Nr.” (Installation ID) field and a “Genehmigungskennung” (Permit ID) field. In the monitoring plan, the „Anlagen-Nr.” (Installation ID) must be entered.



The name of each input substance needed for the production of the product concerned must be selected from the FMS list (Acetaldehyd und Ethylenglycol (Acetaldehyde and Ethylene glycol), Ammoniak (Ammonia), Cyclohexanon (Cyclohexanon), Cyclohexanol (Cyclohexanol), Glyoxal (Glyoxal), KA-Öl (KA oil), Salpetersäure (Nitric acid), stickoxidhaltige Gase (Nitrogen oxide-containing gases)), the method used to determine the substance must be described and the maximum quantity of the input substance at full capacity must be given in tonnes per hour.

For the **determination of N<sub>2</sub>O concentration** (Bestimmung der N<sub>2</sub>O-Konzentration), the measuring instruments must be selected for the parameters N<sub>2</sub>O and O<sub>2</sub> from the list of measuring instruments on page 2, for which a “Messgerät” (Measuring instrument) form must previously have been created (see Chapter 12.5).

The **flue gas flow** (Bestimmung des Abgasstromes) in nitric acid production must be calculated based on a suitable mass balance methodology (cf. Annex IV No 16 B.3 MRR). For all other activities in which the amount of N<sub>2</sub>O emissions has to be determined, there is an option to choose between mass balance methodology and measurement at a representative point. If the flue gas quantity is determined using mass balance, information about the procedures must be provided, cf. Chapter 10. The “N<sub>2</sub>O-Messung” (N<sub>2</sub>O measurement) form includes the following queries:

**Table 16: N<sub>2</sub>O-Messung (N<sub>2</sub>O measurement) form, page 2, Information on flue gas flow determination**

Formularfeld	Nähere Beschreibung
Methode (Method)	If the flue gas flow has not been determined by a direct measurement, “Massenbilanz” (Mass balance) should be selected. For determining the flue gas flow in the activity “Herstellung von Salpetersäure” (Nitric acid production) basically a mass balance has to be chosen.
Messgerät zur Bestimmung des Abgasvolumens (Measuring instrument for determining the flue gas volume)	Both for “Massenbilanz” (Mass balance) and “Messung” (Measurement) in flue gas flow determination, the measuring instrument must be chosen from the measuring instrument list for which a “Messgerät” (Measuring instrument) form must previously have been created (cf. Chapter 12.5). If the flue gas volume has been determined by several measuring instruments, another measuring instrument can be added by pressing the “+” button at the left side of the form.
Beschreibung der Methode zur Bestimmung, ob der Abgasstrom ausreichend homogen ist (Description of the Method to determine whether the flue gas flow is homogeneous enough)	The method to determine whether the flue gas flow is homogeneous enough has to be described to enable the use of the measurement method proposed.
Beschreibung einer alternativen Methode bei Vorliegen eines nicht homogenen Abgasstroms (Description of an alternative method when the flue gas flow is non-homogeneous)	An alternative method must be described if it has been found that the flue gas flow is non-homogeneous.
Parameter / Messgerät (Parameter/ Measuring instrument)	If the flue gas flow has been calculated using a mass balance, the appropriate instruments must be chosen for the parameters “Primärer Luftstrom” (Primary air stream), “Sekundärer Luftstrom” (Secondary air stream) and “Sperrluftstrom” (Sealing air stream) for which a “Messgerät” (Measuring instrument) form must previously have been created (cf. Chapter 12.5).

The explanation about determining CO<sub>2</sub> emissions using continuous CO<sub>2</sub> measurement in Chapter 13.3 should be used equivalent to the information needed for determining N<sub>2</sub>O emissions on page 4 and the necessary information on other emission sources on page 5 of the form.

In addition, all emissions into the atmosphere resulting from unplanned operating conditions (called “Ausfälle” (Failures) in the FMS) must be determined. Therefore, different failure modes are provided on pages 6 and 7 of the “N<sub>2</sub>O-Messung” (N<sub>2</sub>O measurement) form (instrument failure, catalytic converter failure, bursting disc rupture, exceeding the measuring range).

The monitoring plan must demonstrate how the extent of emissions can be determined in such cases (cf. field “Beschreibung der Ermittlungsmethode von N<sub>2</sub>O-Emissionen während des Ausfalls” (Description of the N<sub>2</sub>O emission determination method during failure)) and how the occurrence of these operating conditions can be monitored (cf. field “Beschreibung der Methoden, mit denen Ausfälle festgestellt werden” (Description of failure identification methods)). It must be reasonably explained how avoidable unplanned operating conditions can be avoided (e.g. timely regeneration of catalytic converters before the measuring instruments reach the limits of their measuring ranges). This also applies to installations that carry out relevant activities but ultimately do not emit N<sub>2</sub>O into the atmosphere. In addition, information about the frequency and duration of the failure and the amount of associated N<sub>2</sub>O emissions must be provided. More failure modes can be indicated and described on page 8 of the form.

## 14.2 Transferred N<sub>2</sub>O („N<sub>2</sub>O-Weiterleitung“ (N<sub>2</sub>O transfer) form)

In case of transferred N<sub>2</sub>O to other installations, both the methods for determining the amount of N<sub>2</sub>O at the transferring installation as well as at the receiving installation have to be described.

## 15 PFC Emissions Monitoring (“Zelltyp” (Cell Type) Form)

In addition to CO<sub>2</sub> emissions, primary aluminium producing installations are also required to report on PFC emissions in accordance with Annex IV No 8 MRR. A “Berichtsanlagenteil PFC” (PFC activity specific reporting) including a “Zelltyp” (Cell type) form must be created in FMS. A separate “Zelltyp” (Cell type) form is required for each cell type used in primary aluminium production. The “Zelltyp” (Cell type) form’s structure is as follows:

- ▶ Page 1 and 2: Information about expected PFC emissions, annual primary aluminium production volume, weight fraction, fugitive emissions and other information that is relevant to both methods
- ▶ Page 3: Information on slope emission factor and anode effect minutes for Method A
- ▶ Page 4: Information on procedures for both Method A and Method B
- ▶ Page 5: Information on overvoltage coefficient and anode effect overvoltage for Method B

The cell type should be selected from the available list on page 1 in the “Zelltyp” (Cell type) form in the field “Zelltyp und Anode” (Cell type and anode), or if the cell type is not shown in the list, „Sonstige” (Others) should be selected. In the latter case, the cell type used must be described in more detail in the field “Beschreibung des Zelltyps” (Cell type description) field, e.g. by stating the design characteristics.

The choice between Method A (Slope method) and Method B (Overvoltage method) in the field “Methode” (Method) decides which fields must be completed or which ones will be locked. Information that is required for Method A will be queried in the first pages of the form. Information for Method B shall be entered on the last page of the form.

Furthermore, the expected PFC emissions separated into tetrafluoromethane and hexafluoroethane and the annual primary aluminium production quantity which is produced by this cell type, shall be shown.

The field “Ebene nach Monitoring-Verordnung (Soll-Ebene)” (Monitoring Regulation tier (required tier)) is automatically completed. The operator specifies the “Vorgesehene Ebene” (tier to be used) with which he wants to determine the annual production quantity. The following table explains some of the information needed to determine the annual production quantity (jährliche Produktionsmenge):

**Table 17: “Zelltyp” (Cell type), page 1, Annual Aluminium production quantity (PrAl)**

Form field	Description
Wird von der Ebene nach Monitoring-Verordnung abgewichen? (Is there a deviation from the Monitoring Regulation tier?)	<p>If the “Vorgesehene Ebene” (Intended tier) corresponds to at least the “Ebene nach Monitoring-Verordnung (Soll-Ebene)” (Monitoring Regulation tier (required tier), “Nein” (No) shall be selected from the dropdown list.</p> <p>If the “Vorgesehene Ebene” (Intended tier) deviates downwards from the “Ebene nach Monitoring-Verordnung (Soll-Ebene)” (Monitoring Regulation tier (required tier)), a reason must be selected from the dropdown list in this field:</p> <ul style="list-style-type: none"> <li>▶ “Ja, da emissionsschwach und unverhältnismäßig“ (Yes, because minor source stream and unreasonable) if the criterion in Art. 19 (3) a) MRR is met (cf. Chapter 4.2).</li> <li>▶ “Ja, da de-minimis” (Yes, because de minimis) if the criterion in Art. 19 (3) b) MRR is met (cf. Chapter 4.2).</li> <li>▶ “Ja, da unverhältnismäßig” (Yes, because unreasonable) if the required Monitoring Regulation tier (required tier) is unreasonable (cf. Chapter 4.3.1). The document in which the evidence of disproportionality is recorded must be specified in the field “Beschreibung der Ermittlungsmethode” (Description of determination method) field and attached to the “Zelltyp” (Cell type) form.</li> </ul>
Messgerät (Measuring instrument)	The measuring instrument must be selected from the list for which a “Messgerät” (Measuring instrument) form has previously been created and with which the production quantity has been determined (cf. Chapter 12.5). If the production volume has been determined by several measuring instruments, another measuring instrument can be added by pressing the “+” button at the left edge of the form.
Beschreibung der Ermittlungsmethode (Description of determination method)	<p>If the production quantity has been estimated (“Schätzung” (Estimate) has been entered into the “Vorgesehene Ebene” (Intended tier)), the estimation method must be described.</p> <p>If no instrument has been selected (“kein Messgerät” (No instrument) has been entered into the “Messgerät” (Measuring instrument) field), the method for determining production quantity must be explained.</p>

Similar to the production quantity determination, the “Ebene nach Monitoring-Verordnung (Soll-Ebene)“ (Monitoring Regulation tier (required tier)) is automatically preset for weight fraction and slope emission factor in Method A (or for weight fraction and overvoltage coefficient in Method B). The operator specifies the tier in the “Vorgesehene Ebene” (Intended tier) field that he wants to use to determine the respective emission factor.

- ▶ If “Ebene 2” (Tier 2) is specified as “Vorgesehene Ebene” (Intended tier), the operator selects in the next step the previously created “Analyseverfahren” (Analysis procedure) (cf. Chapter 12.6) that is used to determine the emission factor (“Analyseverfahren” (Analysis procedure) dropdown list). If the determination method has already been described in the “Analyseverfahren” (Analysis procedure) form, reference can be made to it in the “Beschreibung der Ermittlungsmethode” (Description of determination method) field. The operator also selects the previously created “Labor” (Laboratory) which determines the emission factor concerned (cf. Chapter 12.7).
- ▶ If the operator has selected “Schätzung” (Estimate) in the “Vorgesehene Ebene” (Intended tier) field, the estimation method used to determine the calculation factor must be outlined in the corresponding “Beschreibung der Ermittlungsmethode” (Description of determination method) field.

If there is a deviation from the required tier according to the Monitoring Regulation, a selection must be made in the field “Wird von der Ebene nach Monitoring-Verordnung (Soll-Ebene) abgewichen” (Is there a deviation from the Monitoring Regulation tier (required tier)?). The same conditions apply here as for information about the determination of the annual production quantity.

The determination method for fugitive emissions and the determination method for relevant changes in the installation which necessitate the re-determination of emission factors, must also be described. The schedule for the entire third trading period must be shown in the field “Terminplanung für die Bestimmung von Gewichtungsfaktor, Koeffizienten und diffusen Emissionen” (Schedule for the determination of weight fraction, coefficients and fugitive emissions) in accordance with the provisions in Annex IV No 8 MRR.

Depending on the method chosen (A or B), details of the determination of the anode effect minutes (Method A, page 3) or of the determination of the anode effect overvoltage (Method B, page 5) must be provided. Both the designation of the measuring system to be used has to be indicated and the specific method has to be explained.

In addition, the method to be used for data determination when the measuring electronics fail (field “Beschreibung der Methode bei Ausfall” (Description of the method in case of failure)) must be explained.

Details of procedures for the determination of the weight fraction and the coefficients (Method A or B), fugitive emissions and scheduling must be entered on page 4.

## PART 3: EMISSIONS REPORT

### 16 Basics

#### 16.1 Emissions report functions and significance

The annual emissions report is the sum result of the emission monitoring in the reporting year. It is the basis for determining the surrender liability to be met by operators, and the starting point of the verifiers' and DEHSt's checks.

To facilitate the preparation of emissions reports, DEHSt provides forms in FMS, which query the necessary data and information in a pre-structured way (cf. Section 3.2).

A separate emissions report must be submitted for each installation. If it is an installation requiring approval according to the Federal Pollution Control Act (Bundes-Immissionsschutzgesetz, BImSchG), the pollution control permit situation determines which emission sources and source streams are part of an installation, cf. § 2 (4) TEHG (see Section 2.3.1).

#### 16.2 Trade and business secrets

DEHSt protects and safeguards trade and business secrets contained in emission reports according to legal regulations. If the operator answers the relevant question on the Form Management System's cover page with „yes“, he has to explain in a separate document, which information is to be regarded as trade and business secrets. This document is to be attached the covering page.

### 17 Eelectronic Emission Report Drafting and Reporting

#### 17.1 Mandatory electronic communications

Emissions reports must be created in the electronic templates provided by the DEHSt on their websites (Forms Management System, FMS). The submission of emission reports and their signature (see Section 3.4) must also be made in electronic form via the Virtual Post Office (VPS) (see Section 17.3). The obligation to use FMS, VPS and electronic signature follows from § 23 (5) TEHG in conjunction with the notification of the German Environment Agency of 22.05.2012 in the electronic Federal Gazette (eBAnz of 31.05.2012).

#### 17.2 Forms Management System (FMS)

The FMS maps the necessary information into an emissions report according to MRR, in particular its Annex X, and helps operators submit an error-free report. Detailed information on the FMS can be found in the „User's manual for electronic emissions reporting pursuant to §5 TEHG“ („[Benutzerhandbuch zur elektronischen Emissionsberichterstattung nach §5 TEHG](#)“).

FMS offers different roles for the users: operators and verifiers work sequentially on the same report. The role concept allows easy exchange of data between users by sharing the editing rights to the relevant report. The operators entries and the verifiers approvals can be read by other role partners.

## **An emissions report can be created exclusively in the FMS based on a monitoring plan prepared in the FMS.**

When creating the emissions report, the operator chooses the monitoring plan valid for the reporting year. When the emissions report is based on several monitoring plans, the most extensive monitoring plan is recommended to be selected.

To keep the data of the emissions report traceable, the operators must not overwrite the version chosen as the basis for the emissions report (see Section 3.2).

### **Marking Forms**

When creating a report, a large part of the content of the selected monitoring plan will be adopted. Some forms (for example, source stream forms, „CO<sub>2</sub> measurement“ form), which are automatically filled with the contents of the forms of the same name from the underlying monitoring plan are marked with „Origin: Monitoring plan “. This marking indicates that the majority of the adopted content cannot be changed.

If existing data in a form taken from the monitoring plan needs to be adjusted, it is possible to create a new form. If, for example, a source stream is compiled that is not (any more) listed in the underlying monitoring plan, a new (empty) source stream form can be created in the emissions report for this purpose. The requirements in Chapter 13 provide guidance to filling out „empty“ forms.

### **Copying function**

In addition, there is the option to copy source stream forms. The copying function will collect all information except for data on source stream quantities and calculation factors and can be customised. Copying a source stream form is useful when the use and monitoring of hard coal has in general been described in the monitoring plan and the coal actually employed (from different provenances) are known after the reporting year. After copying the source stream forms only the source-stream-specific data must be added (for example, fields: „value“ of material quantity and calculation factors).

- ▶ the installation from which the inherent CO<sub>2</sub> has been obtained has changed (see page 3 of the source stream form)
- ▶ the monitoring method for a source stream was changed in the reporting period (for example, switch from default value to analysis, cf. Section **Fehler! Verweisquelle konnte nicht gefunden werden.**).

## **17.3 Virtual Post Office (VPS)**

Electronic communication with DEHSt has to be performed via the secure VPS (cf. Section 3.3).

The emissions reports will be compressed to a ZIP file by the verifiers in the FMS. When transmitting this to DEHSt it must be ensured that it is this ZIP file that is sent. PDF and XML files are not sufficient for processing the reports by DEHSt. The ZIP file will be sent as an attachment to a VPS message. For this purpose, the verifiers add their QES to the message with the report in the mailbox software „VPSMail“ and then send it to the operator. After the operator has signed this message electronically, he forwards it to DEHSt<sup>14</sup>.

**It is absolutely necessary to ensure that the verifiers' original message is „forwarded“ and no new message is sent to DEHSt.** If the operator creates a new message and fails to add the verified report to the message, the verifiers' signature will not be forwarded to DEHSt. In this case DEHSt cannot see whether the emissions report has been changed after verification e.g. by the operator, and consequently DEHSt would demand a formal correct report. When the verifier's message has properly been forwarded, VPSMail creates a new VPS message. This automatically includes the original message with the verified data in a „enveloped“ form so that the file containing the data is no longer directly visible to the operator. When the operator has signed and submitted the message, both signatures arrive at DEHSt in an encapsulated message. VPSMail places a copy and evidence for the operator in the folder „Sent“. A forwarded message can be recognised by a plus sign and can be opened at any time by double-clicking on it. The content can then be individually read and separately saved.

<sup>14</sup> The 2013 emissions report has to be sent for the first time directly to DEHSt and no longer to the competent state authorities, see § 5 TEHG.



Detailed information regarding the use of VPSMail for submitting emission reports is available in the „Guide for the use of the Virtual Post Office“ (“Leitfaden für die Nutzung der Virtuellen Poststelle“) in the Chapter „Message type emissions report“ (“Nachrichtentyp Emissionsbericht“) on the DEHSt website.

## 18 Requirements for Emission Reporting

### 18.1 Completeness of emissions reports

The minimum content of an emissions report follows from the requirements in Annex X MRR. Certain data fields in FMS are marked as mandatory to support the operators. This function is not available to the verifiers. If not all information required by MRR can be accommodated in FMS (for example, for lack of space), it must be shown in additional documents, which are then part of the emissions report. In addition, operators and verifiers should ensure that information which is not comprehensible at first glance, is explained (if necessary in documents which are annexed to the emissions report).

### 18.2 Reporting and surrendering obligation for a change in installation operator

If the operator of an installation, his identity or legal status changes, DEHSt must be notified without delay. If the system requires approval according to BImSchG, the competent state authority responsible for the emissions permit must also be notified as soon as possible. The new operator is responsible for reporting and surrendering over the entire calendar year, see § 25 (1) TEHG. The new operator of an installation must therefore report CO<sub>2</sub> emissions of the takeover year and surrender a corresponding number of emission allowances, provided that the old operator did not do the reporting and surrendering before the change of operators occurred. This also applies when the change is made after the end of the reporting year. The law does not recognise a divided responsibility for reporting and surrender obligation for several operators. Multiple reports for an installation subject to emissions trading must therefore not be submitted. In addition, the installation account must be handed over to the new operator in the Union Registry, and an authorised representative must be nominated (see [http://www.dehst.de/DE/Service/Unionsregister/Konto/Betreiberwechsel/Betreiberwechsel\\_node.html](http://www.dehst.de/DE/Service/Unionsregister/Konto/Betreiberwechsel/Betreiberwechsel_node.html)).

### 18.3 Installation without emissions

Installations performing Annex 1 Part 2 TEHG activities and having an authorisation to release emissions shall also be subject to emissions trading if they cannot release emissions due to practical reasons. Therefore, operators of such installations must also submit an emissions report to DEHSt.

The scope of the emissions report can be limited to filling out the “Deckblatt” (Covering page) form, all address forms and the form “Überwachungsplan“ (Monitoring plan).

**Note for verifiers:** The verifiers confirm on the covering page that the information is correct and the installation has not released emissions during the reporting period. They must explain the reason on the form “Verifizierung“ (Verification) text field “Ergänzende Hinweise“ (Additional Notes). A 0 (zero) must be entered for this installation in the “Geprüfte Emissionen“ (Verified emissions) field in the Union Registry.

However, a complete emissions report shall be compiled for installations which, although currently do not release any emissions, would technically be capable of doing so. This concerns for example installations whose greenhouse gases are not emitted through their own chimneys, but entirely forwarded to other installations for further processing or flaring off so that no emissions are released at the installation itself that causes the flue gases.

### 18.4 Entry of verified emissions in the registry

Since 02.04.2015 verified emissions of an installation have had to be entered in the Union Registry separated into CO<sub>2</sub>, N<sub>2</sub>O and PFC (each in CO<sub>2</sub>(e) ) (see Art. 35 i.c.w. Table IX-I of the Registry Regulation (Regulation (EU) 389/2013)).

The relevant figures to be entered can be found on the form „Deckblatt“ (Covering page) in the emissions report. A „0“ must always be entered in the Union Registry when there are no emissions for the relevant greenhouse gas. If the installation had no emissions at all, a „0“ must be entered in all three boxes.

After entry and confirmation of the emissions separately according to CO<sub>2</sub>, N<sub>2</sub>O and PFC in the Union Registry the sum of CO<sub>2</sub>(e) is calculated. From that moment, only the sums of the emissions, but not the individual values are displayed below the Zum Konto > Compliance (To Account > Compliance) path.

The value(s) of verified emissions determined according to emissions report must be entered in the registry either by an authorised representative of the operator or by a representative of the verifiers. To assign a verifier to an installation, an authorised representative of the installation account must select the verifier in the Union Registry. The verifier must accept this assignment in the Union Registry. Thereafter, the verifier may enter the verified emissions and approve the entry for the respective reporting year. If the entry is made by one of the operator's authorised representatives, an authorised representative of the verifier's must approve this entry. If the entry and approval has not taken place by 31 March, DEHSt, as registry administrator, closes the account until this has been addressed. Missing items can be completed and confirmed by authorised representatives and verifiers even after 31 March and even after 30 April. However, erroneous VET entries that have been confirmed by the verifiers, can only be corrected by authorised representatives and verifiers until 30 April. After that, incorrect entries can only be corrected at DEHSt's order.

In order that operators can assign verifiers, a „Verifier account“ („Prüferkonto“) is need, which is referred to in the Union registry as an Expert account (Sachverständigenkonto). The application procedure for a verifier account is explained on the DEHSt website, see the following link: [http://www.dehst.de/DE/Service/Unionsregister/Konto/Kontoeroeffnung/Kontoeroeffnung\\_node.html](http://www.dehst.de/DE/Service/Unionsregister/Konto/Kontoeroeffnung/Kontoeroeffnung_node.html). Verifiers must nominate at least one authorised representative. If the verifiers make the entries themselves, they need at least two authorised representatives. DEHSt may prevent the entry of the annual verified emissions into the „Table of verified emissions“ („Tabelle der geprüften Emissionen“) until it has received the verified emissions report about the relevant installation. The changes in the verified emissions necessitated by a correction in the emissions reports will be entered by the DEHSt into the verified emissions table according to Art. 29 (6) of EU Registry Regulation 920/2010. The account holder shall immediately be informed about the entry.

## 18.5 Enforcement of reporting and surrendering obligations

Proper compliance with reporting and surrendering obligations is a prerequisite for a functioning emissions trading where competitive distortions have been avoided. In the event that operators fail to meet these obligations, Section 5 TEHG envisages various forms of sanctions.

### 18.5.1 Account locking

If an operator has failed to submit an emissions report for the previous calendar year by 31.03., DEHSt must lock his account according to § 29 TEHG. As a result, the operator can still fulfill his surrender obligations, but he no longer has control over his emission allowances. In particular, he cannot make arrangements for these allowances to be transferred to another account, apart from surrendering them. The lock will not be lifted until a proper emissions report has been filed to DEHSt or the emissions estimated.

### 18.5.2 Sanctions for violation of surrender obligation

If insufficient allowances have been surrendered for the previous calendar year by 30.04, the operator will be penalised by 100 euros<sup>15</sup> per missing allowance according to § 30 (1) TEHG. In addition, he must surrender the missing allowances by 31.01. of the following year.

The cause of violating the surrender liability is irrelevant for the sanctioning. DEHSt is only authorised to waive a penalty in the case of force majeure. Reasons of force majeure are only natural forces or other external influences, which could not have been prevented by the operator even with the utmost care, but not e.g. through lack of care of individual employees.

<sup>15</sup> Payment shall be increased pursuant to § 30 (1) (2) TEHG according to the increase in the European consumer price index for the reporting year compared to the reference year 2012.

For causes other than force majeure it is not within DEHSt's discretion, whether it imposes sanctions or to what extent it specifies the payment obligation<sup>16</sup>. However, when surrendering the allowances, the operator may rely on the allowances recognised in his emissions report and confirmed by the verifiers<sup>17</sup>. If DEHSt detects an error in the report after the 30.04., no payment obligation will be imposed as per § 30 (1) TEHG, but the missing allowances must be surrendered retroactively in this case as well.

### 18.5.3 Imposition of fines

A number of offenses are named in § 32 TEHG for which fines may be imposed. Of these, the following are essentially relevant for emission monitoring and reporting:

- ▶ An operator who has not reported correctly and thus fails to specify the emissions caused in accordance with the approved monitoring plan, can be fined by up to 500,000 € pursuant to § 32 (1) (1) i.c.w. § 32 (2) and (4) TEHG. If the operator has been negligent, the fine is up to 50,000 €. This includes cases where the operator disregards ancillary provisions in the notification approving the monitoring plan. This applies, in particular, to cases where the operator is not careful when preparing the report, thereby supplying erroneous information. If there is an error in the emissions report, DEHSt checks to see if an appropriate fine should be imposed.
- ▶ If an operator fails to submit a monitoring plan for the trading period or fails to submit it to DEHSt by the deadlines specified in Annex 2 (1) (1) (a) and (b), a fine of up to 50,000 € can be imposed in accordance with § 32 (3) (4) i.c.w. § 32 (4) TEHG.
- ▶ A fine of up to 50,000 € impends operators if they hinder DEHSt in performing their duty, for example if they refuse to provide information or submit documents requested or if they fail to provide such information in time or provide erroneous information.

If an operator violates his obligations to report changes in his installation to DEHSt in accordance with § 22 ZuV 2020, fines may also be imposed. Specifically, these offenses are named in § 31 (2) (2) and (3) ZuV 2020. Fines of up to 50,000 € can be imposed if DEHSt is not informed, or the information is incorrect, incomplete or delayed.

## 19 Superior Topics and Data on the Installation

### 19.1 Summary of greenhouse gas emissions (“Zusammenfassung” (Summary) form)

The “Zusammenfassung” (Summary) form is automatically created and filled in with information entered by the operator in the Source stream/CO<sub>2</sub> measurement/N<sub>2</sub>O measurement/Cell type forms. On page 1 of the form, the total emissions [t CO<sub>2</sub>(e)] emitted from the installation during the reporting period and relevant to surrendering are displayed. In addition to the CO<sub>2</sub> emissions per activity according to Annex 1 Part 2 TEHG, the memo items highlight certain information required by Annex X MVO (transfer of substances, receiving of transferred substances, biomass). Page 2 of the form provides an overview of N<sub>2</sub>O and PFC emissions that may have occurred in the installation.

On 15.10.2013, the European Commission and the Member States decided to amend the MRR regarding greenhouse gas potentials (Global Warming Potentials, GWP) retroactively from 01.01.2013. The affected GWPs (N<sub>2</sub>O, CF<sub>6</sub> and C<sub>2</sub>F<sub>6</sub>) with their updated value for the calculation of CO<sub>2</sub> equivalents are applied in the FMS.

<sup>16</sup> European Court of Justice, Verdict of 17.10.2013, Case C-203/12.

<sup>17</sup> European Court of Justice, Verdict of 29.4.2015, Case C-148/14

**Table 18: Greenhouse gas potentials**

Gas	Greenhouse gas potentials		
	Up to 2012	From 2013	Unit
N <sub>2</sub> O	310	298	t CO <sub>2(e)</sub> / t N <sub>2</sub> O
CF <sub>4</sub>	6,500	7,390	t CO <sub>2(e)</sub> / t CF <sub>4</sub>
C <sub>2</sub> F <sub>6</sub>	9,200	12,200	t CO <sub>2(e)</sub> / t C <sub>2</sub> F <sub>6</sub>

## 19.2 The monitoring plan underlying the emissions report (“Überwachungsplan“ (Monitoring plan) form)

All relevant information on the monitoring plan is automatically displayed in the “Überwachungsplan“ (Monitoring plan) form under the heading “Angaben zum ausgewählten Überwachungsplan” (Data on selected monitoring plan), on which the emissions report is based. Changes in the monitoring plan in the reporting year may lead to the fact that the emission report content is based on more than one monitoring plan (see Section 19.3).

The operator shall enter the key data on other monitoring plans under the heading “Angaben zu weiteren verwendeten Überwachungsplänen“ (Data about further monitoring plans used). The necessary information in the fields (“Überwachungsplan ist gültig ab“ (Monitoring plan is valid from), “Versionsnummer“ (Version number) and “Letztes Änderungsdatum“ (Last modified) can be found in the “Deckblatt“ (covering page) of the relevant monitoring plan.

**Note for verifiers:** Verifiers must confirm the data on the monitoring plans used (see selection field “Angaben zu verwendeten Überwachungsplänen sind ...“ (Data on monitoring plans used are ...)). If the data are not correct, the reasons must be explained in the following field.

## 19.3 Mapping changes in tiers and/or the monitoring method during the reporting year

Changes in the monitoring plan during the reporting year may lead to the final emissions report being based on multiple monitoring plans. This will be the case when the tier or the monitoring methodology changes.

Changes in the tier of a parameter (source stream quantity or calculation factors) or other modifications of the monitoring methodology of a source stream are to be mapped by copying the source stream form concerned in the emissions report (see Section 3.2). Both the original and the copied form must be checked and, if necessary, corrected in all places in line with the respective method. Moreover, the validity period for each method must be manually adjusted in the fields “Gültig von“ (Valid from) and “Bis“ (Until) (see Section 20.1.1). In this way, it is obvious from the emissions report what quantities and calculation factors and at what accuracy level and what monitoring methodology have been reported for what period of the year.

Basically, the monitoring plan must be immediately adapted and submitted to DEHSt for approval if there are changes in the tiers and/or the monitoring methods (see Explanations on significant and non-significant modifications in Section 2.4) so that the emissions report is based on an approved monitoring plan.

### Example 1:

The calculation factors emission factor and net calorific value for the source stream of natural gas L, for which the respective standard value from the „DEHSt list“ had previously been applied, had been determined by individual analysis from 01.04.2013 onwards. To create an emissions report in FMS, the operator used the first monitoring plan, which applied standard values. Since the natural gas source stream form only displays the use of default values in this example, the source stream form stemming from the monitoring plan must be copied in the emissions report to reflect the new method. The “Ebene gem. ÜP“ (Tier according to MP) must be changed to tier 3 both for the emission factor and the lower calorific value in the copied form and “Analyse“ (Analysis) must be entered for the determination method. The operator must answer the question “Methode genehmigt?“ (Method approved?) with „Ja“ (Yes) if the change in method has already been approved by DEHSt.

The validity periods must be adjusted both on the original and the copied source stream forms (original source stream form: „valid from 01.01.2013“, „to 31.03.2013“; copied source stream form: „valid from 01.04.2013“ „to 31.12.2013“). Moreover, the source stream quantities, for which a standard value was used originally and which was analysed later, must be specified.

### Example 2:

This is a case where there is a change in the methodology, for example, when CO<sub>2</sub> emissions from a part of the installation's source streams of whose emissions had been calculated prior to 30.09.2013, have then been determined by continuous measurement since 01.10.2013. If the monitoring plan on which the emissions report is based, only contains the calculation method (i.e. source stream forms), both a "CO<sub>2</sub>-Messung" (CO<sub>2</sub> measurement) form must be created and completed and all relevant source stream forms for the corroborating calculation must be copied and adapted in the emissions report. The operator must answer the question "Methode genehmigt?" (Method approved?) with „No“ when DEHSt has not yet approved the continuous CO<sub>2</sub> measurement. The validity periods must be adjusted both in the original and the copied source stream forms and in the "CO<sub>2</sub>-Messung" (CO<sub>2</sub> measurement) form (original source stream form: „gültig von 01.01.2013“, „bis 30.09.2013“ (valid from 01.01.2013, to 30.09.2013); copied source stream forms for the corroborating calculation: „valid from 01.10.2013“ „to 31.12.2013“; and the newly created form "CO<sub>2</sub>-Messung" (CO<sub>2</sub> measurement): „valid from 01.10.2013“ „to 31.12.2013“).

## 19.4 Dealing with data gaps and nonconformities

If there are no or incomplete data or pieces of evidence for individual data (**Data gap/Evidence gap**), or a value has not been determined in accordance with the method specified in the approved monitoring plan (**Non-compliance**), the data must be estimated and corrected using appropriate analogies. The operator must carry out the estimation or correction and the verifiers must confirm it. Estimates and corrections must be done conservatively (see Art. 63 and 65 MRR), i.e. based on all available information, and it must be ensured that the determined CO<sub>2</sub> quantities are at a 95%<sup>18</sup> confidence level no lower than the actual CO<sub>2</sub> emissions (Art. 3 (19) MRR). If the verifiers conclude that the estimate is wrong because the principles indicated have not been adhered to, the operator must correct them in accordance with the verifiers' instructions. The individual case circumstances will determine the estimation or correction method to be chosen.

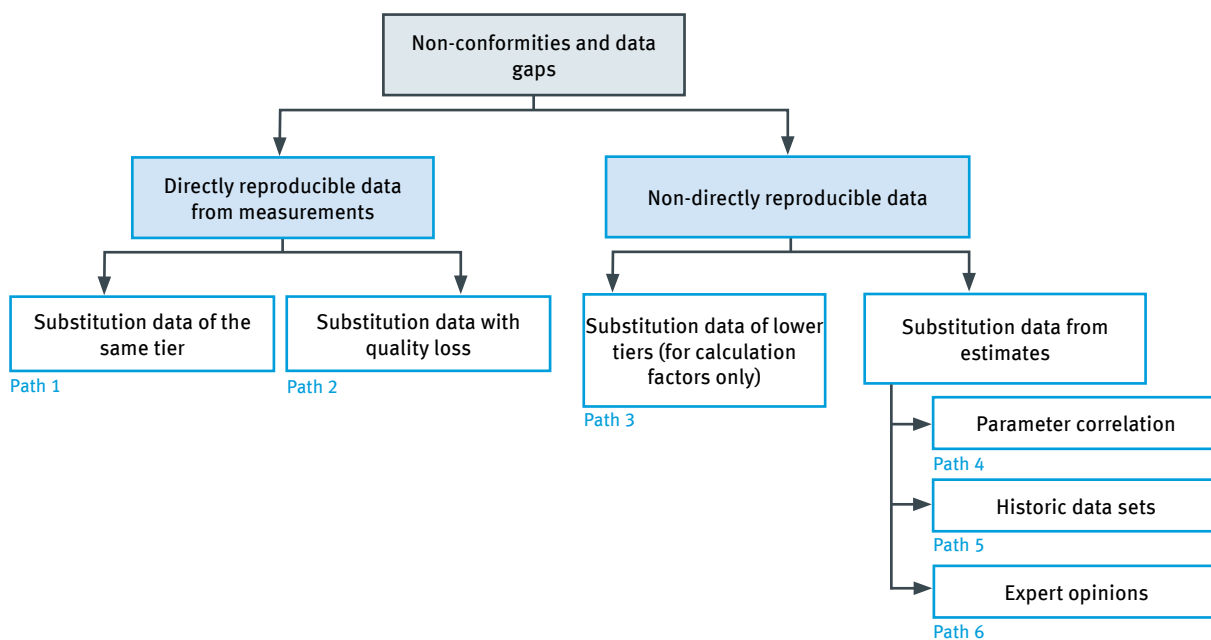
### Compliance with the approved tier is temporarily impossible:

If substitution data are available and the approved tier is met for the entire reporting year, no surcharge is required, even if the substitution values were individually determined at a lower tier than approved. The prerequisite is however that evidence is provided for compliance with the required uncertainty in view of the substitution method's uncertainty for the reporting year. In addition, the principles of MRR must be adhered to, i.e. in particular, the most accurate data must be used and systematic underestimations avoided.

The methods outlined below must be understood as aids for closing data gaps or for the correction of non-conformities. If the conditions described below are adhered to, it can be assumed that DEHSt accepts the method. The aid does not include closing data gaps for continuous emissions measurement. If this is needed, see chapter 9.4.1.

Once it is detected that data gaps or non-conformities are present, immediate and appropriate corrective actions must be initiated to ensure that emissions are determined again according to the approved monitoring plan as soon as possible.

<sup>18</sup> The 95% confidence level results from the requirement in Art. 3 (6) MRR.



**Figure 6: Methods for closing data gaps and correcting non-conformities**

If the accuracy loss cannot be quantified by the estimate or correction method, a surcharge shall be applied. In case of output components of the mass balance or in case of biomass fraction a subtraction is required (hereinafter, only the surcharge will be treated for reasons of clarity of the text). The operator must justify the extent of this surcharge by supplying adequate evidence.

Operators must comprehensibly explain their action in the emissions report for any case of data gap or non-conformity (in the boxes on page 2 in the source stream forms or page 2 in the "Zelltyp" (Cell type) form), under the heading "Angaben zu Datenlücken/Nichtkonformitäten oder nicht genehmigten Methoden" (Information on data gaps/non-conformities or non-approved methods):

- ▶ explaining the reasons for data gaps/non-conformity,
- ▶ describing the period (start and end dates, including time), in which data gaps/non-conformity occurred,
- ▶ specifying the emissions calculated based on substitute data and description of the method used for this purpose,
- ▶ explaining why the method used does not lead to an underestimation of emissions in that period.

If the method used to calculate the emissions from substitution data has already been described and approved in the monitoring plan, it need not be described again. However, all other information listed above must be shown in the emissions report.

**Note for verifiers:** If DEHSt has already approved the substitution method, the verifiers will check whether it has been applied in accordance with the monitoring plan. They will continue to check if the conditions for the application of the substitution method were actually given, the primary method could really not have been applied and what improvement options are available to avoid such failures in the future. If necessary, they must specify improvement options in their verification report, see Art. 27 (3) (p) AVR and Art. 30 MRR. If the substitution method has not yet been approved, the verifiers will check to ensure emissions cannot be underestimated in this way, see Art. (18) (1) MRR. If necessary, they can evaluate the emissions report with fully „satisfactory“ in this point.



### 19.4.1 Path 1: Directly reproducible substitute data of the same level

If missing or incorrect data can be replaced by data that have been determined by methods meeting the same tier, no surcharge is required.

**Table 19: Examples for Path 1**

Examples	
Source stream quantity	Calculation factors
A redundant measuring system provides data of the same tier. For example, a second verified scale is installed for the same material or fuel stream. This scale was in operation when the data gap occurred in the first verified scale.	Both the operator and the supplier have established procedures under Art. 32-35 MRR to have the carbon content of a source stream sampled and analysed by accredited laboratories. If the analyses commissioned by the operator are erroneous, the supplier's records can be used.

### 19.4.2 Path 2: Directly reproducible substitute data with quality loss

If missing or incorrect data can be replaced by data whose uncertainty is greater than the approved tier of the primary system, a surcharge is required if the approved tier for the reporting year as a whole can no longer be met.

When determining the quantity of a source stream by a measuring instrument, an uncertain determination method has to be assumed when the measuring instrument has not been calibrated in accordance with the monitoring plan, or no evidence exists that the test stand has an uncertainty of less than 1/3 of the required uncertainty for the calibrated measuring instrument.

MRR does not envisage uncertainty limits for the determination of calculation factors. However, this is associated with a higher uncertainty if, for example, the calculation factors have been determined by the in-house non-accredited analytical laboratory (instead of by an accredited laboratory) whose equivalence has not been proved as per Art. 34 (2) and (3) MRR.

The uncertainty of the substitution system can be determined in many cases. For source stream quantities, this can be done using an uncertainty analysis according to Section 6.1 (Case 2-1), by comparative studies with the primary system or by test stand verification before re-calibration of the primary system (Case 2-2).

The uncertainty for calculating factors can be determined by a comparative study with an accredited laboratory. In comparative studies, the deviation determined must be added to the substitution data (Case 2-2).

**Table 20: Determination of the surcharge to the substitution data in comparative studies**

Number of comparisons	Deviation type: Compared to the data of the primary system (without correction), the data of the secondary system would lead to an	
	overestimation of emissions in 95 % of the cases	Unterschätzung der Emissionen führen
1	No surcharge required	Difference of the comparative study
2-19	No surcharge required	Maximum difference of the comparative studies
≥20	No surcharge required or systematic error <sup>19</sup> must be subtracted and statistical error <sup>20</sup> must be added	Average of deviation plus its double standard deviation or the maximum difference

If the extent of deviation cannot be determined, a conservative surcharge of x% must be applied to the substitution data which has to be explained by the operator.

<sup>19</sup> The systematic error can be defined as the average of deviations.

<sup>20</sup> The statistical (random) error can be defined as the double standard deviation of differences.

**Case 2-1:** Substitution data with quantifiable higher uncertainty taken from uncertainty assesment.

$$D_r = S + S * (U_s - U_t)$$

with

$D_r$  = data for use in the emissions report

$S$  = substitution data with higher uncertainty

$U_s$  = quantifiable uncertainty [%] in the substitution system including corrective action

$U_t$  = uncertainty [%] of the approved tier of primary system

**Case 2-2:** Substitution data with quantifiable higher uncertainty taken from a comparative study

$$D_r = S + S * U_s$$

with

$D_r$  = data for use in the emissions report

$S$  = substitution data with higher uncertainty

$U_s$  = deviation determined [%]

**Case 2-3:** Substitution data with non-quantifiable higher uncertainty

$$D_r = S + S * x \%$$

with

$D_r$  = data for use in the emissions report

$S$  = substitution data with higher uncertainty

$x \%$  = surcharge to be individually justified by the operator

**Table 21: Examples of Path 2**

Examples	
Source stream quantity	Calculation Factors
<p>a) The verified measuring instrument fails with a maximum permissible error in service of 1 % fails, thus one has to fall back on a calibrated redundant measuring device with an uncertainty of 2% (uncertainty assessment according to Chapter 6.1.2 is available). The deviation of 0.5 % from the approved tier 4 (1.5 %) is used as a surcharge (Case 2-1).</p> <p>b) Corrective action must be taken since an inadmissible drift was identified in the calibration (Case 2-1), and the required tier has not been met.</p> <p>c) A secondary measuring device that measures data with lower accuracy (e.g. because it is not calibrated according to the requirements) was used to measure the same source stream and was being used when the data gap occurred in the primary measuring system (Case 2-2).</p>	<p>a) Corrective action must be carried out if a systematic error is identified and quantified, for example, analysis samples have been contaminated by the transport vessels. (Case 2-2)</p> <p>b) The in-house laboratory takes part in an inter-laboratory comparison. If the lab fails in this comparison, i.e. is not equivalent to an accredited laboratory, the deviation found is used as Us (Case 2-2).</p> <p>c) The results of an accredited laboratory are lost or found to be invalid. There are however, analysis results of regular control analyses available from the in-house, non-accredited laboratories (Case 2-2).</p>

### 19.4.3 Path 3: Substitution data of lower tiers that cannot be directly reproduced

This path is only applicable for calculation factors when missing values can be replaced with standard factors (usually tier 2 or tier 1). Default factors can stem from the following sources:

1. DEHS list, MRR or IPCC guidelines ([www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html](http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html))
2. Other literature values

The uncertainty of such standard factors varies with the source stream and is frequently mentioned in publications (Case 3-1). If no information is available on the uncertainty of the standard factors, a conservative surcharge of x % (to be justified by the operator) must be added to the substitution standard factor (Case 3-2).

#### Case 3-1: Substitution data from law, guidelines or literature

$$D_r = S + U_L \text{ or } D_r = S_U$$

with

$D_r$  = data for use in the emissions report

S = standard factor from law, guidelines or literature

$U_L$  = uncertainty that is identified by the source (law, guideline, literature)

$S_U$  = standard factor of law, guidelines or literature, in which the uncertainty is already taken into account.

#### Case 3-2: Substitution data from law, guidelines or literature, in which the indication of the uncertainty is missing.

$$D_r = S + x \% * S$$

with

$D_r$  = data for use in the emissions report

S = standard factor from law, guidelines or literature

x % = surcharge to be individually justified by the operator

**Table 22: Examples of Path 3**

Examples	
Source stream quantity	Calculation factors
Not applicable	A data gap that was caused by missing/invalid analyses is closed by a standard factor, taken for instance, from the IPCC guidelines, after it has been demonstrated that the standard factor is suitable as a substitute value (e.g. an appropriate value from guideline was used) (Case 3-1)

### 19.4.4 Path 4: Substitution data that cannot be directly reproduced, based on a correlation of parameters

Correlations may be used to derive substitution data for both quantity of a source stream and calculation factors. The quality of correlation is usually indicated by the correlation coefficient (a coefficient close to ± 1 indicates a high correlation). It should be noted however, that although a correlation coefficient close to ± 1 is an appropriate indication, there is no guarantee that the correlation function provides a suitable substitution value. For a correlation to apply at all, substitution data must be derived by a correlation function, collected in parallel with the primary system over a period of time before or after the data gap, and compared with the data of the primary system. The deviation between the collected substitution data and the data from the primary system is used to determine the standard deviation.<sup>21</sup> Twice the standard deviation is added to the substitution data (Case 4-1). If no parallel monitoring has been performed, the correlation can be assumed from scientifically proven facts (e.g. correlation between steam generation and fuel consumption in a thermal power station), and a conservative surcharge of x % (to be justified by the operator) must be added to the substitution value (Case 4-2).

#### Case 4-1: Installation-specific substitution data on the basis of correlation of parameters

$$D_r = S + 2 * \sigma$$

with

$D_r$  = data for use in the emissions report

S = substitution data derived from the correlation function

$\sigma$  = standard deviation determined from concurrent monitoring of parameters before or after the data gap

#### Case 4-2: Installation-specific substitution data based on scientifically proven correlation of parameters (a concurrent monitoring of the parameters has not taken place)

$$D_r = S + x \% * S$$

with

$D_r$  = data for use in the emissions report

S = substitution data derived from the correlation function

x % = surcharge to be individually justified by the operator

<sup>21</sup>  $s = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X})^2}$  with

s: empirical standard deviation; n: sample size (number of values);  $X_i$ : characteristics of the element i of the sample;

$\bar{X}$ : (mit Strich oben drauf auf dem X): arithmetic average of the sample

**Table 23: Examples of Path 4**

Examples	
Source stream quantity	Calculation Factors
<p>Source stream quantity show quantities exhibit a correlation to parameters which are usually also monitored at standard operating conditions and are not affected by the cause of the data gap. Correlation can frequently be found between:</p> <ul style="list-style-type: none"> <li>▶ Fuel consumption and output</li> <li>▶ Energy consumption and air temperature</li> </ul>	<p>Calculation factors show a correlation to parameters that are available at the time of the data gap. Correlation can frequently be found between:</p> <ul style="list-style-type: none"> <li>▶ Gross calorific value and net calorific value</li> <li>▶ Density and gross calorific value</li> <li>▶ Density and emission factor</li> </ul>

### 19.4.5 Path 5: Substitution data that cannot be directly reproduced based on historical records

This approach can be applied for source stream quantities and calculation factors. It must be applied to substitution data derived from long-term historical records when no other information is available to obtain substitution data. It must be demonstrated that the historical data for the operating conditions at the time of data gaps are representative and that the historical behaviour of the data provides an acceptable substitution value. Twice the standard deviation<sup>22</sup> of the historical data must be added to the average of these data.

To build a reliable substitution value from the statistics, at least twenty records must be available for use (Case 5-1a). The twenty records should be selected so that the period preferably before and after the data gap is covered or – if the installation was operated differently – the data are taken from a period when the installation was operated in the same way as at the time of the data gap. If there are less than 20 records available, the most conservative data (maximum or minimum value) is to be used as a substitution value (Case 5-1b), unless another substitution value can also be used to rule out an underestimation of the emissions.

If „exotic“ source streams are there, where no standard deviation can be derived from historical data, a conservative surcharge of x % (to be justified by the operator) must be added to the substitution value (Case 5-2).

**Case 5-1a:** Substitution data derived from the statistical behaviour of historical data

$$D_r = S + 2 \cdot \sigma$$

with

$D_r$  = data for use in the emissions report

$S$  = substitution data derived from the statistical behaviour of historical data (for example, average or trend value; if the data show a periodicity, it must first be checked if correlations are there, see Path 4)

$\sigma$  = standard deviation of the historical data

**Case 5-1b:** Installation-specific substitution data based on limited historical data (only or calculation factors)

$$D_r = S$$

with

$D_r$  = data for use in the emissions report

$S$  = maximum value of the analysis results (if there are less than twenty analysis results)

22  $s = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X})^2}$  with

$s$ : empirical standard deviation;  $n$ : sample size (number of values);  $X_i$ : characteristics of the element  $i$  of the sample;

$\bar{X}$ : (mit Strich oben drauf auf dem  $X$ ): arithmetic average of the sample

**Case 5-2:** Substitution data for source streams where no standard deviation can be derived from historical data

$$D_r = S + x\% * S$$

with

$D_r$  = data for use in the emissions report

$S$  = substitution value derived from the statistical behaviour of historical data

$x\%$  = surcharge to be individually justified by the operator

**Table 24: Examples of Path 5**

Examples	
Source stream quantity	Calculation factors
<p>a) A measuring device shows a malfunction for a given monitoring period, or there has been no measurement for several batches. However, historical results are available for the majority of the source stream quantity so that substitution data can be created by means of the statistical behaviour of historical measurement results (Case 5-1a).</p> <p>b) An installation will be shut down for regular summer maintenance. During this time, various ancillary equipment will be supplied with heating oil from a neighbouring installation (installation not subject to ETS). The quantity of heating oil is measured by a flow meter. Heating oil consumption during the shutdown of the installation is statistically the same as for normal operation. During a given period one failed to observe that the flow meter was not working and no other measurements were available (Case 5-2).</p>	<p>The carbon content of limestone from a mine is constantly rises during extraction. This is caused by different geological structures being mined layer by layer. The analysis of the limestone failed in some months. However, the increase in carbon content was observed before and after the data gap (Case 5-2).</p>

### 19.4.6 Path 6: Not directly reproducible substitution data based on expert opinions

In the event that none of the above-described five paths are applicable, substitution data should be derived using a combination of different methods, including expert opinions. It must – as in the other cases – be proven that the chosen procedure does not underestimate emissions. Path 6 should be used if the missing data is subject to fluctuations or cannot be anticipated, for example, in flaring off gases, fire in an installation or when the analysis results of a batch are missing and there are no representative values from historical analysis or literature. Such data gaps should be evaluated depending on the individual cases and conservatively closed.

**Table 25: Examples of Path 6**

Examples	
Source stream quantity	Calculation factors
<p>The source stream quantity when flaring off the source stream during an unplanned shutdown has not been determined. At this time, varying quantities were flaring off. Historical values of similar situations may be considered. However, potentially different operating conditions must be considered. For additional information, data should be obtained from other parts of the process.</p>	<p>See source stream quantity</p>



### 19.4.7 Description of the installation (“Anlage“ (Installation) form), information on the installation units and production (“Anlagenteil und Produktion“ (Installation unit and production) form)

The installation had already been identified and described in the monitoring plan. Therefore, most of the information listed on the „Anlage“ (Installation) form is taken from the selected monitoring plan and cannot be changed. Changes in the installation description can be entered in the „Ergänzende Erläuterungen“ (Supplementary Information) field under the heading „Eigenschaften der Anlage“ (Characteristics of the Installation).

Information regarding production is exclusively required from Annex 1 Part 2 Number 8 to 11 TEHG installations that are considered an amalgamation of installations according to § 24 TEHG. Products from the underlying monitoring plan are automatically accepted. Production volume data must be entered in the fields under the heading „Angaben zur Produktion“ (Production information) in the category „Anlagenteil und Produktion“ (Installation unit and production) has to be completed. Specifically, the net annual production volumes must be reported for each installation unit, see § 28 (1) (4b) TEHG i.c.w. § 29 (2) ZuV 2020.

**Note for verifiers:** Verifiers must confirm the accuracy and completeness of these data as well.

### 19.5 Data for describing the installation activity (“Berichtsanlagenteil“ (Activity specific reporting) form)



Activity specific reporting and its contents are automatically copied from the underlying monitoring plan and cannot be changed.

## 20 CO<sub>2</sub> Emissions Reporting

### 20.1 Fuel and material streams („Stoffstromformulare“ (Source stream forms) „Brennstoffstrom\_HW“ (Fuel stream\_CV), „Brennstoffstrom\_MV“ (Fuel stream\_MV) and „Materialstrom“ (Material stream))

All source streams of the underlying monitoring plan are included in the emissions report. If one of these source streams is not entered in the reporting period, the question „Wurde der Stoffstrom im Berichtszeitraum eingesetzt?“ (Was the source stream entered in the reporting period?) on Page 1 of the source stream form is to be answered „nein“ (no). Additional details on the source stream form are not necessary in this case.



#### 20.1.1 Information on the validity period

The fields „gültig von ...“; „bis ...“ (valid from ...; to ...) on the „Stoffstromformulare“ (Source stream forms) are generated automatically with the year for which the emissions report is filled out (e.g. reporting year 2013: „gültig von 01.01.2013“; „bis 31.12.2013“ (valid from 01.01.2013, to 31.12.2013). This applies for the source stream forms with „Herkunft: Überwachungsplan  „ (Origin: Monitoring plan  ) as well as for source stream forms that are copied by the operator or newly created.

If there are **modifications to the tiers and/or the monitoring methods** in the current reporting year for a parameter (substance quantity or calculation factors), this must be shown by a manual adjustment of the validity period on the appropriate form in the emissions report (cf. fields „gültig von“ (valid from) and „bis“ (to), cf. Section 19.3). If e.g. on 01.06. of the reporting year 2013 the monitoring methods for the calculation factors of a source stream are changed from default values to analysis, the relevant „Stoffstromformular“ (Source stream form) is to be copied. The period for the respective method is to be adjusted manually both on the original source stream form („gültig von 01.01.2013“; „bis 31.05.2013“ (valid from 01.01.2013, to 31.05.2013)) and on the copied source stream form („gültig von 01.06.2013“; „bis 31.12.2013“ (valid from 01.06.2013, to 31.12.2013)). The same applies if e.g. a source stream, that was previously determined with a belt scale that had complied with tier 3, is now determined with a belt scale that complies with tier 4.

#### 20.1.2 Information on source stream quantities and calculation factors

Page 2 of the „Stoffstromformular“ (Source stream form) presents in tabular form an overview of the information on substance quantity and the calculation factors of the source stream.



If the source stream form is identified with „Herkunft: Überwachungsplan  „ (Origin: Monitoring plan  ) (cf. Section 3.2), the tier provided in the monitoring plan (the tier in accordance with MP), the determination method (only relevant for calculation factors) and the data source (only relevant for calculation factors and the use of default values) are taken from the underlying monitoring plan and cannot be changed. Data that must be supplemented by the operator concern the following fields:

**Table 26: „Stoffstromformular“ (Source stream form), Page 2**

Form field	Detailed description
"Wert" (Value)	This field is for entering the substance quantity determined for the source stream and accordingly the respective value for the determined calculation factor. For substances with a biomass fraction > 0 % the „provisional emission factor“ (see Art. 3 (35) MRR), i.e. the overall emission factor (biomass fraction plus fossil share) is to be specified. With the use of standard factors from the DEHSt list or Annex VI MRR, this field is filled out automatically.
"Methode genehmigt?" (Method approved?)	If the applied method complies with the method approved in the monitoring plan, then „ja“ (yes) is to be selected from the selection list. „Nein“ (no) is to be selected if e.g. <ul style="list-style-type: none"> <li>▶ a new source stream is created that up to now is not included in the monitoring plan or for which no approval exists for its monitoring up to the time of submission of the emissions report.</li> <li>▶ a source stream is copied because as from a certain time in the reporting year another tier/ monitoring method is applied to it for which no approval yet exists.</li> </ul> In such cases the determination method is to be described in the fields under the heading „Angaben zu Datenlücken/Nichtkonformitäten oder nicht genehmigten Methoden“ (Information on data gaps/non-conformities or unapproved methods) at the end of Page 2.
"Handelt es sich um flüssige Biomasse oder Biokraftstoff?" (Does it involve liquid biomass or biofuel?)	For liquid biofuels, as from reporting year 2014 (i.e. as from 01.01.2014), sustainability must be demonstrated in accordance with Biomass Electricity Sustainability Ordinance (BioSt-NachV) (cf. §§ 3 and 13 emissions trade regulation; EHV). The question is to be answered „ja“ (yes) if the source stream involves a liquid biofuel (cf. Chapter 8.4). Substances without proof of sustainability will be treated as fossil fuels pursuant to BioSt-NachV.
"Anteil nachhaltiger Biomasse am Gesamtkohlenstoff [%]" (Proportion of sustainable biomass in total carbon [%])	This field becomes a required field if the question "Handelt es sich um flüssige Biomasse oder Biokraftstoff?" (Does it involve liquid biomass or biofuel?) is answered „ja“ (yes) If only a part of the biogenic carbon is sustainable, only this proportion of the total carbon may be entered in this field. The unsustainable biogenic share will be treated on the other hand as fossil carbon content. The calculation of the individual proportions is to be presented transparently in a document and appended as a separate file attachment to the „Stoffstromformular“ (Source stream form).

If the „Stoffstromformular“ (Source stream form) was created manually (through copy or new creation, cf. Section 3.2), in addition the following function can be used for material streams:

**Table 27: „Stoffstromformular“ (Source stream form), Page 2, other data source**

Form field	Detailed description
„Datenquelle“ (Data source) 	For material streams (cf. source stream form „Material stream“), another data source can be selected manually from the selection list for the emission factor and the net calorific value by first activating the checkbox. Subsequently, the source actually used for the determination of the calculation factor is to be selected from the selection list under „Datenquelle“ (Data source). If „Sonstiges“ (Other) is selected as data source, the data source used is to be explained in detail in the fields under the heading „Angaben zu Datenlücken/Nichtkonformitäten oder nicht genehmigten Methoden“ (Information on data gaps/non-conformities or unapproved methods) at the end of Page 2.
Wert (Value) 	Only in cases for which no default value appears for FMS for the approved data source (DEHSt list, MRR list) (e.g. use of a mixture from liquid gas (100 % propane) and liquid gas (100 % butane)), the checkbox must be activated manually in order to enter a value.

Since according to Art. 32 (3) MRR all analyses results shall only be used for the delivery period or the batch of the fuel or material, for which the representative samples were picked, it is essential to check that the calculation factors are weighted correctly. This means that the emission of the source stream must be identical to the sum of the CO<sub>2</sub> emissions of each (sub-) batch used.

Note: The emission factor is determined from the carbon content (C content), the factor 3.664 t CO<sub>2</sub>/t C and, if necessary, the calorific value (NCV). The conversions are given in the table below.

**Table 28: Conversion of calculation factors**

	C-content [t C/t] or [t C/1,000 Nm <sup>3</sup> ]	EF <sub>NCV related</sub> [t CO <sub>2</sub> /TJ]	EF <sub>mass-/volumen related</sub> [t CO <sub>2</sub> /t] or [t CO <sub>2</sub> /1,000 Nm <sup>3</sup> ]
C-content	-	$\frac{EF_{NCV\ related} * NCV}{3,664}$	$\frac{EF_{mass-/volumen\ related}}{3,664}$
EF <sub>NCV related</sub>	$\frac{C\text{-content} * 3,664}{NCV}$	-	$\frac{EF_{mass-/volumen\ related}}{NCV}$
EF <sub>mass-/volumen related</sub>	C-content*3,664	EF <sub>NCV related</sub> *NCV	-

For the calculation of the combustion emissions, the net calorific value (NCV) has to be determined as mass or volume based average for the respective reporting year:

$$NCV_{weighted} = \frac{\sum_i^n (NCV_i * x_i)}{\sum_i^n x_i}$$

With:

NCV<sub>weighted</sub>: weighted net calorific value for the reporting year

NCV<sub>i</sub>: net calorific value for batch i

x<sub>i</sub>: source stream quantity for batch i

The emission factor based on the net calorific value is determined as energy weighted average due to the requirement in Art. 24 MRR that the emission factor has to be determined consistent with the use of NCV:

$$EF_{weighted} = \frac{\sum_i^n (EF_i * NCV_i * x_i)}{\sum_i^n (NCV_i * x_i)}$$

If an operator is allowed to use a mass or volume based emission factor instead of a energy related emission factor for the combustion emissions (see chapter 7.3.1), the emissions factor has to be determined as mass- or volume weighted average. A mass- or volume weighted emission factor is also used for determining process emissions:

$$EF_{weighted} = \frac{\sum_i^n (EF_i * x_i)}{\sum_i^n x_i}$$

Special case: Since the net calorific value is often analyzed more frequently than the carbon content or the emission factor for process control reasons, attention must be paid to the correct weighting of the individual emission factors based on the net calorific value. It is recommended to carry out the weighting by taking the carbon content or the emission factor based on mass or volume. Below, the weighting through the carbon content is shown:

$$EF_{\text{weighted}} = \frac{\sum_k^n (\text{C-content}_k * x_k)}{NCV_{\text{weighted}} * \sum_k^n x_k} * 3,664$$

with

$EF_{\text{weighted}}$ : weighted emission factor for the reporting year

$\text{C-content}_k$ : carbon content for batch k

$x_k$ : source stream quantity of batch k

### 20.1.3 Information on continuous emission measurement

For those source streams for which emissions are measured continuously, separate „Stoffstromformulare“ (Source stream forms) must be created in the monitoring plan for the corroborating calculation. The reference to the respective source is taken automatically from the monitoring plan. If appropriate, further sources can be supplemented if a source stream is monitored for continuous emission measurements through further systems.

If a source stream is newly created or copied for the corroborating calculation, the measurement number is to be selected for which the corroborating calculation should be carried out. If applicable, more measurements can also be selected.

### 20.1.4 Information on acquisition of transferred substances

If the question „Handelte es sich um den Bezug von weitergeleitetem (inhärentem) CO<sub>2</sub>?“ (Is the acquisition of transferred (inherent) CO<sub>2</sub> involved?) is answered „ja“ (yes) on Page 1 of the „Stoffstromformular“ (Source stream form), information is to be added on Page 3.

In the „CO<sub>2</sub>-Menge (ggf. nach Abgleich mit weiterleitender Anlage)“ (CO<sub>2</sub> amount (if applicable after alignment with transferring installation)) field, the **total fossil CO<sub>2</sub> amount of the received source stream is to be specified (i.e. CO<sub>2</sub> calculated from the total carbon including inherent CO<sub>2</sub>)**. This has to be – in any case in relation 1:1 – identical to the information of the transferring installation to the transferred source stream according to Art. 48 MVO (cf. Section 20.6.1). This value in single cases can be different from CO<sub>2</sub>-amount, which respectively automatically calculated by transferring or receiving installation from the reporting activity rate and substance parameter on the page 2 of the source stream form and will be shown in the field “CO<sub>2</sub>-Emissionen” (CO<sub>2</sub>-Emissions). The CO<sub>2</sub> amount relevant to the transfer (in consideration of the conversion factor for material streams) is calculated automatically in the field with the same name on the basis of information in the fields

- ▶ „Inhärentes CO<sub>2</sub> abzugsfähig?“ (Inherent CO<sub>2</sub> subtractable?),
- ▶ „Menge des inhärenten fossilen CO<sub>2</sub> im bezogenen Stoffstrom [t CO<sub>2</sub>]“ (Amount of the inherent fossil CO<sub>2</sub> in the acquired source stream [t CO<sub>2</sub>]) and
- ▶ „CO<sub>2</sub>-Menge (ggf. nach Abgleich mit weiterleitender Anlage)“ (CO<sub>2</sub> amount (if applicable, after alignment with the transferring installation)).

If the CO<sub>2</sub> amount of the acquired substance is determined both by the transferring and the receiving installation, the values must be compared beforehand and, if applicable, adjusted pursuant to Art. 48 (3) MRR. The aligned fossil CO<sub>2</sub> amount to be entered without taking into account the CO<sub>2</sub> amount from biomass in the „CO<sub>2</sub>-Menge (ggf. nach Abgleich mit weiterleitender Anlage)“ (CO<sub>2</sub> amount (if applicable, after alignment with transferring installation)) field. If only one of the two installations measures the source stream, both installations must use the same measurement.

### Information if inherent fossil CO<sub>2</sub> in the acquired source stream is not subtractable

In most cases, CO<sub>2</sub> is transferred to an installation subject to compulsory emissions trading and it enters there as part of a fuel (e.g. waste gases from iron, steel and coke production: coking plant gas, blast furnace gas, converter gas). The receiving installation may not subtract the inherent CO<sub>2</sub> in the acquired fuel stream (question „Inhärentes CO<sub>2</sub> abzugsfähig?“ (Inherent CO<sub>2</sub> subtractable?) is answered „nein“ (no)). In such cases the „Menge des inhärenten fossilen CO<sub>2</sub> im bezogenen Stoffstrom [t CO<sub>2</sub>]“ (Amount of inherent fossil CO<sub>2</sub> in the acquired source stream [t CO<sub>2</sub>]) field can be filled out with „0“ because the receiving installation must report anyway on the total carbon of the acquired source stream and not only on the (inherent) CO<sub>2</sub> contained therein.

### Information if inherent fossil CO<sub>2</sub> in the acquired source stream is subtractable

Acquired (inherent) CO<sub>2</sub> is exceptionally subtractable (question „Inhärentes CO<sub>2</sub> abzugsfähig?“ (Inherent CO<sub>2</sub> subtractable?) is to be answered „ja“ (yes)) if the transferring installation, due to special regulations in accordance with No. 10 (lime), Number 14 (pulp and paper), No. 17 (ammonia) or No. 20 (soda and sodium bicarbonate) in Annex IV MRR, must already surrender emission allowances for the transferred CO<sub>2</sub>. Also subtractable is CO<sub>2</sub> acquired from another installation subject to emissions trading if it is entered in the receiving installation as material. In this case the transferring installation must surrender emission allowances for the transported CO<sub>2</sub>. In such cases the receiver must indicate the amount of CO<sub>2</sub> in the acquired source stream in the „Menge des inhärenten fossilen CO<sub>2</sub> im bezogenen Stoffstrom [t CO<sub>2</sub>]“ (Amount of inherent fossil CO<sub>2</sub> in the acquired source stream [t CO<sub>2</sub>]) field.



## 20.2 Carbon balances („Massenbilanz“ (Mass balance) form)

If the CO<sub>2</sub> emissions calculation is done totally or partially by means of mass balance, the explanations for the procedure for fuel and material streams (cf. Section 20.1) apply analogously. For transferring of (inherent) CO<sub>2</sub>, the instructions in Section 20.6.1 are to be observed.

**In the „Massenbilanz“ (Mass balance) form, values are to be entered exclusively as positive values. The sign of the mass balance element is set automatically through labelling of the mass balance element as „Input“ (Input) (+), „Produkte“ (Products) (-) or „Export“ (Export) (-).**

## 20.3 Continuous measurement of CO<sub>2</sub> („CO<sub>2</sub>-Messung“ (CO<sub>2</sub> measurement) form)

All continuous CO<sub>2</sub> measurements („CO<sub>2</sub>-Messung“ (CO<sub>2</sub> measurement) form) of the underlying monitoring plan will be undertaken in the emissions report. Likewise, those of the „Stoffstromformular“ (Source stream form) set up for the corroborating calculation will be undertaken from the monitoring plan.

If the CO<sub>2</sub> measurement (with „Herkunft: Überwachungsplan  „ (Origin: Monitoring plan  )) is not carried out in the reporting period, the question „Wurde die kont. Messung im Berichtszeitraum angewendet?“ (Was continuous measurement applied in the reporting period?) on Page 1 of the „CO<sub>2</sub>-Messung“ (CO<sub>2</sub> measurement) form is to be answered „nein“ (no). Likewise, on all „Stoffstromformulare“ (Source stream forms) taken from the monitoring plan for the corroborating calculation that make reference to this CO<sub>2</sub> measurement, the question on Page 1 „Wurde der Stoffstrom im Berichtszeitraum eingesetzt?“ (Was the source stream entered in the reporting period?) is to be answered „nein“ (no). Additional details on the „CO<sub>2</sub> measurement“ form and the source stream forms for corroborating calculation are thereby unnecessary.

However, for source streams, whose emissions originally (according to monitoring plan) were supposed to be determined by means of CO<sub>2</sub> measurement, a calculation of the emissions for the emissions report is to be provided now. This means that all relevant source stream forms newly created or those source stream forms taken automatically from the monitoring plan for the corroborating calculation are to be copied and the question „Wurde CO<sub>2</sub> aus diesem Stoffstrom durch kontinuierliche Messung erfasst?“ (Was CO<sub>2</sub> from this source stream determined by continuous measurement?) is to be answered „nein“ (no). **Copying the latter is required so that the information on the source stream forms is taken into account in the calculation of the total emissions of the installation** (information on source streams for the corroborating calculation do not feed into the calculation of the total emissions of the installation).



The direct emission of CO into the atmosphere is to be treated as the molar equivalent amount of CO<sub>2</sub>, i.e. the CO concentration is to be multiplied by the factor 1.571 t CO<sub>2</sub>/t CO and taken into account in the „CO<sub>2</sub>-Konzentration (gewichtetes Jahresmittel)“ (CO<sub>2</sub> concentration (weighted annual average)) field.

## 20.4 Information on the validity period

The instructions for the information on the validity period for fuel and material streams apply analogously for CO<sub>2</sub> measurements, i.e. the validity period is to be adjusted manually both for modifications to the tiers and for fundamental modifications – such as e.g. the fitting of a new sampling probe for continuous emission measurement – (cf. Section 20.1.1).

For the mapping of the modified tier/monitoring methods in the emissions report, a new „CO<sub>2</sub>-Messung“ (CO<sub>2</sub> measurement) form must be created. The copy function for forms is not available here.

## 20.5 Information on CO<sub>2</sub> measurement

If the „CO<sub>2</sub>-Messung“ (CO<sub>2</sub> measurement) form is marked „Herkunft: Überwachungsplan “, (Origin: Monitoring plan ) (cf. Section 3.2), the information for „Nummer der Quelle“ (Number of the source), „Beschreibung der Quelle“ (Description of the source) and the tier provided in the monitoring plan („Ebene gem. ÜP“ (Tier in accordance with MP“)) are taken from the underlying monitoring plan and cannot be changed. The answer to the question „Emissionen aus der Regeneration von Katalysatoren in Raffinerien?“ (Emissions from the regeneration of catalysts in refineries?) is also taken from the monitoring plan, but is however changeable. Data that must be supplemented by the operator concern the following fields:

**Table 29: „CO<sub>2</sub>-Messung“ (CO<sub>2</sub> measurement) form, Page 1, „Angaben zur Ermittlung der CO<sub>2</sub>-Emissionen aus der Quelle“ (Information on the determination of CO<sub>2</sub> emissions from the source)**

Form field	Detailed description
„Ergänzende Erläuterungen“ (Additional explanations)	It must be ensured that the measurement is properly carried out according to all the rules and that all maintenance work is carried out in a timely manner. Therefore, all instructions of the designated measuring point are supposed to be rendered here for maintenance, for calibration in conformity with QAL 2, for the annual surveillance test (AST) as well as for drift and precision controls in conformity with QAL 3 of EN 14181. If the size of the field is not sufficient for the explanations, a separate file is to be attached to the „CO <sub>2</sub> -Messung“ (CO <sub>2</sub> measurement) form.
„CO <sub>2</sub> -Konzentration (gewichtetes Jahresmittel) [kg CO <sub>2</sub> /1000 Nm <sup>3</sup> ]“ (CO <sub>2</sub> concentration (weighted annual average) [kg CO <sub>2</sub> /1000 Nm <sup>3</sup> ])	The hourly CO <sub>2</sub> concentration in the flue gas flow determined during operation of the installation, averaged over the reporting year. It is to be ensured that, in addition to the measured values, replacement values for missing hourly data (e.g. due to equipment failure) are also taken into account in this information.
„Abgasvolumen [1000 Nm <sup>3</sup> ]“ (Flue gas volume [1000 Nm <sup>3</sup> ])	The flue gas volume determined during the operation of the installation, totalled over the reporting year. Also for this information, if applicable, replacement values must be taken into account for missing measurement data.
„Biogener Anteil [%]“ (Biogenic share [%])	Ratio of the carbon originating from biomass to the total carbon content in percent. If information is supplied here that deviates from a biogenic share = 0 %, supporting documents appropriate for the emissions report are to be attached as separate file attachments to this „CO <sub>2</sub> -Messung“ (CO <sub>2</sub> measurement) form.



Form field	Detailed description
„Anrechenbarer Anteil der Biomasse am Gesamtkohlenstoff [%]“ (Chargeable proportion of biomass on total organic carbon [%])	For liquid biofuels, sustainability, pursuant to Biomass Electricity Sustainability Ordinance (BioSt-NachV), must be demonstrated from reporting year 2014 (i.e. from 01.01.2014) (cf. §§ 3 and 13 emissions trade regulation; EHV). From this time onwards, substances without proof of sustainability will be treated as fossil fuels in conformity with BioSt-NachV. The chargeable proportion of biomass on total organic carbon is to be entered in the field for the reporting year 2014. The calculation of this proportion is to be presented transparently in the above-mentioned document. For the reporting year 2013, the field is automatically filled in with the value from the „Biogener Anteil [%]“ (Biogenic share [%]) field and is disabled.
„Wie viele Stundenmittelwerte fehlen?“ (How many hourly average values are missing?)	The number of hours is to be entered for which, instead of the measurement results, other calculation methods were utilised. This information is to be taken from the evaluation computer/evaluation software.
„Abweichungen vom Überwachungsplan“ (Deviations from the monitoring plan)	All deviations from the monitoring plan and measures undertaken are to be explained in this field and, if applicable, in a supplementary document. In particular, the following information is necessary in accordance with Art. 45 (1) and 59 (2) (2) MRR: <ul style="list-style-type: none"> <li>▶ Method for the generation of replacement values for missing data</li> <li>▶ Explanation of the measures undertaken for reductions of downtime</li> <li>▶ Information if quality assurance measures in compliance with DIN EN 14181 (as e.g. QAL 3) were not carried out at scheduled intervals or were not properly carried out</li> <li>▶ Information if it was determined from quality assurance that the uncertainty of the CEMS (e.g. as a result of drift) was larger than the maximum allowed uncertainty (tier) according to the approved monitoring plan,</li> <li>▶ If applicable, corrections made on measurement data and measuring instruments</li> </ul>

CO<sub>2</sub> emissions from the source are automatically calculated through multiplication of the averaged hourly CO<sub>2</sub> concentration by the averaged hourly volumetric flow rates of flue gases and by subtracting the emission from the chargeable proportion of biomass. In variation from this, the CO<sub>2</sub> emissions from the regeneration of catalysts in refineries must be manually entered.

For the supporting calculation of CO<sub>2</sub> emissions, the information on the „Stoffstromformulare“ (Source stream forms) is to be added (cf. Section 20.1) so that the continuous measurement of CO<sub>2</sub> can be validated with a supporting calculation.

**Note for verifiers:** Not only is the operator’s reported information to be verified, but also – as for measuring instruments that determine activity data – whether the standards were properly implemented pursuant to Art. 42 MRR and those it mentions (including the other standards referred to there, e.g. EN ISO 14956). That is, the verifiers must check whether quality assurance was carried out at scheduled intervals within the scope of QAL3 and AST. They must moreover check whether deviations were determined by these quality assurance measures from the tier/maximum allowable uncertainty specified in the monitoring plan or from the calibration range identified in the QAL2 and, if applicable, whether corrective measures were taken for the restoration of the required quality. They must, if applicable, also explain how the operator treated data that were measured outside the specified limits of uncertainty or the calibration range. If the verifiers find that the operator had not implemented the provisions in the monitoring plan, in Art. 42 MRR and the standards referred to there in a compliant fashion, this must be pointed out in the verification report.

## 20.6 Transfer of CO<sub>2</sub>

### 20.6.1 Transfer mapping on the „Massenbilanz“ (Mass balance) form

The answer to the question „Handelte es sich um einen Stoff, der weitergeleitet wurde?“ (Does it involve a substance that was transferred?) on Page 1 of the „Massenbilanz“ (Mass balance) form specifies whether Page 4 of the „Weiterleitung von Stoffen“ (Transfer of substances) form must be filled out. If the substance is transferred, then the following fields are to be filled out on Page 4 of the form.

**Table 30: „Massenbilanz“ (Mass balance) form, Page 4, „Weiterleitung von Stoffen“ (Transfer of substances)**

Form field	Detailed description
„Menge“ (Quantity)	If the complete source stream is transferred, the quantity of substance indicated here corresponds to the quantity that is queried on Page 2 of the form in the „Wert“ („Value“) field on the line „Menge“ (Quantity). Otherwise, a specification differing from the quantity on Page 2 is to be accounted for here.
„C-Gehalt“ (C content)	If the complete source stream is transferred, then the C content of the substance indicated here corresponds to the C content that is queried in the „Wert“ (Value) field on the line „C-Gehalt“ (C content) on Page 2 of the form. Otherwise, a C content differing from the specification entered on Page 2 is to be accounted for here.
"Menge des inhärenten fossilen CO <sub>2</sub> im weitergeleiteten Stoffstrom [t CO <sub>2</sub> ]" (Amount of inherent fossil CO <sub>2</sub> in the transferred source stream [t CO <sub>2</sub> ])	The specification of the amount of inherent fossil CO <sub>2</sub> that is contained in the transferred source stream is necessary if it is not subtractable. In most cases, the inherent fossil CO <sub>2</sub> is subtractable because it is part of the fuel that is transferred to other installations subject to emissions trading (e.g. waste gases from iron, steel and coke production: coking plant gas, blast furnace gas, converter gas) and the transferring installation can subtract the total carbon contained in the transferred fuel stream (question „Inhärentes CO <sub>2</sub> abzugsfähig?“ (Inherent CO <sub>2</sub> subtractable?) is to be answered „ja“ (yes)). In these cases, the „Menge des inhärenten fossilen CO <sub>2</sub> im weitergeleiteten Stoffstrom [t CO <sub>2</sub> ]" (Amount of inherent fossil CO <sub>2</sub> in the transferred source stream [t CO <sub>2</sub> ]) field can be filled out with „0“ because the amount of inherent CO <sub>2</sub> is no longer relevant.
„Menge des inhärenten biogenen CO <sub>2</sub> im weitergeleiteten Stoffstrom [t CO <sub>2</sub> ]" (Amount of inherent biogenic CO <sub>2</sub> in the transferred source stream [t CO <sub>2</sub> ])	Specification of the amount of inherent biogenic CO <sub>2</sub> contained in the transferred source stream.
"Inhärentes CO <sub>2</sub> abzugsfähig?" (Inherent CO <sub>2</sub> subtractable?)	Only CO <sub>2</sub> that is transferred as part of a fuel to an installation subject to emissions trading is subtractable pursuant to Art. 48 MRR. Exceptions to this rule apply for transfers from installations in accordance with Annex IV MRR No. 10 (lime), No. 14 (pulp and paper), No. 17 (ammonia) or No. 20 (soda and sodium bicarbonate).
"CO <sub>2</sub> -Menge (ggf. nach Abgleich mit aufnehmender Anlage) [t CO <sub>2</sub> ]" (CO <sub>2</sub> amount (if applicable, after alignment with the receiving installation) [t CO <sub>2</sub> ])	The total fossil CO <sub>2</sub> amount of the transferred source stream is to be specified (i.e. CO <sub>2</sub> calculated from the total organic carbon including inherent CO <sub>2</sub> ). According to Art. 48 MRR, this must be identical to the transferred source stream specified by the receiving installation. It can differ from the CO <sub>2</sub> amount that is calculated automatically from the reported activity rate and the substance parameters on Page 2 of the „Stoffstromformular“ (Source stream form) and displayed in the „CO <sub>2</sub> -Emissionen“ (CO <sub>2</sub> emissions) field.

If the source stream is transferred to more than one other installation, each transfer to another installation is to be presented in a separate segment on Page 4. The sum of the subtractable CO<sub>2</sub> amounts over all transfers (segments) is automatically calculated in the field of the same name on top of Page 4 of the form.

### 20.6.2 Transfer mapping on the „CO<sub>2</sub>-Messung“ (CO<sub>2</sub> measurement“) form

The question „Diente diese kontinuierliche Emissionsmessung der Erfassung von weitergeleitetem CO<sub>2</sub> an andere Anlagen?“ (Does this continuous emission measurement apply to the determination of transferred CO<sub>2</sub> to other installations?) on Page 1 of the „CO<sub>2</sub>-Messung“ (CO<sub>2</sub> measurement) form specifies whether Page 2 of the „Weiterleitung von CO<sub>2</sub>“ (Transfer of CO<sub>2</sub>) form must be filled out. If this is the case, the following fields are to be filled out on Page 2 of the form:

**Table 31: „CO<sub>2</sub>-Messung“ (CO<sub>2</sub> measurement) form, Page 2, „Angaben zur Weiterleitung von CO<sub>2</sub>“ (Specification of CO<sub>2</sub> transfer)**

Form field	Detailed description
<p>„Menge des inhärenten fossilen CO<sub>2</sub> im weitergeleiteten Stoffstrom [t CO<sub>2</sub>]“ (Amount of inherent fossil CO<sub>2</sub> in the transferred source stream [t CO<sub>2</sub>])</p>	<p>Specification of the amount of inherent fossil CO<sub>2</sub> contained in the transferred source stream.</p>
<p>„Menge des inhärenten biogenen CO<sub>2</sub> im weitergeleiteten Stoffstrom [t CO<sub>2</sub>]“ (Amount of inherent biogenic CO<sub>2</sub> in the transferred source stream [t CO<sub>2</sub>])</p>	<p>Specification of the amount of inherent biogenic CO<sub>2</sub> contained in the transferred source stream.</p>
<p>„Abzugsfähige oder abgaberelevante CO<sub>2</sub>-Menge (ggf. nach Abgleich mit aufnehmender Anlage) [t CO<sub>2</sub>]“ (Subtractable CO<sub>2</sub> amount or that which is subject to surrendering (if applicable, after alignment with receiving installation) [t CO<sub>2</sub>])</p>	<p>The derivation of the subtractable CO<sub>2</sub> amount or that which is subject to surrendering is to be carried out in a separate document and provided with the emissions report.</p> <p>The following aspects are to be taken into account in the derivation of the subtractable CO<sub>2</sub> amount or that which is subject to surrendering:</p> <ul style="list-style-type: none"> <li>▶ Is the continuous emission measurement entered for the determination of only a part of the emissions from the installation (the other part is determined e.g. by the standard methodology) or for the determination of the complete emissions from the installation?</li> <li>▶ Do special regulations apply to the transferring installation regarding the transfer according to Annex IV MRR No. 10 (lime), No. 14 (pulp and paper), No. 17 (ammonia) or No. 20 (soda and sodium bicarbonate)?</li> <li>▶ Does the transfer take place to an installation subject to emissions trading or not subject to emissions trading?</li> </ul> <p><b>Examples:</b></p> <p>a) The CO<sub>2</sub> amount that is determined by continuous emission measurement and transferred is fed as positive input into the calculation of the installation's total emissions if the transferred CO<sub>2</sub> is not yet considered in the total emissions and is sent to an installation not subject to emissions trading. This is e.g. the case if the total emissions of the installation are determined by a separate continuous emission measurement -&gt; <b>Specification without a sign of the CO<sub>2</sub> amount that is subject to surrendering</b></p> <p>b) Subtractability applies if the transferred CO<sub>2</sub> amount is already considered in the total emissions of the installation and the transferred CO<sub>2</sub> is sent to an installation subject to emissions trading. This then applies e.g. if the total emissions of the installation are determined by a calculation method -&gt; <b>Specification of the subtractable CO<sub>2</sub> amount with a negative sign</b></p> <p>c) The following examples have no effects on the total emissions of the installation:</p> <ul style="list-style-type: none"> <li>▶ CO<sub>2</sub> is transferred in example (a) to an installation subject to emissions trading -&gt; <b>Specification of the CO<sub>2</sub> amount with „0“</b></li> <li>▶ CO<sub>2</sub> is transferred in example (b) to an installation not subject to emissions trading -&gt; <b>Specification of CO<sub>2</sub> amount with „0“</b></li> </ul> <p>d) For ammonia installations for which special regulations are provided regarding the transfer pursuant to No. 17 of Annex IV MRR, it is irrelevant whether the installation transfers to an installation subject to emissions trading or to one not subject to emissions trading. This installation must report on and surrender the inherent CO<sub>2</sub> amount transferred.</p>

## 20.7 Automatic calculation of the CO<sub>2</sub> emissions in the FMS

The following tables give an overview of which information on the „Stoffstromformulare“ (Source stream forms) and accordingly on the „CO<sub>2</sub>-Messung“ (CO<sub>2</sub> measurement) form is fed into the stored FMS calculation of the total emissions of the installation (provided the source stream was applied in the reporting year or the CO<sub>2</sub> measurement was used in the reporting year).

### Legend:

- ▶ **Measurement:** „Wurde CO<sub>2</sub> aus diesem Stoffstrom durch kontinuierliche Messung erfasst?“ (Was CO<sub>2</sub> from this source stream determined by continuous measurement?) on Page 1 of the „Stoffstromformular“ (Source stream form)
- ▶ **Acquisition:** „Handelt es sich um den Bezug von weitergeleitetem (inhärentem) CO<sub>2</sub>?“ (Does it involve the acquisition of transferred (inherent) CO<sub>2</sub>?) on Page 1 of the „Stoffstromformular“ (Source stream form)
- ▶ **Transfer:** „Handelt es sich um einen Stoff, der weitergeleitet wurde?“ (Does it involve a substance that was transferred?) on Page 1 of the „Stoffstromformular“ (Source stream form)
- ▶ **Transfer CO<sub>2</sub> measurement:** „Diente diese kontinuierliche Emissionsmessung der Erfassung von weitergeleitetem CO<sub>2</sub> an andere Anlagen?“ (Does this continuous emission measurement apply to the determination of transferred CO<sub>2</sub> to other installations?) on Page 1 of the „CO<sub>2</sub>-Messung“ (CO<sub>2</sub> measurement) form
- ▶ **EF:** Emission factor
- ▶ **NCV:** Net calorific value
- ▶ **OF:** Oxidation factor
- ▶ **CF:** Conversion factor
- ▶ **Bio:** Biomass fraction (ratio of biogenic carbon to the total organic carbon in per cent)

**Table 32: Calculation of the CO<sub>2</sub> emissions on the Source stream forms „Brennstoffstrom\_HW“ (Fuel stream\_CV), „Brennstoffstrom\_MV“ (Fuel stream\_MV), „Materialstrom“ (Material stream)**

1) fuel stream_CV 2) fuel stream_MV 3) material stream	Calculation of the CO <sub>2</sub> emissions
Measurement = no Acquisition = no	Page 2 of the „Stoffstromformular“ (Source stream form): 1) Quantity * EF * NCV * OF * (1-Bio/100) 2) Quantity * EF * OF * (1-Bio/100) 3) Quantity * EF * CF * (1-Bio/100)
Measurement = no Acquisition = yes	Page 3 of the „Stoffstromformular“ (Source stream form): Manually entered CO <sub>2</sub> amount in the field „CO <sub>2</sub> amount (if applicable, after alignment with transferring installation) [t CO <sub>2</sub> ]“ „minus“ inherent CO <sub>2</sub> (if inherent CO <sub>2</sub> is exceptionally subtractable for the recipient because the transferring installation must surrender it)
Measurement = yes	<i>The calculation of the CO<sub>2</sub> emissions is performed on the basis of information on the „CO<sub>2</sub>-Messung“ (CO<sub>2</sub> measurement) form. The information on the „Stoffstromformulare“ (Source stream forms) serve solely for the corroborating calculation.</i>

In the „Massenbilanz“ (Mass balance) form, values are to be entered exclusively as positive values. The sign of the mass balance element, which is fed into the calculation of the CO<sub>2</sub> emissions, is set automatically through labelling of the mass balance element as „Input“ (Input) (+), „Produkte“ (Products) (-) or „Export“ (Export) (-).

**Table 33: Calculation of the CO<sub>2</sub> emissions on the Source stream form „Massenbilanz“ (Mass balance)**



Mass balance	Calculation of the CO <sub>2</sub> emissions
Measurement = no Acquisition = no Transfer = no	Page 2 of mass balance: Quantity * C content * 3.664 * (1-Bio/100)

Mass balance	Calculation of the CO <sub>2</sub> emissions
Measurement = no Acquisition = no Transfer = yes	Page 4 of the „Massenbilanz“ (Mass balance) form (Transfer is output element with a negative sign): Manually entered CO <sub>2</sub> amount in the „CO <sub>2</sub> -Menge (ggf. nach Abgleich mit aufnehmender Anlage) [t CO <sub>2</sub> ]“ (CO <sub>2</sub> amount (if applicable, after alignment with receiving installation) [t CO <sub>2</sub> ]) field <b>„plus“</b> inherent CO <sub>2</sub> (if inherent CO <sub>2</sub> is not subtractable)
Measurement = no Acquisition = yes (Transfer is not possible in this case.)	Page 3 of the „Massenbilanz“ (Mass balance) form (acquisition is input element with a positive sign): Manually entered CO <sub>2</sub> amount in the „CO <sub>2</sub> -Menge (ggf. nach Abgleich mit weiterleitender Anlage) [t CO <sub>2</sub> ]“ (CO <sub>2</sub> amount (if applicable, after alignment with transferring installation) [t CO <sub>2</sub> ]) field <b>„minus“</b> inherent CO <sub>2</sub> (if inherent CO <sub>2</sub> is exceptionally subtractable for the recipient because the transferring installation must surrender it)
Measurement = yes	<i>The calculation of CO<sub>2</sub> emissions is performed on the basis of the information on the „CO<sub>2</sub>-Messung“ (CO<sub>2</sub> measurement) form. The information on the „Stoffstromformulare“ (Source stream forms) serves solely for the corroborating calculation.</i>

**Table 34: Calculation of the CO<sub>2</sub> emissions on the „CO<sub>2</sub>-Messung“ (CO<sub>2</sub> measurement) form**

CO <sub>2</sub> measurement	Calculation of the CO <sub>2</sub> emissions
Transfer CO <sub>2</sub> measurement = no	CO <sub>2</sub> concentration/1000 * waste gas volume * (1-Bio/100)
Transfer CO <sub>2</sub> measurement = yes	Page 3 of the „CO <sub>2</sub> -Messung“ (CO <sub>2</sub> measurement) form (a negative sign is then to be entered manually if the CO <sub>2</sub> amount of the total emissions of the installation is subtractable.): Manually entered CO <sub>2</sub> amount in the field „Abzugsfähige oder abgaberelevante CO <sub>2</sub> -Menge (ggf. nach Abgleich mit aufnehmender Anlage) [t CO <sub>2</sub> ]“ (Subtractable CO <sub>2</sub> amount or that which is subject to surrendering (if applicable, after alignment with the receiving installation) [t CO <sub>2</sub> ])

## 21 Reporting of N<sub>2</sub>O Emissions („N<sub>2</sub>O-Messung“ (N<sub>2</sub>O Measurement) Form)

For the reporting of N<sub>2</sub>O emissions from installations producing nitric acid, adipic acid and glyoxal or glyoxylic acid, the N<sub>2</sub>O measurement („N<sub>2</sub>O-Messung“ (N<sub>2</sub>O measurement) form) of the underlying monitoring plan is carried into the emission report and marked as „Herkunft: Überwachungsplan  „ (Origin: Monitoring plan  ) (cf. Section 3.2). For this, the specifications of „Nummer der Quelle“ (Source number), „Beschreibung der Quelle“ (Source description) and the tier provided in the monitoring plan („Ebene gem. ÜP“ (Tier according to MP)) are taken from the underlying monitoring plan and are not changeable. Data that must be supplemented by the operator concern the following fields:

**Table 35: „N<sub>2</sub>O-Messung“ (N<sub>2</sub>O measurement) form, Page 1, „Angaben zur Ermittlung der N<sub>2</sub>O-Emissionen aus der Quelle“ (Information on the determination of N<sub>2</sub>O emissions from the source)**


Form field	Detailed description
„Ergänzende Erläuterungen“ (Additional explanations)	It must be ensured that the measurement was carried out properly according to all the rules and all maintenance was performed in a timely manner. Therefore, all instructions made by the accredited measuring institution are supposed to be reproduced here for the indicated monitoring point for maintenance, for calibration pursuant to QAL 2, for the annual surveillance test (AST) as well as for drift and precision controls pursuant to QAL 3 of the EN 14181. If the size of the field is not sufficient for the explanations, a separate file is to be attached to the „N <sub>2</sub> O-Messung“ (N <sub>2</sub> O measurement) form.

Form field	Detailed description
„N <sub>2</sub> O -Konzentration (gewichtetes Jahresmittel) [kg N <sub>2</sub> O /1000 Nm <sup>3</sup> ]“ (N <sub>2</sub> O concentration (weighted annual average) [kg N <sub>2</sub> O /1000 Nm <sup>3</sup> ])	The hourly N <sub>2</sub> O concentration in the flue gas flow determined during operation of the installation, averaged over the reporting year. It is to be ensured that, in addition to the measured values, substitution values for missing hourly data (e.g. due to equipment failure) are also taken into account in this information.
„Abgasvolumen [1000 Nm <sup>3</sup> ]“ (Flue gas volume [1000 Nm <sup>3</sup> ])	The flue gas volume determined during the operation of the installation, totalled over the reporting year. If applicable, substitution values must also be taken into account for missing measurement data.
„Wie viele Stundenmittelwerte fehlen?“ (How many hourly average values are missing?)	The number of hours is to be entered for which, instead of the measurement results, other calculation methods were used. This information is to be taken from the evaluation computer/ evaluation software.
„Abweichungen vom Überwachungsplan „ (Deviations from the monitoring plan)	All deviations from the monitoring plan and measures undertaken are to be explained in this field and, if applicable, in a supplementary document. In particular, the following information is necessary in accordance with Art. 45 (1) and 59 (2) (2) MRR: <ul style="list-style-type: none"> <li>▶ Method for the generation of substitution values for missing data</li> <li>▶ Explanation of the measures undertaken for reductions in downtime</li> <li>▶ Information if quality assurance measures in compliance with DIN EN 14181 (as e.g. QAL 3) were not carried out at scheduled intervals or were not properly carried out</li> <li>▶ Information if it was determined from quality assurance that the uncertainty of the CEMS (e.g. as a result of drift) was larger than the maximum allowed uncertainty (tier) according to the approved monitoring plan,</li> <li>▶ If applicable, corrections made on measurement data and measuring instruments</li> </ul>

In addition, all emissions into the atmosphere are to be reported that result from unplanned operating conditions (identified in the FMS as „Ausfälle“ (**Failures**)). Therefore, the number of failures, the total duration of failures and the N<sub>2</sub>O emissions for each type of failure (catalyst failure, bursting disc breakage, exceedance of the measurement range) are to be accounted for on Page 2 of the „N<sub>2</sub>O-Messung“ (N<sub>2</sub>O measurement) form. If there are more types of failure, the specification of number of failures, the total duration of failures and the N<sub>2</sub>O emissions for each type of failure are also to be added. The calculations of emissions of the failures are to be attached to the emission report in supporting documents as a separate file attachment to this „N<sub>2</sub>O-Messung“ (N<sub>2</sub>O measurement) form.

**Note for verifiers:** Not only is the operator’s reported information to be verified, but also – as for measuring instruments that determine activity data – whether the standards were properly implemented pursuant to Art. 42 MRR and those it mentions (including the other standards referred to there, e.g. EN ISO 14956). That is, the verifiers must check whether quality assurance was carried out at scheduled intervals within the scope of QAL3 and AST. They must moreover check whether deviations were determined by these quality assurance measures from the tier/maximum allowable uncertainty specified in the monitoring plan or from the calibration range identified in the QAL2 and, if applicable, whether corrective measures were taken for the restoration of the required quality. They must, if applicable, also explain how the operator treated data that were measured outside the specified limits of uncertainty or the calibration range. If the verifiers find that the operator had not implemented the provisions in the monitoring plan, in Art. 42 MRR and the standards referred to there in a compliant way, this must be pointed out in the verification report.

## 22 Reporting PFC Emissions (“Zelltyp“ (Cell Type) Form)

All “Zelltyp“ (Cell type) forms of the underlying monitoring plan will be included in the emissions report and marked with ”Herkunft: Überwachungsplan “ (Origin: Monitoring Plan MP) (cf. Section 3.2). For this, the data to the “Zelltyp und Anode“ (Cell type and anode) and “Beschreibung des Zelltyps” (Description of the cell type) are taken from the underlying monitoring plan and cannot be changed.



If a cell type was not used in the reporting period, the question on page 1 of the source stream form „Wurde der Zelltyp im Berichtszeitraum eingesetzt?“ (Was the cell type used in the reporting period?) must be answered with “Nein“ (No). Thus no more information on the ”Zelltyp“ (Cell type) form is required.

Fields “gültig von ...“ (valid from ...)“ and “bis ...“ (to ..) on page 1 are automatically filled in with the year for which the emissions report is being created (for example, reporting year 2013: “gültig von 01.01.2013“, “bis 31.12.2013“ (valid from 01.01.2013“, „to 31.12.2013“)). If there are **changes in the tiers and/or the monitoring methods** for a parameter (production volume of aluminium or calculation factors) in the reporting period, e.g. from 01.06.2013, this must be shown in the emissions report. For this, a new “Zelltyp“ (Cell type) form must be created, on which the validity period for the amended tier/monitoring methodology is entered (for example, “gültig von 01.06.2013“, “bis 31.12.2013“ (valid from 01.06.2013, to 31.12.2013). The validity period must also be adjusted manually on the “Zelltyp“ (Cell type) form with the original tier/monitoring method (for example, “gültig von 01.01.2013“, ”bis 31.05.2013“ (valid from 01.01.2013, to 31.05.2013).

Operators must add following data on page 2 of the “Zelltyp“ (Cell type) form:

**Table 36: “Zelltyp“ (Cell type) form, page 2**

Form field	Detailed description
Value	The quantity of aluminium produced or the respective value for the calculation factor determined must be entered for the calculation of PFC emissions.
Method approved?	If the method used corresponds to the method approved in the monitoring plan, “Ja“ (Yes) must be chosen from the drop-down list. ”Nein“ (No) has to be selected if, for example, a measuring device was used for determining the quantity of aluminium produced from a certain time in the reporting year and that device met higher tier requirements which had not previously been included in the monitoring plan, or its approval was not yet available at the time of submitting the emissions report. In these cases, the determination method must be described in the fields under the heading “Angaben zu Datenlücken/Nichtkonformitäten oder nicht genehmigten Methoden“ (Information on data gaps/non-conformities or non-approved methods) at the end of page 2.

The average duration of anode effects has to be specified in seconds.

## 23 Verifiers

### 23.1 Preliminary remarks

As mentioned in the introduction, not only have emissions monitoring and reporting been regulated by MRR as a European regulation directly applicable to the third trading period, but AVR also uniformly regulates the verification of emissions reports by independent third parties (verifiers) across the EU for the 3<sup>rd</sup> trading period 2013 – 2020.

In conjunction with DIN EN ISO 14065 and DIN EN ISO/IEC 17011, AVR forms an uniform and comprehensive legal framework with regard to

- ▶ organisational, procedural and competence-based requirements for verifiers,
- ▶ procedures for the verification of emissions reports,
- ▶ requirements for the accreditation procedure (certification procedure) and supervision of verifiers,
- ▶ organisational and procedural requirements for accreditation bodies (certification offices),
- ▶ mutual recognition of accredited or certified verifiers within the European emissions trading system and
- ▶ cooperation and information exchange between emissions trading authorities and accreditation bodies or certification bodies.

## 23.2 Accredited / certified verifiers

The system of expert bodies announced by DEHSt as practiced in Germany in the first two trading periods had to be abandoned because of the Accreditation and Verification Regulation and Monitoring Regulation's new requirements.

Therefore, the annual emissions report to be submitted by 31 March at DEHSt must be verified in the third trading period in accordance with AVR, see Art. 67 (1) MRR. Only offices previously accredited or certified according to AVR are allowed to verify under §§ 5 (2), (21) TEHG, and verifiers commissioned by the operator must be specifically certified for the scope that covers the operator's emissions trading activity (Art. 43 and Art. 34 i.c.w. Annex I AVR).

The German Accreditation Body (DAkKS; [www.dakks.de](http://www.dakks.de)) is responsible for the accreditation of verifiers based in Germany, and only legal entities or companies can be accredited.

The Deutsche Akkreditierungs- und Zulassungsgesellschaft für Umweltgutachter mbH (German Accreditation and Approval Body for Environmental Experts) (DAU; [www.dau-bonn-gmbh.de](http://www.dau-bonn-gmbh.de)) is responsible for the certification of verifiers<sup>23</sup>. Individuals are identified as verifiers by being certified.

The above institutions can provide more information about accreditation and certification and the accredited or certified verifiers. They are also responsible for publishing a list of verifiers accredited and certified by them. In the third trading period, DEHSt will stop publishing a list of verifiers operating in Germany.

According to Art. 66 AVR, verifiers accredited or certified in another Member State may also verify emission reports in Germany. In this respect, DEHSt no longer requires special registration or notification.

## 23.3 Verification

Verifiers are expected to observe this entire guidance document including the specific notes about monitoring and reporting issues, some of which are specifically addressed to them in previous chapters.

AVR and DIN EN ISO 14065 extensively regulate the requirements for verifiers and the emissions reports verified by them. In addition, in agreement with the Member States, the European Commission's Directorate-General for Climate Action has published a number of guidance documents on its website to assist in the practical application of these rules. A deep understanding of the European guidelines is a prerequisite for accreditation. Below, reference is made to the explanations in the guidelines concerning verification. The guidance documents are not directly legally binding, but they contain information on best verification practice. The following guidelines have been published so far:

- ▶ General overview ([Explanatory Guidance Document No.1](#))
- ▶ Verification scope ([Key guidance note II.1 Objective and scope of verification](#))
- ▶ Risk analysis ([Key guidance note II.2 Verifier's risk analysis](#))
- ▶ Process analysis ([Key guidance note II.3 Process analysis](#))
- ▶ Random sampling ([Key guidance note II.4 Sampling](#))
- ▶ On-site audit ([Key guidance note II.5 on site visits concerning installations](#))
- ▶ Content of the verification report ([Key guidance note II.6 Verification report](#))
- ▶ Competence necessary for verifiers ([Key guidance note II.7 Verifiers competence](#))
- ▶ Relationship between AVR and EN ISO 14065 ([Key guidance note II.8 Relation between EN ISO 14065 and AVR](#))
- ▶ Determination of time allocation for verification ([Key guidance note II.12 Time allocation in verification](#))

Please note that more guidance documents will be published in the future.

<sup>23</sup> Note: At the time that this guideline was published, the commissioning of DAU with the task of a national certification body for verifiers pursuant to § 28 (4) TEHG i.c.w. § 8 (1) (1) EHV 2020 was not yet fully effective since the Cost Ordinance per § 8 (1) (2) EHV 2020 required for charging expenses and fees in connection with certification was not yet in force.

In addition, we would like to point out that an on-site audit according to Art. 21 AVV is mandatory with regard to the 2013 emissions report. Potential exceptions in the coming reporting years from the principle of on-site audit pursuant to Art. 31 AVR are described in the above-linked Guidelines of the European Commission for on-site audits.

## 23.4 Evaluation of the emission report and verification report

The audit's objective is to determine with reasonable certainty that an emissions report does not contain basic false data. To achieve this goal, the operator, on the verifiers' orders, must carefully correct all identified false data and non-conformities with the approved monitoring plan. The audit is concluded with a final assessment which must be clear and the report must be assessed as either „satisfactory“ (i.e. free of basic false data) or „unsatisfactory“. In exceptional cases, the assessment can be issued as „satisfactory with comments“.

It must be ensured that a „satisfactory“ or „satisfactory with comments“ assessment is only issued in circumstances where there is reasonable assurance of the absence of any basic false data. However, great care is recommended since not only are false data beyond the respective applicable false data threshold (Art. 23 AVR) considered „basic“, but also false data that may influence the evaluation of the report by DEHSt (Art. 3 No. 5 AVR). A report must also be assessed as „unsatisfactory“ if the verifiers conclude that, due to one or more uncorrected non-compliance(s), it cannot be excluded with sufficient certainty that the report does not contain basic false data (Art. 27 (1) sentence 2 lit. d AVR). The same applies if the verification's scope was too limited as to obtain sufficient certainty for the absence of basic false data (Art. 27 (1) sentence 2 lit. c i.c.w. Art. 28 AVR).

The assessment of an emissions report as „satisfactory with comments“ (also referred to as „qualified verifier's opinion), not to be confused with an assessment of the report as „unsatisfactory“ according to Art. 27 (1) sentence 2 lit. c) i.c.w. Art. 28 AVR), includes the statement that the emissions report contains no material misstatements which means that the emissions are not underestimated by the operator. The reason that has caused the verifiers to assess as “satisfactory with comment” can but must not be the operator's negligence. For example, a so-called non-significant modification of the monitoring plan (see chapter 2.4) which was notified in due time, but which has not yet been approved by the DEHSt, can lead to an assessment of the emissions report as „satisfactory with comments“. In this case, the qualified verifier's opinion results from the short time interval between the notification for the non-significant change in the monitoring plan and the deadline for the submission of the verified emissions report.

False data or non-conformities detected by the verifiers but not corrected by the operator (Art. 27 (3) (j) AVR) must be marked in the verification report in each case.

The final assessment of the emissions report required by Art. 27 (1) AVR and the actual verification report with the necessary elements as per Art. 27 (3) AVR are integrated into the FMS emissions reporting software, as already practiced in the first two trading periods. The scope, however, has increased. This in particular is due to the fact that the European Commission has published a verification report template representing minimum requirements that had to be observed in the templates used in Germany. Although some areas in the FMS structure differ from the European Commission's templates, the query fields were mapped so that the guidance document for the verification report linked under the previous item can be largely consulted when filling in the FMS fields.

The verification report must be complete, concise and transparent. If the templates are not large enough in certain aspects to accommodate the verifiers' comments, the verifiers are free to attach additional files. Please note, however, that FMS must be used as a priority. A complete export of the verification report to an attached document is not permitted.

## 23.5 Verification report specifics: verifier data about installation's operation (§ 22 ZuV 2020)

Operators who receive a free allocation for the third trading period are required by § 22 ZuV 2020 to monitor and report actual and planned changes in capacity, activity rates and in the installation's operation. The "Leitfaden Zuteilungsverfahren 2013-2020 – Teil 6 Kapazitätsverringerungen und Betriebseinstellungen" (Allocation Procedure Guideline 2013-2020 – Part 6 Capacity reductions and shutdowns) gives instructions for the correct preparation of the annual report about the operation, including the identification and notification of capacity reductions and shutdowns. Monitoring methods and procedures that can ensure a proper report according to § 22 ZuV 2020 are specified in the monitoring plan (see Section 12.4). The annual reports on operations according to § 22 ZuV 2020 and the immediate notification of substantial capacity reductions and shutdowns need not be verified separately.

In conjunction with emissions reporting, the verifiers shall check whether the procedures specified in the monitoring plan have been properly implemented according to Art. 17 (4) and Art. 27 (3) (o) AVR. In addition, the verifiers shall also check whether the operator has reported all actual and planned operational changes to DEHSt. The audit result is a part of the verification report for the emissions report and has to be entered into the "Verifizierung – Betrieb der Anlage (§22 ZuV 2020)" (Verification – operation of the installation (§22 ZuV 2020)) form. If deviations from the methods specified in the monitoring plan have been found or not all operational changes have been reported, the verifiers must explain these deviations.

## 23.6 Waiver of an on-site inspection pursuant to Art. 31 AVR

### 23.6.1 General

AVR extensively regulates the procedure verifiers are expected to implement to verify emission reports in the third trading period. The key regulations are summarised in Art. 6 to 33 AVR. The general overview of the Commission guidance about AVR (Section 3.2 in the [Explanatory Guidance Document No. 1](#)) provides an explanation for the specified verification steps. Optionally, however, verifiers also publish their explanations about the verification process and steps.

Basic verification activity on the site is a key feature of the procedure according to Art. 21 AVR. The term "on-site inspection" does not only include verification activities on the installation site such as technical site inspections, checking the system boundaries for monitoring or measuring devices used etc., but also includes random data sampling, inspection of original documents (e.g. vendor invoices) or interviews with the company's responsible staff.

Under certain circumstances, a number of the company's sites must be visited in verifying the emissions report for one of the operator's installations, for instance where the management do not have their offices on-site (also see Art. 21 (4), Art. 3 (13) AVR). If even only a part – e.g. checking the installation or the management offices – is waived in such a case, it is a (partial) waiver of the on-site inspection.

Art. 31 AVR allows on-site inspections to be waived under certain exceptional conditions set out in more detail in the Art.. This waiver must not be detrimental to the verification's reliability. According to Art. 31 AVR, it depends on the annual amount of greenhouse gas emitted by an installation whether the verifiers may independently decide if the waiver or an additional approval is required from the competent emissions trading authority, i.e. DEHSt:

- ▶ If it is an „Anlage mit geringen Emissionen“ (Low-emission installation) according to Art. 47 MRR (cf. Section 4.4), Art. 31 AVR authorises the verifiers to decide to waive the on-site audit independently. The waiver must be entered and briefly explained in the emissions report in the „Verifizierung – Übergreifende Vermerke“ (Verification – Cross-cutting comments) form under „Angaben zur Planung und Durchführung der Prüfung“ (Planning data and performing the inspection).
- ▶ If it is not a low-emission installation, a permit from DEHSt is also required. Again, the verifiers must first assess if waiver conditions apply and inform the operator. The operator must submit an application to waive an on-site inspection to the DEHSt.

In the following, the conditions referred to in Art. 31 AVR that must be fulfilled before the on-site inspection waiver is permitted (Section 23.6.2) is explained, then some notes are given about how to apply (Section 23.6.3).

## 23.6.2 Preconditions for a waiver

As for waiving the on-site inspection, Art. 31 (1) AVR must be observed. This standard specifies the requirements under which such a waiver is eligible. Art. 31 (1) AVR also refers to requirements by the European Commission under which emissions monitoring circumstances on-site inspection can be waived. The provisions of Art. 31 (1) AVR are described and briefly explained in Section 23.6.2.1.

In addition, Art. 31 (3) AVR must be observed. Even if the requirements in Art. 31 (1) AVR are met, an on-site inspection must be performed in the cases listed (see Section 23.6.2.2).

### 23.6.2.1 Positive conditions according to Art. 31 (1) AVR

A waiver is eligible according to Art. 31 (1) AVR if all conditions listed below are met:

- ▶ The verifiers have established in their risk analysis that no on-site inspection is needed to determine „reasonable certainty“ that the emissions report is not free from material misstatements. *Explanation: This criterion is of central importance. If the verifiers are convinced that the identified risks can only be met by an on-site inspection, it must be carried out. There is no obligation compelling the verifiers to waive the on-site inspection.*
- ▶ All information/documents can be remotely verified by the verifiers. *Explanation: The operator must enable the verifiers to appropriately perform the audit, e.g. by granting access to a virtual data room or handing over copies of the documents.*
- ▶ The requirements of the European Commission to waive on-site inspections are met. *Explanation: These specifications are already mentioned in the Commission’s guidance about on-site inspection ([Key guidance note II.5 on site visits concerning installations](#)) laid down in Chapter 3. Four criteria groups have been developed in it, which specify the monitoring and reporting circumstances where a waiver is eligible. These criteria groups I to IV. take into account the fact that an on-site inspection is the rule and a waiver may only be eligible in exceptional situations. The criteria are presented along with a brief explanation in Table 36. The following applies generally to the criteria:
 
  - ▶ All sub-criteria must be met, unless the word „or“ provides for options in individual cases.
  - ▶ The approved monitoring plan and adherence to it will decide whether the sub-criteria are met. This means that a waiver will not be eligible if monitoring/reporting is intended to deviate from the approved monitoring plan.*

**Table 37: European Commission guideline for the on-site inspection to be waived**

Criteria Group I (Only for installations A and B)	
Sub Criteria	Explanation
Natural gas as a fuel is monitored and reported.	The main fuel is natural gas.
Activity data are determined by the supplier on the basis of officially verified (or at least calibrated) measuring devices.	The requirements of the European Commission included the concept of "fiscal metering". From this, it is assumed that in Germany this refers mainly to officially verified measuring devices. Since the requirements of the Commission are formulated in a wider way, the use of calibrated measuring devices by the supplier will also be accepted, provided this method is permitted in the monitoring plan.
Standard factors are used for the calculation factors.	This means, for example, that in this case category B installations may only submit an application, provided that the monitoring plan exceptionally allowed reporting using standard factors (such as due to unreasonable costs). If the calculation factors are determined by sampling and analysis, this criteria will not be fulfilled.



### Criteria Group I (Only for installations A and B)

<p>The above-mentioned fuel can be added by one or more de-minimis source streams, provided that the de-minimis threshold according to Art. 19 MRR is not exceeded.</p>	<p>By this, the use of further fuels is possible, if these fuels are de-minimis source streams (e.g. for ignition and auxiliary firing or as back-up fuels). The de-minimis threshold according to Art. 19 MRR must not be exceeded by the additional cumulated fuels. It is also possible that solely non-gaseous de-minimis source streams are reported.</p>
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### Criteria Group IIb<sup>24</sup> (Only for installations with low emissions)

Sub Criteria	Explanation
<p>A single fuel that does not lead to process emissions is monitored and reported. In case of a solid fuel a direct firing without temporary storage has to take place. In case of a liquid or gaseous fuel a temporary storage may be carried out.</p>	<p>Criterion II contains no specific restriction on the type of the fuel. However, it is assumed that this criterion can be met mainly by installations using gaseous or liquid fuels, as solid fuels are often temporarily stored. Additionally, fuels are excluded where, (during its combustion for example,) a flue gas cleaning is necessary for removing sulphur oxides, as this generally leads to process emissions.</p> <p>One possibility is simply the combination of a major or minor fuel with at most, a de-minimis source stream e.g. for ignition/auxiliary firing or as a back-up fuel.</p>
<p>Activity data are determined by the operator himself or by the supplier (accounting data) based on officially verified or calibrated measuring devices. In case accounting data are used, stock changes of liquid or gaseous fuels – if applicable – have to be considered.</p>	<p>To determine the activity data, determination by officially verified or calibrated measuring devices must either be assigned to the supplier (see also explanation to criteria I) or to the operator himself of each installation. In case there is a temporary storage of liquid or gaseous fuel stock changes have to be considered.</p>
<p>Standard factors are used for the calculation factors.</p>	<p>Only the use of standard factors is permitted. Individual determination methods for calculation factors is not applicable.</p>
<p>The above-mentioned fuel can be added by one or more de-minimis source streams, provided that the de-minimis threshold according to Art. 19 MRR is not exceeded.</p>	<p>By this, the use of further fuels is possible, if these fuels are de-minimis source streams (e.g. for ignition and auxiliary firing or as back-up fuels). The de-minimis threshold according to Art. 19 MRR must not be exceeded by the additional cumulated fuels. It is also possible that solely non-gaseous de-minimis source streams are reported.</p>

### Criteria Group III<sup>24</sup>

Sub Criteria	Explanation
<p>This applies to an installation with no operating personnel on site, where data are measured remotely and transmitted directly to the central point where all data is collected, processed, managed and stored; thus one person is solely responsible for the complete data management and recording process.</p>	<p>Criterion III contains no restriction on fuels or installation categories. In this respect, under this criterion the risk analysis of the verifiers becomes of central importance. The verifiers must decide whether the verification of such an installation can be achieved waiving the site survey/ on-site audit yet with all „reasonable certainty“ regarding the absence of “material misstatements. Ultimately, this criterion supports an almost completely automated and properly controlled monitoring and reporting process and data flow from data source through to the emissions report by one person solely in charge. The criterion is not met, if only the management of the business processes in a company runs via corresponding software. Inherent and control risks must be low to meet this criterion.</p>

<sup>24</sup> Here, only the criteria group IIb is explained, as the criteria group IIa is not applicable for Germany. Prerequisite for criteria group IIb is the use of simplified monitoring plans according to Art. 13 MRR.



### Criteria Group III<sup>24</sup>

The measuring devices of the installation should already have been examined on-site by the operator or a laboratory in accordance with Art. 59 MRR and a signed and dated evidence (e.g. a date stamped photocopy of the certificate) from the operator confirming that no metrological or operational changes have been performed since that inspection.

The operator must provide the verifiers with appropriate evidence, as required by Art. 59 MRR, that the quality assurance of the control systems (Art. 58 MRR) has been properly conducted and the uncertainty requirements have been met and no changes have been/are performed after carrying out the quality assurance measures.

### Criteria Group IV

Conditions	Explanation
The installation is located in a remote/inaccessible area, has a high volume of identified data from the installation and these are transmitted directly to another location where they are processed, managed and stored in compliance with strict quality requirements.	Accordingly, the model for criterion III applies on a fundamental basis. The criterion was developed by the Commission especially for installations in offshore areas. On-Site-Inspections in these installations lead to an exceptionally high financial, time and safety-related costs. Because the location of an installation has little to do with the risk of whether a report could contain false data, the risk analysis provided by the verifiers is of central importance. For Germany there is no applications of this criterion.
The measuring devices of the installation should already have been examined on-site by the operator or a laboratory in accordance with Art. 59 MRR and a signed and dated evidence (e.g. a date stamped photocopy of the certificate) from the operator confirming that no metrological or operational changes have been performed since that inspection.	The operator must provide the verifiers with appropriate evidence that, as required by Art. 59 MRR, the quality assurance of the control systems (Art. 58 MRR) has been properly conducted and the uncertainty requirements have been met and no changes have been/are performed after carrying out the quality assurance measures.

**Important:** If during the verification process in subsequent inspection steps, the verifiers find risks that they need to respond to appropriately, an on-site inspection will have to be carried out even if the verifiers initially signalled that this could be waived. This also applies even if a DEHSt consent for waiving the on-site inspection has been already received. The verifiers must assess within their own responsibility during the inspection process, as to whether their findings trigger the need for additional inspection procedures. They carry the verification risk and, based on their expert assessment, must be able to judge whether material misstatements can be excluded with sufficient certainty.

#### 23.6.2.2 Negative preconditions pursuant to Art. 31 (3) AVR

Under Art. 31 (3) AVR an on-site inspection must always be carried out if

- ▶ it is the first time the verifiers examines the emissions report for that installation or
- ▶ no on-site inspection has been carried out for two consecutive years or
- ▶ the monitoring plan for the current reporting period compared with the previous reporting period has been substantially modified or would have needed to be changed.

#### 23.6.3 How to apply

As mentioned in Section 23.6.1, consent must be obtained from the DEHSt to waive any on-site inspection where the facilities are not considered to be low emission installations within the meaning of Art. 47 MRR. The operator of the concerned installation must submit the application. To make an application, the following indications have to be taken into account:

- ▶ If during the risk analysis, the verifiers find that the on-site inspection of an installation can be waived in accordance with Art. 31 AVR, then they should inform the operator.
- ▶ So long as the operator provides all the necessary documents for the verification and agreement is reached between the operator and the verifiers that an application to waive should be made as per Art. 31 AVR, the verifiers download and complete the „Declaration of the verifiers to waive an on-site inspection pursuant to Art. 31 (1) AVR“ from the DEHSt website.

- ▶ The form is then completed electronically by the verifiers and sent via the VPS as a qualified signed document to the operator. The verifiers specify the file number of the concerned installation in the subject field and add „Waiver of on-site inspection“. Please select „Allgemeine Anfrage“ (General Question) as the document type.
- ▶ The operator forwards the verifiers' message to the DEHSt. As it is only the operator that can make an application, he must enclose a short note to identify the installation that is subject to the application for the waiver. The operator's message is again sent as an electronically signed qualified document.

In addition, we ask to observe our general instructions in Section 17.3. „Virtual Post Office (VPS)“.

## 23.7 How to present indications for open misstatements and non-conformities as well as deviations from the MRR and recommendations for improvements in FMS

According to Art. 27 (2) j) and p), Art. 29 and Art. 30 AVR a verifier has to describe in his verification report open non-conformities (deviations from the approved monitoring plan) and misstatements as well as has to raise awareness to improvement possibilities. Moreover the verification report has to contain violations against the MRR discovered during the verification.

Concerning open non-conformities and recommendations for improvements, the following should be considered: According to Art. 69 (4) MRR, operators have to react on recommendations for improvements with the submission of an improvement report to DEHSt. In order to distinguish between recommendations, which can be solved between operator and verifier, and recommendations, for which an improvement report to DEHSt is reasonable, the verifier should document his recommendations in different fields in FMS:

Fields on the form „Verifizierung“ (verification) which indicate an obligation for submitting an improvement report to the operator are following:

- ▶ Page 4, field „Dabei handelt es sich um folgende Nichtkonformitäten mit dem genehmigten Überwachungsplan“ (These are following non-conformities with the approved monitoring plan)
- ▶ Page 2, field „Empfehlungen zur Verbesserung der Überwachung und Berichterstattung“ (recommendations for improvements of the monitoring and reporting)

The verifier should indicate recommendations for improvement of the monitoring method for parameters which are relevant for the determination of emissions in the field „Empfehlungen zur Verbesserung der Überwachung und Berichterstattung“ (recommendations for improvements of the monitoring and reporting). Example: „The uncertainty of the measuring instrument can be reduced and a higher tier could be reached through encapsulation of the measuring instrument (and thereby reducing the influence of the environment's temperature)“.

Recommendations for improvements, which refer to editorial changes or amendments of the monitoring plan, data collection and data processing or updating of procedures, e.g.

- ▶ „the version number should be incremented when updating the monitoring plan“,
- ▶ „the operator should pay attention to the compliance of the procedure for monitoring the analyses results“,
- ▶ „The procedure/method for data determination and data preparation for the emissions report has to be updated and regularly maintained“,

should be documented in following fields:

- ▶ Page 2, field „Erläuterung mit Blick auf die Vollständigkeit der Überwachung und Berichterstattung (zwingend, wenn Zweifel daran bestehen)“ (explanation concerning the completeness of monitoring and reporting (mandatory if verifier has doubts about this)) or in the field „Erläuterung mit Blick auf die Konsistenz von Überwachung und Berichterstattung (zwingend, wenn Zweifel daran bestehen)“ (explanation concerning the consistency of monitoring and reporting (mandatory if verifier has doubts about this)), or
- ▶ Page 4, field „Stellungnahme zur Risikobewertung und zum Qualitätssicherungssystem des Betreibers“ (statement on operator's risk assessment and quality assurance system).

Other requirements in the MRR referring to the monitoring plan should be marked as deviations from the MRR. Examples:

- ▶ “A procedure for monitoring the analyses results has to be established and maintained”,
  - ▶ “A procedure/method for data determination and preparation for the emissions reports has to be developed.
- These statements should be documented in following fields:

- ▶ “Erläuterungen, inwiefern die Vorgaben der Monitoring-Verordnung nicht eingehalten wurden“ (explanation how requirements of the MRR were not met)
- ▶ „Wurden Verstöße gegen die Monitoring-Verordnung im Emissionsbericht festgestellt, die vor Erstellung des Prüfberichtes nicht berichtet wurden?“ (Does the emissions report contain violations against the MRR?) and „Dabei handelt es sich um folgende Verstöße gegen die Monitoring-Verordnung“ (This concerns following violations against the MRR)

## 24 Activity-Specific Requirements

It should be noted that, in addition to industry-specific requirements described in this Chapter, the provisions described in the previous Chapters and the industry-specific requirements of Annex IV MRR must be adhered to.

The following instructions valid for all industries must be observed:

- ▶ All emissions from combustion must be assigned to the installation in which they occur, regardless of whether heat is transferred to another installation and regardless of whether a free allocation of emission allowances for the heat generated for the third trading period has taken place.
- ▶ Consistency requirement between allocation and reporting for standard factors, which was to be strictly observed in the 2<sup>nd</sup> trading period, no longer applies (cf. Chapter 2.2).
- ▶ Due to the revision of the table in Annex 1 Part 2 TEHG, some of the activities' numbers have changed and other activities have become subject to emissions trading and emissions reporting. A more detailed description of the newly recorded and modified activities are contained in the document “Anwendungsbereich des Treibhausgas-Emissionshandelsgesetzes (TEHG) für die Zuteilungsperiode 2013-2020: Hinweise der Deutschen Emissionshandelsstelle (DEHSt)“. (Scope of the Greenhouse Gas Emissions Trading Act (TEHG) for the 2013-2020 allocation period: information from the German Emissions Trading Authority (DEHSt), available in German). By granting the emissions permit, federal state authorities as specified by the Federal Immission Control Act decide as to what (i.e. which installations or activities) is to be monitored (cf. Chapter 2.3.1).
- ▶ The operator generally has the choice and possibility (with some exceptions) of combining different methods of determining the emissions from his installation (cf. Chapter 4.1).
- ▶ Even so-called “Zero-emission installations” are required to submit a monitoring plan (cf. Chapter 4.5).

### 24.1 Energy installations and fuel combustion emissions (Annex 1 Part 2 No 1 to 6 TEHG 2011)

#### Recorded activities

By revising the table in Annex 1 Part 2 TEHG, the scope of activities included in emissions trading has been expanded. Based on the new definition of combustion, combustion units fall within one installation under emission trading obligation regardless of the combustion's purpose.

#### Applicable methods

Emissions from all combustion processes are calculated according to Art. 24 MRR (see Chapter 4.1). The mass balance methodology is only permitted if fuels are monitored and reported together with other materials of another activity for which MRR allows the mass balance approach or if the combustion processes take place in gas processing terminals. In this case, the requirements of Annex II paragraph 3 MRR apply.

Emissions from flue gas scrubbing processes are calculated based on the carbonates used or gypsum produced (stoichiometric ratio of dry gypsum to CO<sub>2</sub>) (Art. 24 (2) MRR).

It should be noted that, when calculating the emissions from flares, emissions of all operating conditions, including emergency and inherent CO<sub>2</sub> must be recorded and reported pursuant to Art. 48 MRR.

## Deviations from general methodology provisions

For monitoring emissions from flares, Annex IV paragraph 1 D contains deviating tier requirements for the emission factor.

If, within the monitoring of emissions, the composition of flare gases is not determined analytically and the emissions factor is not able to be determined according to Annex IV paragraph 1 D MRR (tier 2b), then tier 1 has to be applied with a conservative reference emissions factor of 3,93 t CO<sub>2</sub>/1000Nm<sup>3</sup>. If the emissions factor of 3,93 t CO<sub>2</sub>/1000Nm<sup>3</sup> exceptionally is not conservative due to specific characteristics of the flare gases, then tier 1 cannot be approved. The operator then has to estimate an emissions factor as well as provide evidence to prove the estimated factor to be conservative. However, if an emissions factor of 3,93 t CO<sub>2</sub>/1000Nm<sup>3</sup> leads to exaggerated emissions, the operator has the opportunity to claim a lower emissions factor, as long as the value can be shown not to lead to an underestimation of emissions. For further information regarding monitoring of emissions from flares see Chapter 24.2.

## 24.2 Petroleum refineries (Annex 1 Part 2 No 7 TEHG 2011)

### Recorded activity

All CO<sub>2</sub> emissions from combustion and production processes in refineries that are covered by the emissions permit or alternatively by a separate TEHG permit according to § 4 (4) TEHG, will be monitored. Due to the revision of TEHG, the following should be observed from 2013:

- ▶ Installations as per Annex I Part 2 No 7 TEHG, together with installations operated by the same operator on the same site in a technical compound, qualify as a “Single installation”. Treatment as a “Single installation” should be considered in the preparation of the monitoring plan and the emissions reporting for the third trading period.

Emissions from chemical industry processes that are listed as a separate activity in Annex 1 Part 2 TEHG and specified for separate requirements in Annex IV MRR (e.g. ammonia installations) have to be reported according to the provisions contained therein. Unlike the above, emissions from hydrogen production units shall be determined according to Annex IV paragraph 2 MRR. Emissions from the production of bulk organic chemicals in a petroleum refinery shall also be determined according to Annex IV paragraph 2 MRR.

According to Chapter 12.2, an activity specific reporting has to be created for each process unit. An activity specific reporting must be created for each existing CWT process and other CO<sub>2</sub> sources.

### Applicable methods

According to Annex IV paragraph 2 MRR, emissions from combustion processes are reported according to Art. 24 and Annex IV paragraph 1 MRR using the standard methodology. For this, the provisions in Chapter 24.1 apply.

In cases where the use of an energy-related emission factor would cause unreasonable costs, a mass- or volume-related emission factor can be specified instead of a calorific-value-based emission factor (see Chapter 7.3.1) under Art. 36 MRR for the reporting of combustion processes. Notwithstanding this, emissions from flare activities and thermal or catalytic oxidation must always be determined using the mass- or volume-based emission factor.

It should be noted that emissions from fuels used for process input must be treated as combustion emissions in terms of the applicable monitoring and reporting methods, see Annex IV No 1 MRR. Exceptions to this rule are described below.

For monitoring emissions from flue gas scrubbing and monitoring of combustion and flaring emissions, see explanations in Chapter 24.1.

### Mass balance method

As before, emissions from heavy oil gasification and calcination can be determined based on mass balance according to Art. 25 of MRR. Unlike in the 2008-2012 Monitoring Guidelines, mass balance can also be applied for the entire refinery.

If emissions from combustion processes, scrubbing or flare emissions are determined by mass balance, separate monitoring of these emissions by a standard methodology (see Chapter 24.1) is not necessary. As to the accuracy requirements, the same thresholds are required for the mass balance as for coking plants according to Annex II of MRR (mass balance methodology). In determining whether an input or output stream can be classified as de-minimis or minor source stream, the explanations in 4.2 should be observed.

#### Regeneration of catalytic converters from cracking and reforming processes

Emissions from the regeneration of catalytic converters from cracking and reforming processes shall be determined by continuous emission measurement systems. All CO in the flue gas is accounted for as CO<sub>2</sub> using the mass relation:  $t\text{ CO}_2 = t\text{ CO} \times 1.571$ . According to Annex IV No 2 MRR, a mass balance, whereby the state and the composition of the input air and flue gases are taken into account, shall determine the flue gas stream. The instruments used must be tested according to the requirements in Chapter 9. The uncertainty of emission measurement results from the uncertainties of the individual measurements and the correction for temperature, pressure and humidity (see also Chapter 6.1). The uncertainty of emission measurements should be determined according to the provisions in Chapter 6.2. For reporting emissions from the regeneration of catalytic converters from cracking and reforming processes, the “CO<sub>2</sub>-Messungen” (CO<sub>2</sub> measurements) form must be created and the answer to the question “Emissionen aus Regenerationsvorgängen nach Anhang IV Nr. 2 Monitoring-VO?” (Emissions from regeneration processes according to Annex IV No 2 MRR?) must be „Ja” (Yes). For this determination type, unlike in Art. 46 MRR, no corroborating calculation is required (see also Chapter 9).

The determination of the annual emissions from the regeneration of catalytic converters from cracking and reforming processes is based on a mass balance, taking into account the CO<sub>2</sub>, CO, NO<sub>x</sub> and SO<sub>2</sub> contents in the flue gas from the regeneration and in the amount of air supplied in accordance with Art. 43 (5) a) MRR. In the subsequent processes, a complete conversion of CO to CO<sub>2</sub> is assumed:

$$E_{total,coke} = (a_{CO_2} + b_{CO}) \times V_{calc} \times \frac{44,01}{22,41 \times 1000}$$

$E_{total,coke}$  overall CO<sub>2</sub> emissions from coke burnout in t CO<sub>2</sub>

$V_{calc}$  calculated annual volume of the flue gas (converted into dry flue gas) in Nm<sup>3</sup>

$a_{CO_2}$  measured carbon dioxide content of dry flue gas in % by volume

$b_{CO}$  measured carbon monoxide content of dry flue gas in % by volume

#### **Formula 8: Determination of the amount of emissions from the regeneration of catalysts from cracking and reforming processes**

The flow rate of the flue gas is not usually measured, thus it must be calculated by a mass balance. In the regeneration, the coke-loaded catalyst is regenerated by an air supply and all combustible constituents are burned to CO<sub>2</sub>, CO, H<sub>2</sub>O and SO<sub>2</sub>. The calculation of the dry flue-gas volume has to be carried out via an inertgas massbalance, where the composition of the supply air and of the flue gas will be considered. Concerning the composition of the supply air all air and nitrogen feed-in (e.g. input of a seal gas in catalyst standpipe between regenerator and reactor) have to be considered:

$$V_{calc} = \frac{79,07 \times V_{air,dry} + 100 \times V_{nitrogen}}{100 - a_{CO_2} - b_{CO} - c_{O_2} - d_{NO_x} - e_{SO_2}}$$

$V_{air,dry}$  volume of dry air supplied in Nm<sup>3</sup>

$V_{nitrogen}$  volume of nitrogen supplied in Nm<sup>3</sup>

$a_{CO_2}$  measured carbon dioxide content of dry flue gas in % by volume

$b_{CO}$  measured carbon monoxide content of dry flue gas in % by volume

$c_{O_2}$  measured oxygen content of dry flue gas in % by volume

$d_{NOx}$  measured NOx content of dry flue gas in % by volume

$e_{SO_2}$  measured SO<sub>2</sub> content of dry flue gas in % by volume

### Formula 9: Calculation of dry flue gas volume

If NOx and SO<sub>2</sub> cannot be individually determined in the flue gas at reasonable cost, conservative values should be assumed. A prerequisite for the mass balance shown is that coke contains hardly any nitrogen compounds or they are converted into NOx (this is usually the case).

### Determination of the overall uncertainty of the emissions quantity with calculation example

Note: in this example it is assumed that the parts of other gases (e.g. O<sub>2</sub>, SO<sub>2</sub>, NOx) in the flue gas of the catalyst regenerator are negligible low. If this is not the case, those quantities have to be considered when determining the overall uncertainty.

The uncertainty for the overall emissions of the installation unfolds from the following three influencing parameters: inert gas quantity of the supply air and of the supply nitrogen, inert gas in flue gas and the greenhouse gas concentration in the flue gas (CO<sub>2</sub> and CO).

1. Step: determination of the uncertainty of the inert gas quantity of the supply air and supply nitrogen.

The measured air and nitrogen quantity will be corrected with respect to temperature, pressure and moisture. Table 37 represents associated uncertainties with these parameters.

**Table 38: Uncertainty associated with the correction of the volume measurement of the supply air and nitrogen**

	Uncertain variable	Relative uncertainty, $U_i$	Quantity
Air	$V_{air,overall}$	±2%	1 000 000 Nm <sup>3</sup>
	Temperature, T	±0.5%	
	Pressure, p	±0.5%	
	Moisture, m	±1.5%	
Nitrogen	$V_{nitrogen}$	±2%	1 000 Nm <sup>3</sup>
	Temperature, T	±0.5%	
	Pressure, p	±0.5%	
	Moisture, m	n.a. for nitrogen	

The uncertainty of the correction has to be calculated according to Section 6.2.2 (independent uncertainty in multiplication):

$$U_{V Air,dry} = \pm \sqrt{U_{V air overall}^2 + U_T^2 + U_p^2 + U_m^2}$$

$$= \pm 2.6\%$$

### Formula 10: Calculating the uncertainty associated with the correction of the volume measurement of dry air

$$U_{Vnitrogen} = \pm \sqrt{U_{Vnitrogen overall}^2 + U_T^2 + U_p^2}$$

$$= \pm 2.1\%$$

### Formula 11: Calculating the uncertainty associated with the correction of the volume measurement of nitrogen



For each measuring location for measuring air and nitrogen, uncertainties according to Formula 10 and Formula 11 have to be applied. The uncertainty for inert gas quantity from the sum of the supply air and supply nitrogen has to be determined according to calculation formula for independent uncertainties (see Section 6.2.1):

$$U_{V \text{ inert gas quantity}} = \pm \frac{\sqrt{(U_{V \text{ air,dry}} \times 0.7907 \times V_{\text{air,overall}})^2 + (U_{V \text{ nitrogen}} \times V_{\text{nitrogen}})^2}}{0.7907 \times V_{\text{air overall}} + V_{\text{nitrogen}}}$$

$$= \pm 2.6\%$$

**Formula 12: Calculation of the uncertainty of the supplied inert gas quantity**

2. Step: Determination of the uncertainty of the flue gas V<sub>calc</sub>

The flue gas quantity results from the relation of the inert gas quantity of the supply air and the inert gas part in the flue gas. For the determination of the inert gas part in the flue gas the CO<sub>2</sub>, SO<sub>2</sub>, O<sub>2</sub>- and NO<sub>x</sub>-concentrations are to be included. As it is mentioned above, it is assumed, that the parts from SO<sub>2</sub>, O<sub>2</sub> and NO<sub>x</sub> are low. Hence, only the influence of the CO<sub>2</sub> and CO concentration will be considered for the further examination. The uncertainties for CO<sub>2</sub>- and CO- concentrations results from the calibration of the measuring instruments (see Section 9.3).

**Table 39: Typical operation area, relative and absolute uncertainty**

Gas	Typical operation area of the measuring instrument, xi	Relative uncertainty, Ui	Absolute uncertainty, xi×Ui
CO <sub>2</sub>	16 Vol.-%	± 3 %	± 0,48 Vol.-%
CO	2 Vol.-%	± 3 %	± 0,06 Vol.-%

$$U_{\text{inert gas part in waste gas}} = \pm \frac{\sqrt{(U_{CO_2} \times x_{CO_2})^2 + (U_{CO} \times x_{CO})^2}}{100\% - x_{CO_2} + x_{CO}}$$

$$= \pm 0.6\%$$

**Formula 13: Calculation of the uncertainty<sup>25</sup> of the inert gas part in the flue gas**

The uncertainty of the flue gas results from independent uncertainty by multiplication (see Section 6.2.2):

$$U_{V \text{ calc}} = \pm \sqrt{U_{V \text{ inert gas quantity}}^2 + U_{\text{inert gas part in flue gas}}^2}$$

$$= \pm 2.7\%$$

**Formula 14: Calculation of the flue gas uncertainty**

3. Step: Determination of the uncertainty of the greenhouse gas concentration (CO<sub>2</sub>+CO)

The uncertainty for the greenhouse gas concentration results from the independent uncertainty in a sum (see Section 6.2.1):

25 Note: The formula to calculate the uncertainty is greatly simplified. It however gives comparable results as by application of the partial derivation. Correctly applied, the uncertainty components associated with the GHG CO<sub>2</sub> and CO in Formula 8 and Formula 9 should be considered at the same time.

$$U_{GHG} = \pm \sqrt{\frac{(U_{CO_2} \times x_{CO_2})^2 + (U_{CO} \times x_{CO})^2}{x_{CO_2} + x_{CO}}}$$

$$= \pm 2.7\%$$

**Formula 15: Calculation of the GHG concentration uncertainty<sup>26</sup>**

4. Step: Determination of the overall uncertainty

For the overall uncertainty the uncertainties of Step 2 and 3 have to be summarized according to the independent uncertainty in multiplication (see Section 6.2.2)

$$U_{E \text{ overall coke}} = \pm \sqrt{U_{V \text{ calc}}^2 + U_{GHG}^2}$$

$$= \pm 3.8\%$$

**Formula 16: Calculation of the uncertainty associated with the CO<sub>2</sub>-emissions**

Continuous emission measuring systems

Continuous emission measuring systems can also be used to monitor other CO<sub>2</sub> emission sources. Chapters 9 and 13.3 describe how continuous emission measuring systems are mapped in the FMS and what requirements must be fulfilled.

**Deviations from general methodology provisions**

Hydrogen producing systems

In contrast to the second trading period, calculation of CO<sub>2</sub> emissions from hydrogen production can no longer rely on the determination of flue gas from the PSA (Pressure Swing Adsorption) stage (tail gas) and its carbon content.

Emissions from hydrogen production are calculated based on the quantity of hydrocarbon used multiplied by the emission factor (expressed as t CO<sub>2</sub>/t feed). The following tiers are specified for the emission factor:

**Tier 1:** The operator shall use an ethane-based conservative reference value of 2.9 tonnes of CO<sub>2</sub> per tonne of processed input material. For this purpose the entry in the “Datenquelle” (Data source) field must be changed on page 3 of the “Materialstrom” (Material stream) form. This can be done by activating the field “vom Standard abweichen” (Deviation from standard) and selecting “Sonstiges” (Others) in the field “Datenquelle” (Data source). Then „EF = 2.9 t/t according to Annex IV No 2 MRR“ must be entered in the field “Beschreibung der Datenquelle oder Ermittlungsmethode“ (Description of data source or calculation method). Unlike the general rules set out in Annex II MRR, no national standard factors can be used.

**Tier 2:** The operator must use an activity-specific emission factor as a basis, determined according to Art. 32 to 35 MRR (see Chapter 7.2).

**Other particularities**

Claus plant

Emissions due to the use of acid gases in the Claus plant must be reported in accordance with Chapter 24.1. If the composition of the Claus feed gas has not been analysed, the composition must be estimated. Reinhardt and Heisel (1999)<sup>27</sup> suggest the following values as a basis for estimating the composition and emission factor:

- ▶ CO<sub>2</sub> concentration: 23.9 % by volume,

<sup>26</sup> Note: The formula to calculate the uncertainty is greatly simplified. It however gives comparable results as by application of the partial derivation. Correctly applied, the uncertainty components associated with the GHG CO<sub>2</sub> and CO in Formula 8 and Formula 9 should be considered at the same time.

<sup>27</sup> H. J. Reinhardt and M. Heisel (1999): Leistungssteigerung von Clausanlagen durch den Einsatz von Sauerstoff (Performance improvement of Claus plants using oxygen), Berichte aus Technik und Wissenschaft, Vol. 87, p. 18-24

- ▶ hydrocarbon concentration (conservative as propane): 0.036 % by volume and
- ▶ volume-based emission factor<sup>28</sup>: 0.47 t/1000 Nm<sup>3</sup>.

Estimation methods may only be used to determine emissions from the use of acid gases in the Claus plant if the Claus feed gas is classified as a de-minimis source stream. If Claus feed gases from heavy oil gasification and other processing installations are used simultaneously, Claus feed gases must be declared as output (“export”) in the heavy oil gasification mass balance to avoid double counting.

### Flaring

Emissions from flaring are mapped in the “Brennstoffstrom\_MV (Brennstoffstrom, Emissionsfaktor masse-/vol. bezogen)” (Fuel source stream\_MV (fuel source stream, mass-/volume-based emission factor)) form. It must be ensured that emissions from both the use of pilot gases and flaring in start-up and shutdown processes, rinsing processes and in the case of breakdown of normal plant operation and suchlike shall be taken into account.

If the use of pilot gas has already been reported with the consumption rate of the fuel source stream used as pilot gas, it need not be declared separately as pilot gas. If the quantities flared must be estimated because of lacking measurements, the basis of the estimation shall be detailed in the monitoring plan. The estimation methods must ensure that

- ▶ the periods of flaring (flare events) shall be determined and recorded by applications in the monitoring system (for example at pressure monitoring measuring points at the suction side of the flare gas compressor, at pressure monitoring measuring points at the flare emission or at measuring points for valve position measurement in the flare gas system),
- ▶ flared quantities in normal operation and breakdown of normal operation in the installations connected to the flare gas system (e.g. flare loading during emergency relief of equipment or gas circuits) shall be sufficiently taken into account when determining the flared gas quantities to be allocated to individual flare events,
- ▶ a comparison with the annual report of flare loading to the immission control authority shall be made and
- ▶ information on flare loading from the operating documentation (e.g. flare logbook) shall be used.

If material and consumption parameters monitored by measurements are not available for the determination of flare emissions, flare events during the reporting period must be recorded in a flare logbook. The flare logbook should contain information about date, cause, period and flared gas data and a conservative estimate of the flared gas quantity.

If the flare gas composition has not been monitored analytically and the emission factor cannot be determined as per Annex IV No 1 D according to tier 2b<sup>29</sup> tier 1 with a reference emission factor of 3.93 t CO<sub>2</sub>/1000Nm<sup>3</sup> shall be applied.

<sup>28</sup>  $EF = 0.239 \times 44 \text{ [g/mol]} / 22.4 \text{ [l/mol]} + 3 \times 0.00036 \times 44 \text{ [g/mol]} / 22.4 \text{ [l/mol]} = 0.47 \text{ g/l} = 0.47 \text{ t/1000 Nm}^3$

<sup>29</sup> Tier 2b: Installation-specific emission factors can be calculated from an estimate for the molecular weight of the flare gas stream using process modeling based on industry-standard models. By considering the relative proportions and the molecular weights of the respective source streams, a weighted annual average value can be calculated for the molecular weight of the flare gas. Alternative: If individual flare events can be clearly attributed to various gas qualities (e.g. recycle gas, vaporised liquid gas, etc.), a weighted emission factor of the flare gas can be determined.

## FCC installations

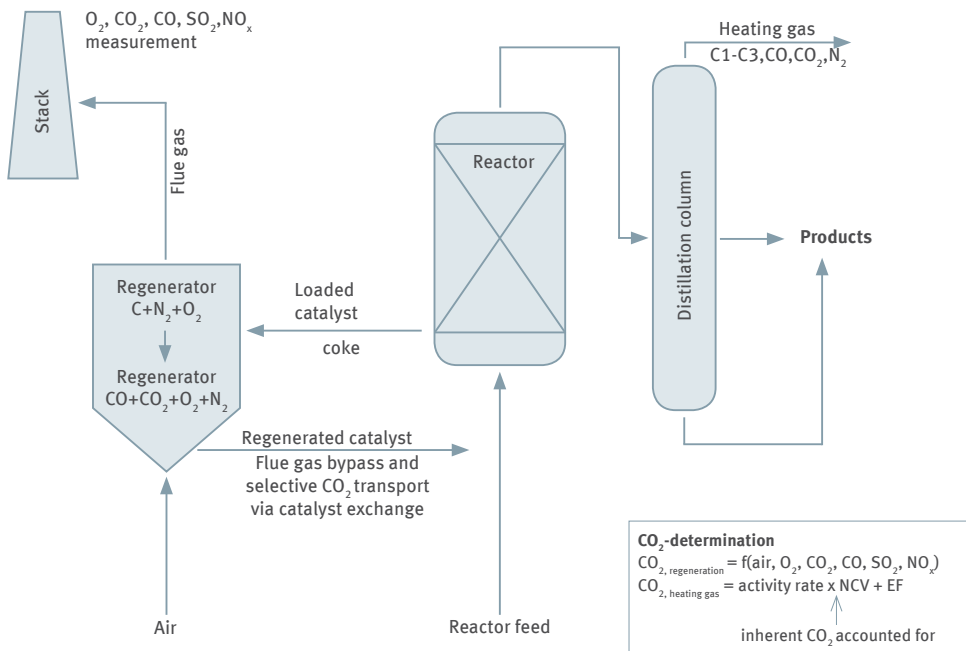


Figure 7: FCC installation scheme

CO<sub>2</sub> adsorbed on the activated catalyst and flue gas are supplied to the reactor by catalyst exchange between regenerator and reactor in FCC installations (see Figure 5). Not only can continuous emission measurement and mass balance during FCC regeneration record CO<sub>2</sub> emissions from the stack, but also CO<sub>2</sub> that is supplied into the reactor together with flue gas (bypass). However, continuous emission measurement fails to record the transfer of adsorbed CO<sub>2</sub>. Due to the bypass, crack gas volume (heating gas) produced during the reaction process is increased by the quantity of flue gas and CO<sub>2</sub> input from regeneration and, accordingly, N<sub>2</sub> and CO<sub>2</sub> ratios are changed in the heating gas. Release of inherent CO<sub>2</sub> in the heating gas during combustion must be taken into account in the emissions reporting, which may result in minor double counting (less than 1 % of the emissions from the FCC installation). To avoid double counting, the flue gas volume can be adjusted by the flue gas input into the reactor using a nitrogen balance in the heating gas. The quantity of nitrogen in the heating gas is composed of nitrogen from the reactor feed and that from the bypass. Using the conservative assumption that all nitrogen in the reactor feed appears in the heating gas, the flue gas volume can be calculated as follows:

$$V_{\text{calc}} = \frac{79.07}{100 - a_{\text{CO}_2} - b_{\text{CO}} - c_{\text{O}_2} - d_{\text{NO}_x} - e_{\text{SO}_2}} \cdot \left( V_{\text{air, dry}} - \frac{N_{2, \text{heating gas}} - N_{2, \text{feed}}}{1.25 \cdot 0.78} \right)$$

$N_{2, \text{heating gas}}$  determined nitrogen quantity in heating gas in kg  
 $N_{2, \text{feed determined}}$  nitrogen quantity in reactor feed in kg

**Formula 17: Calculating the amount quantity of dry gas of the FCC installation taking account of flue gas discharge**

## 24.3 Coke ovens, metal ore roasting and sintering installations, and pig iron and steel production and processing installations, and ferrous metal production or processing (Annex 1 Part 2 No 8 to 11 TEHG 2011)

### Recorded activities

Due to the revision of the table in Annex 1 Part 2 TEHG, activity numbers have been changed in the iron and steel sector and other activities have become subject to emissions trading and emissions reporting (cf. „Anwendungsbereich des Treibhausgas-Emissionshandelsgesetzes (TEHG) für die Zuteilungsperiode 2013-2020: Hinweise der Deutschen Emissionshandelsstelle (DEHSt)“. (Scope of the Greenhouse Gas Emissions Trading Act (TEHG) for the 2013-2020 allocation period: information from the German Emissions Trading Authority (DEHSt), available in German).

### Applicable methods

Installations in the iron and steel sector subject to emissions trading can continue to apply the mass balance method for monitoring the emissions in accordance with Annex IV No 3 to 6 MRR. Alternatively, the standard methodology can be used in accordance with Annex IV No 3 to 6 MRR – with the restrictions listed therein.

### Deviations from general methodology provisions

If the operator uses the mass balance approach, tier requirements specified in Annex II MRR to be applied.

For installations according to Annex IV No 5 MRR (Production of pig iron and steel) carbon content in tier 3 is specified as follows: “The operator shall derive the carbon content of input or output stream following Art. 32 to 35 in respect to the representative sampling of fuels, products and by-products, the determination of their carbon contents and biomass fraction. The operator shall base the carbon content of products or semi-finished products on annual analyses following Art. 32 to 35 or derive the carbon content from mid-range composition values as specified by relevant international or national standards.”

Alternatively, the operator calculates the carbon content of products or intermediates from composition averages as laid down in international or national standards. In this case, “Standardwert” (Standard factor) must be chosen for the carbon content under “Ermittlungsmethode” (Determination method) on page 4 of the relevant “Massenbilanz” (Mass balance) form in the FMS. Next to the field “Datenquelle” (Data source), the “vom Standard abweichen” (Deviation from standard) checkbox should be activated. Then the source actually used for carbon content determination should be selected from the list under „Datenquelle” (Data source) (or “Sons-tiges” (Others) if applicable). In the field “Beschreibung der Datenquelle oder Ermittlungsmethode” (Description of data source or determination method) below, the standards and calculation methods used should be explained.

### Other particularities

The particularities for the iron and steel installations originates from combining the installations into “Unified installations” under § 24 TEHG and from transferring blast furnace gases. In the case of “Unified installations”, the monitoring plan must include the installation boundaries in accordance with the notice of determination pursuant to § 24 TEHG.

If blast furnace gases (coke oven, blast furnace, converter gas) are delivered to one or more third-party installations, the operator must ensure that only those quantities of blast furnace gases are subtracted which indeed have left the balance boundary. Source streams within the installation are not subtractable. For this purpose, the provisions in Chapter 13.4 and 13.4.1 must be complied with. Transferring is recorded on the respective FMS mass balance form when mass balance is used (pages 7 to 9).

More information on the classification of source streams into major, minor and de-minimis can be found in Chapter 4.2.

When preparing the monitoring plan in the FMS, basically a new “Berichtsanlagenteil CO<sub>2</sub>” (CO<sub>2</sub> activity specific reporting) has to be created for each activity. For “Unified installations” according to § 24 TEHG, only one “Berichtsanlagenteil CO<sub>2</sub>” (CO<sub>2</sub> activity specific reporting) form must be created, to which the activity most characteristic for the “Unified installation” will be assigned according to Annex 1 Part 2 TEHG (cf. also Chapter 12.3).

In the emissions report for „Unified installations“ the form „Anlagenteil und Produktion“ (installation’s unit and production) will be created automatically, where the respective data will be taken from the monitoring plan. All sub-installations (e.g. Kokerei (coking plant), Sinteranlage (sintering plant), Hochofen (blast furnace), Konverter (converter), Warmwalzwerk (warm rolling facility), Kaltwalzwerk (cold rolling facility), see Chapter 12.2) should be mentioned within the monitoring plan. If in individual cases some installation’s unit are missing in the monitoring plan, it is possible to add relevant information after including another form „Anlagenteil und Produktion“ (installation’s unit and production) to the emissions report. The monitoring plan has to be updated then as well. For all sub-installations below the headline “Angaben zur Produktion“ (information on production) in the fields „Produktkategorie“ (production category), „Produkt“ (product), „Produktionsmenge“ (quantity of production) and „Einheit“ (unit) the following information has to be provided according to § 28 Abs. 1 Nr. 4b TEHG and § 29 Abs. 2 ZuV 2020:

- ▶ Product category of the installation’s unit (e.g. for installation’s unit production category „Warmwalzwerk“ (warm rolling facility) „Walzprodukte“ (rolled products)),
- ▶ All products (main products of the installation’s unit, e.g. for installation’s unit „Warmwalzwerk“ (warm rolling facility) products like „Lang- oder Flachprodukte“ (long or flat products)
- ▶ Respective quantities and units.

Extra lines needed can be added by pressing „+“ on the left on the form.

The method of receiving and transferring blast furnace gases (coking, furnace and converter gases) from and to ETS and non-ETS installations as well as respective deductibility within the emissions report is explained in Chapter 20.1.4 and 20.6.1.

## 24.4 Primary aluminium production installations (Annex 1 Part 2 No 12 TEHG 2011)

### Recorded activities

Separately approved anode production installations are attributed to the activity of primary aluminium production (Annex 1 No 12 TEHG) and their CO<sub>2</sub> emissions must be monitored according to Annex IV No 7 MRR<sup>30</sup>. The scope of Annex IV No 7 MRR explicitly includes separate electrode production installations for primary aluminium production. Emission monitoring for anode production is based on the mass balance methodology and includes all carbon in input materials, stocks, products and other exports in connection with mixing, forming, burning and recycling of electrodes.

## 24.5 Cement clinker Production installations (Annex 1 Part 2 No 14 TEHG 2011)

### Deviations from general methodology provisions

#### Secondary fuels with carbonate content

If secondary fuels with a carbonate content (e.g. paper-making residues) are used in the manufacturing process, this carbonate content must be specified as a process emission if Method A (input method) is used. When applying Method B (output method), the process-related proportions of carbonates are already included in the clinker factor and need not be determined. It should be noted that when Method B is used, the carbonate quantities should be subtracted from the total fuel quantity of the relevant secondary fuel.

#### Cement clinker

If the operator determines his calculation factors according to the “Berechnungsmethode B: Klinker-Output-Betrachtung” (Calculation method B: clinker output approach), the emission factor will be specified as the standard value of 0.525 t CO<sub>2</sub>/t clinker at tier 1.

<sup>30</sup> For Monitoring of PFC-Emissions cf. Chapter 15



### Emissions related to dust separation

For determination of emission factors for dust separation (CKD-, Bypassdust) tiers are defined in Annex IV (9c) MRR. According to this, the highest tier is tier 2 (individual analysis according to Art. 32 to 35 MRR). For tier 1 a standard factor of 0.525 t CO<sub>2</sub>/t dust is available.

### Emissions from non-carbonate carbon in raw meal

The total organic carbon (TOC) in raw material has to be analysed at least once a year or estimated conservatively. If the origin of the raw material is different (e.g. limestone from different mining regions), an annual analysis has to be done for every region when tier 2 is applied.

### **Other particularities**

#### Cement clinker quantity

The quantity of cement clinker can be determined by a recalculation from cement shipments, taking into account cement and cement clinker sales and purchases. In this case the monitoring plan must state how stocks of all cement and cement clinker with the corresponding uncertainty in level measurement are to be included in the calculation. Similarly, a suitable method for determining silo stocks and other stocks shall be set out in the monitoring plan. How the accuracy requirements can be achieved has to be explained.

#### Automated Analysers

Values provided by automated analysers can be used to determine the material parameters of raw meal if the qualifications of the institution supervising the automated analysers is proved (laboratory accredited according to EN ISO/IEC 17025 or equivalent company laboratory according to Art. 34 (3) MRR).

## **24.6 Installations that burn limestone, magnesite and dolomite (Annex 1 Part 2 No 15 TEHG 2011)**

### **Particularities:**

#### TOC in limestone

To monitor TOC levels in limestone, the rules according to Annex IV (9 d) MRR have to be applied analogous to cement clinker, meaning that installations of category B and C have to analyse TOC shares at least once a year. If limestone is extracted in different regions, it is necessary to analyse for each of those areas of extraction annually. For category A installations it is sufficient to submit one unique proof for the whole trading period if the area of extraction remains the same. If limestone is received from another region, category A installations have to analyse these quantities.

If a limestone installation uses method B (output) according to Annex II (4) MRR, the TOC quantity in the raw material has to be monitored and reported as a separate source stream. Annual analyses meet tier 2 MRR, unique analyses for the whole trading period correspond to tier 1. The procedure applied has to be included in the monitoring plan.

The identification threshold of proof for the carbon content is at 0.02 % (DIN EN 13639). If the TOC value is below the threshold of proof, it can be assumed that no organic carbon is included in the limestone and that there is no CO<sub>2</sub> emitted from this source. In the monitoring plan, the source stream has to be classified as “de-minimis” without any CO<sub>2</sub> emissions. If carbon content exceeds the identification threshold, CO<sub>2</sub> emissions can be determined by multiplying the measured percentage of TOC carbon content with the quantity of limestone used. The resulting quantity of carbon then has to be multiplied by a factor of 3.664 t CO<sub>2</sub>/t C. If a conversion from burnt lime to limestone is carried out, the conversion factor of 1.786 t limestone/burnt lime has to be applied.

#### Emission factors for burnt lime and dolomite as well as quantity correction

To determine emission factors for burnt lime and dolomite from analyses according to Annex II (4.3) MRR as well as to correct the standard unit of the received quantity according to § 22 ZuV 2020, it is possible to use the assistance linked in Annex 8

## 24.7 Installations for the production of ceramic products (Annex 1 Part 2 No 17 TEHG 2011)

### Applicable methods

For ceramic products made from purified or synthetic clay, the operator can use either Method A (input approach) or Method B (output approach). For ceramic products made of natural clay and clays or additives with a high organic content, Method A has to be applied.

### Other particularities

If materials with biomass carbon content (e.g. residues from the paper industry) are used, the described activities in Chapter 8.2 should be complied with.

Raw materials and additives that have a specific and distinct composition must be treated as separate source streams (separate FMS “Materialstrom” (Material stream) forms) in the monitoring plan (see Chapter 13.1).

For professional sampling of clay according to best practice, DIN 51061 Part 2: Testing of ceramic raw and finished materials - Sampling of ceramic raw materials“ shall be applied as guidance. DIN 51061 Part 2 contains provisions for the minimum mass of a single sample (Table 1). It has to be considered that specifications made in DIN 51061 Part 2 particularly, serve as a good quality indication of the sampling.

If several operating mixtures of various compositions are processed in an installation, then as a rule, separate determination of emission factors and separate sampling of the raw materials is required. This is especially true when substances with biomass carbon content are used (e.g. getters). Dealing with these substances, special guidelines such as the LAGA PN 98 (“Richtlinie für das Vorgehen bei physikalischen, chemischen und biologischen Untersuchungen im Zusammenhang mit der Verwertung/Beseitigung von Abfällen” (Guidelines for dealing with physical, chemical and biological tests in connection with waste recycling/disposal), see link in Annex 8) may be necessary as a basis for professional sampling.

For simplification it is possible for installations with low emissions to sum up waste used for porosity from the paper industry with a similar waste code number according to the Waste Catalogue Ordinance (Abfallverzeichnis-Verordnung, AVV, Annex to § 2(1)). This approach has to be confirmed and requires that determination of the quantity of substance as well as the weighted emission factor of the summarised source stream is well documented within the emissions report.

When preparing an aggregate sample from several individual samples it must be ensured that the processed source streams are adequately sampled. This means that a production-quantity-weighted aggregate sample must be prepared from the individual samples. This is the only way to guarantee that the aggregate sample, which has been analysed to determine the emission factor, exhibits the required representativeness.

As far sampling, storage and transport are concerned, the provisions of Chapter 7.2.2 should be observed.

More general information about the basic concepts of sampling, in particular the production of aggregate samples, sample sharing and storage can be found in the LAGA Guideline PN 98.

In cases where the raw clay activity data cannot be measured directly at the operator’s site because there are no weighing facilities, the raw clay quantity can be determined using back-calculation. The method for using back-calculation is shown in the linked document in Annex 8. The method for determining activity data must be described in the monitoring plan in sufficient detail.

## 24.8 Installations with N<sub>2</sub>O emissions (Production of nitric acid, adipic acid and glyoxal or glyoxylic acid) (Annex 1 Part 2 No 23 to 25 TEHG 2011)

### Applicable methods

The activities covered must report on both carbon dioxide (CO<sub>2</sub>) and nitrous oxide (N<sub>2</sub>O) emitted. Installations that do not emit CO<sub>2</sub>, must documents this (see below for requirements to installations which emit no CO<sub>2</sub> and/or N<sub>2</sub>O).

## Monitoring of CO<sub>2</sub> emissions

For the amount of CO<sub>2</sub> that originates from the combustion of fuels or the synthesis of products, the regulations for the production of basic organic chemicals are applicable (see Chapter 24.10).

Transferred CO<sub>2</sub> emissions have to be monitored by means of continuous emission measurement systems (see Chapter 13.4.2). In addition, operators are entitled to monitor all other CO<sub>2</sub> emissions for all emission sources of an installation using continuous emission measurement. For this purpose, the provisions in Chapter 9 and Chapter 13.3 must be observed.

## Monitoring of N<sub>2</sub>O emissions

Facilities that emit N<sub>2</sub>O must continuously measure these emissions in the flue gas. The requirements for continuous CO<sub>2</sub> emission measurement (see Chapter 9) are to be applied; with the difference, that for emission sources that emit more than 5,000 tonnes of CO<sub>2</sub>e per year or more than 10 % of the total annual emissions of an installation (whichever is greater) tier 3, the highest tier under Annex VIII MRR, has to be conformed and therefore a maximum uncertainty of 5 % must be achieved for N<sub>2</sub>O emissions.

Reference measurement methods in accordance with EN ISO 21258 (Stationary source emissions -- Determination of the mass concentration of dinitrogen monoxide (N<sub>2</sub>O) - Reference method: Non-dispersive infrared method) must be used to calibrate the continuous measuring systems for monitoring N<sub>2</sub>O emissions. The European Standard EN ISO 16911 (Stationary source emissions - Manual and automatic determination of velocity and volume flow rate in ducts) must be applied when calibrating the flue gas flow parameter.

## Other particularities

### **CO<sub>2</sub> and/or N<sub>2</sub>O are not produced at any point in the process, are not imported from other installations and are therefore not emitted**

In such cases, the requirements for installations subject to emissions trading but without emissions in Chapter 4.5 must be observed.

Note: In the FMS a “Berichtsanlagenteil CO<sub>2</sub>” (Activity specific reporting CO<sub>2</sub>) form is always automatically created. If there are no CO<sub>2</sub> emissions in the installation, “keine CO<sub>2</sub>-Emissionen” (No CO<sub>2</sub> emissions) must be entered in the field “Beschreibung des Berichtsanlagenteils” (Description of activity specific reporting) on this form. All other fields can be left blank.

### **N<sub>2</sub>O (e.g. in the combustion of ammonia), or CO<sub>2</sub> is produced, but processed further (e.g. as an oxidant, reactant)**

Because of the incomplete conversion of the emissions from these installations, some emissions should always be expected in these installations. Simplifications for monitoring those installations are eligible as long as the emissions do not exceed 5,000 t CO<sub>2</sub>e. Simplifications can be, for example, instead of continuous measurement, one single measurement of greenhouse gases within the waste gas is carried out (e.g. annually) and that this is referred to the quantity of waste gas from the installation.

## 24.9 Installations for the production of ammonia (Annex 1 Part 2 No 26 TEHG 2011)

### Applicable methods

For emissions from combustion processes the instructions in Chapter 24.1 must be observed. This also applies to the emissions from the use of fuels as process input, as these are considered combustion emissions in Annex IV No 1 MRR.

### Other particularities

Since hydrogen is produced as an intermediate product in ammonia installations, usually a large amount of CO<sub>2</sub> is produced this can be used for the production of other chemicals.

This CO<sub>2</sub> has been taken into account as an emission from the installation in the development of the product benchmark for ammonia for the 2020 allocation of the third trading period 2013-2020. Accordingly, Annex IV No 17 MRR stipulates that CO<sub>2</sub> from an ammonia installation, which is used for the production of urea or other chemicals, must be considered an emission from the ammonia installation. Transferred CO<sub>2</sub> which is not transported to a carbon capture facility for long-term storage, a transport network or a storage site, is also to be considered an emission from the ammonia plant (see Annex IV No 17 B MRR).

For monitoring emissions from flares, the requirements described in Chapter 24.2 for flares must be observed.

## 24.10 Installations for the production of basic organic chemicals (Annex 1 Part 2 No 27 TEHG 2011)

### Activities covered

It should be noted that monitoring of vinyl chloride monomers (from the chlorinated alkenes substance group) production installations also includes separately permitted installations for the production of their requisite intermediate ethylene dichloride (1,2-dichloroethane) product.

As an exception, if a plant for the production of basic organic chemicals is technically integrated in a petroleum refinery, the specific rules for refineries according to Annex IV No 2 MRR apply.

### Applicable methods

All emissions from combustion processes where the fuels used are not part of the chemical reaction for the production of basic organic chemicals and are not produced from such a reaction must be monitored based on the standard methodology in accordance with Art. 24 and Annex IV No 1 MRR. The instructions in Chapter 24.1 must be observed.

Generally, in all other cases the operator is free to choose between monitoring emissions with the mass balance methodology in accordance with Art. 25 and the standard methodology in accordance with Art. 24 MRR. However, if the standard methodology is used, the installation operator must demonstrate to the competent authority that the method chosen captures all relevant emissions that would have been recorded using the mass balance methodology.

### Deviations from general methodology provisions

For the determination of the carbon content of a substance in accordance with Tier 1 of Annex II No 3.1 MRR, values listed in Annex VI Table 5 MRR apply. If materials are used for which there are no values available from either this table or any other provisions, the operator calculates the carbon content of the source stream as the product of the carbon content of the pure substance and the proportion of this pure substance in the input or output stream.

### Other particularities

In the production of basic organic chemicals, especially in the partial oxidation of organic feedstocks, residual gases containing high loads of volatile organic compounds, carbon monoxide and carbon dioxide are often produced. Depending on technical conditions, monitoring of these residual gas streams may be performed using continuous emission monitoring systems. The corresponding requirements and specifications of the MRR for determination of emissions using CEMS are described in Chapter 9 of this Guidance.

In addition, some installations for the production of basic organic chemicals also produce CO<sub>2</sub> streams that are transferred to other installations as nearly pure gaseous CO<sub>2</sub>. In these cases, the requirements described in Chapter 13.4 of this Guidance are to be observed.

If within the monitoring of emissions from flares, the composition of the flare gas cannot be determined analytically, and if the emission factor is also not able to be determined according to Annex IV (1d) MRR (tier 2b), tier 1 has to be applied with the conservative reference emission factor of 3.93 t CO<sub>2</sub>/1000Nm<sup>3</sup>. If exceptionally, the factor of 3.93 t CO<sub>2</sub>/1000Nm<sup>3</sup> is not conservative due to specific characteristics of flare gases, tier 1 cannot be approved. The operator then has to propose an estimated emission factor as well as submit evidence that the estimation is conservative.

However, if it can be proved that the emission factor of 3.93 t CO<sub>2</sub>/1000 Nm<sup>3</sup> leads to exaggerated emissions, the operator has the opportunity to propose an estimated emission factor, if it can be assured that this is conservative and does not lead to an underestimation of emissions. For monitoring emissions from flares, the requirements described in Chapter 24.2 for flares must be observed.

## 24.11 Installation for the production of hydrogen and syngas (Annex 1 Part 2 No 28 TEHG 2011)

### Activities covered

Insofar as the production of hydrogen or syngas is a technical component of a petroleum refinery, the operator must observe the requirements for refineries in Chapter 24.2 of this Guidance. Otherwise, the following applies:

### Applicable methods

#### Requirements for monitoring emissions from the production of hydrogen:

For emissions from combustion processes, the requirements in Chapter 24 and 24.1 must be observed. This also applies to the emissions from the use of fuels as process input since these are considered combustion emissions under Annex IV No 1 MRR.

#### Requirements for monitoring emissions from the production of syngas:

Carbon from fuels used as process input can be found in syngas in the form of carbon monoxide. Therefore, the input-based reporting methodology used for the hydrogen installation is not suitable for showing the emissions of a syngas installation. For reporting the emissions that result from the use of fuels as process input, the operator must use the mass balance methodology under Art. 25 MRR. For the source streams shown in the mass balance, the operator must specify the activity data (incoming and outgoing quantities in the balance) and the respective carbon contents of the source streams. It is important to ensure that the syngas produced is taken into account as a source stream in the mass balance, so that the CO contained in the syngas is not counted as emissions from the installation. To convert 1 tonne of C to 1 tonne of CO<sub>2</sub>, multiply by 3.664 t CO<sub>2</sub> / t C.

For emissions from combustion processes, the operator has the choice to either integrate the emissions into the mass balance under Art. 25 or to show the emissions separately, using the standard methodology under Art. 24 MRR. However, he must ensure that all emissions are fully accounted for and avoid duplication.

If both syngas and hydrogen are produced in an installation, the operator has the freedom to choose whether he wants to record the emissions from the manufacturing processes with separate monitoring methodologies, using standard methodology and mass balance as described above, or create a joint mass balance.

### Deviations from general methodology provisions

#### Integrating combustion emissions into the mass balance in syngas plants:

If the activities performed in a syngas plant include the activities Nos. 1 to 6 under TEHG “Combustion of fuels”, and activity No 28 under TEHG “Production of syngas ...”, and the operator chooses the option to integrate the resulting combustion emissions into the mass balance, the following procedure in the FMS should be noted:

Only one activity under TEHG can be assigned to each activity specific report in the FMS. Therefore, the operator needs only create one activity specific report for CO<sub>2</sub> to which he assigns activity No 28 TEHG. In this activity specific report, the mass balance is shown according to the above MRR requirements, integrating the combustion emissions. The operator does not have to create an additional activity specific report for the “Verbrennung von Brennstoffen” (combustion of fuels) activity under TEHG.

#### Installations for the production of CO

Installations for the production of CO which are subject to emissions trading are considered syngas installations because at the very least, they produce syngas as an intermediate product according to the procedures referred to in Annex 1 Part 2 No 28 TEHG and exceed the production capacity specified therein. Accordingly, the same requirements as for „typical“ syngas plants apply.

This means that the emissions from the chemical process are shown in a mass balance with all relevant input and output streams, and that the operator has the choice of showing combustion emissions separately using the standard methodology, or integrated in the mass balance.

### **Other particularities**

If CO<sub>2</sub> is transferred as a part of a residual gas stream, the information in 13.4 must be noted.

For monitoring emissions from flares, the requirements described in Chapter 24.2 for flares must be observed.



## ANNEX 1: Comments on Sampling and Analysis for the Determination of Specific Fuel Data by Using Calculations

The comments below refer to:

- ▶ source streams for which calculation factors (e.g. calorific value, carbon content, biomass carbon content, emission factor) must be determined individually in accordance with Art. 32 to 35 MRR and for which no standard factors can be used, and
- ▶ waste fuels, for which the calculation factors must generally be determined individually.

If more strict requirements than those of the MRR apply to sampling and analysis by previously implemented procedures (e.g. because of the quality management system, the permit, or for billing purposes), they are also relevant for the preparation of the monitoring plans and the emissions reports.

Sampling to determine calculation factors should be performed in close temporal and spatial proximity to the determination of the consumption volume. If provisions for the sampling location and for determining the consumption volume have already been made for billing purposes, this data should be used for developing the sampling plan.

In principle individual samples from the same batch can be combined into an aggregate sample (composite sample), which will then serve as the starting sample for the analysis of calculation factors.

For example, if every heating oil delivery is sampled, the individual samples thus obtained can be combined into a composite sample. The analysis sample is then obtained from this composite sample by sample division. For the calculation factors determined thus, annual mean values weighted according to fuel consumption can be indicated in the emissions report. The derivation of annual mean values must be documented in the monitoring plan.

The standards referenced in Annexes 2 and 3 are not a complete list of all applicable standards. Applicable and binding are those standards - in accordance with the standards hierarchy of the MRR (see Art. 32 (1) MRR) - into the scope of which the respective fuel falls. Where appropriate, for certain substances (e.g. waste) for which no specific standards are available, existing standards with a comparable scope should be applied accordingly (e.g. analogous application of standards for natural gas to other gaseous fuels). In these cases, other regulations may be used (e.g. specifications in provisions to the Waste Management and Product Recycling Act (KrWG<sup>31</sup>)) if these are more appropriate in a particular case. This should then be clearly demonstrated by the operator in the monitoring plan.

The specific sampling plan must be approved by the competent authority before the beginning of the reporting period (see Art. 33 MRR and Chapter 7.2.2).

For determining the biogenic carbon content, special requirements in Art. 39 MRR (see Chapter 8.2) also apply.

<sup>31</sup> Gesetz zur Förderung der Kreislaufwirtschaft und Sicherung der umweltverträglichen Bewirtschaftung von Abfällen (Act for Promoting Closed Substance Cycle Waste Management and Ensuring Environmentally Compatible Waste Disposal)

## ANNEX 2: Requirements for Sampling

### Sampling gaseous fuels

Fuel	Parameter to be determined	Sampling			Sampling standards
		Method	Location	Frequency	
Natural gas	Net calorific value Carbon content	Verified measuring instruments of gas supplier (direct or indirect sampling)	Selected points in natural gas networks (e. g. supply points, transfer points)	According to contract situation, depending on the variation range of gas composition	DIN EN ISO 10715 (Sampling natural gas)
Other gaseous fuels (e.g. refinery gases, blast furnace gas)	Calorific value Carbon content Biomass fraction (biomass carbon content) if applicable	Analogous to natural gas (direct or indirect sampling)	Operator	Frequency to be determined individually depending on heterogeneity of fuel	Analogous to natural gas: DIN EN ISO 10715 (Sampling natural gas) DIN 51853 (Sampling fuel gases)

### Sampling liquid fuels

Fuel	Parameter to be determined	Sampling			Sampling standards
		Method	Location	Frequency	
Heating oil according to DIN 51603	Net calorific value	Mainly manual sampling	Mainly at producer, additionally at operator if applicable	Sampling each batch	DIN 51750 Part 1 to 3 (mineral oil sampling)
Other liquid fuels	Net calorific value Carbon content Biomass fraction (biomass carbon content), if applicable	Procedure analogous to heating oil (mainly manual sampling)	Supplier and/or operator	Frequency to be determined individually depending on fuel heterogeneity When supplied in specified quantities: single samples from each batch	Analogous to heating oil: DIN 51750 Part 1 to 3 (mineral oil sampling) Special regulations for sampling: e. g. Waste Oil Regulation, if applicable

### Sampling solid fuels

Fuel	Parameter to be determined	Sampling			Sampling standards
		Method	Location	Frequency	
coal/lignite and their refining products	Net calorific value Carbon content	Automatic or manual sampling	Supplier and/or operator	Sampling each batch; Number of individual samples depends on quantity delivered and type of sampling	ISO 13909 (coal and coke sampling) DIN 51701 (Solid fuel sampling)

Fuel	Parameter to be determined	Sampling			Sampling standards
		Method	Location	Frequency	
Other solid fuels	Net calorific value Carbon content Biomass fraction (biomass carbon content) if applicable	Automatic or manual sampling	Supplier and/or operator	Frequency to be determined individually Depending on fuel heterogeneity When supplied in specified quantities: single samples from each batch	DIN 51701 (Solid fuel sampling) LAGA PN 98 (Basic rules for sampling solid and semi-solid wastes and deposited materials) Solid secondary fuels: DIN EN 15442 Solid biofuels: DIN EN 14778:2011, CEN/TS 14779 BGS test and quality regulations <sup>32</sup> Waste Wood Ordinance Special regulations, if applicable

32 Gütegemeinschaft Sekundärbrennstoffe und Recyclingholz e.V. (Federal Quality Association for Secondary Fuels e.V.)

## ANNEX 3: Requirements for the Analysis

### Analysis of gaseous fuels

#### Natural gas

Fuel	Data source	Analysis method	
		Method	Standards
Net calorific value	Supplier's information or own calculation based on natural gas composition (usually determined by supplier)	Determination of gas components using gas chromatograph; Calculation from net calorific values of gas components	DIN EN ISO6974, DIN 51872 (Gas chromatography) DIN 51857, DIN EN ISO 6976 (Calculation of calorific value) DIN EN ISO 10723 (Performance of online analysis systems)
Carbon content	See calorific value	Determination of gas components using gas chromatograph; Calculation from carbon content of gas components	See calorific value
Emission factor	Supplier's information or own calculation based on calorific value and carbon content analyses	Calculation as weighted annual average for batch	$EF = \frac{C_{total} * 3,664}{NCV}$ <sup>33</sup>

#### Other gaseous fuels

Fuel	Data source	Analysis method	
		Method	Standards
Net calorific value	Own calculation based on gas composition (usually determined by in-house laboratory)	Determining the distribution of gas components using gas chromatograph and calculation from net calorific values of gas components	DIN 51872 (Gas chromatography) DIN 51857 (Net calorific value)
Carbon content	See net calorific value	Determining the distribution of gas components using gas chromatograph and calculation from carbon content of gas components	See net calorific value
Biomass fraction (biomass carbon content)	See net calorific value	C14-Method Alternative: estimation methods, see Art. 39 MRR	DIN EN 15440
Emission factor	Own calculation based on net calorific value and carbon content analyses, taking into account biomass carbon content if applicable	Calculation as weighted annual average for batch	$EF = \frac{C_{total} * 3,664}{NCV}$ <sup>34</sup>

<sup>33</sup> EF = Emission factor, NCV = net calorific value, C<sub>total</sub> = total carbon content

<sup>34</sup> When source streams with biomass content are used, both the emission factor (based on the total carbon content) and the biomass fraction (biomass carbon content based on the total carbon content) are indicated in FMS.

## Analysis of liquid fuels

### Heating oil according DIN

Fuel	Data source	Analysis method	
		Method	Standards
Net calorific value	Supplier's information and/or own analysis	Analysis using bomb calorimeter or calculation based on density and sulphur content according to DIN 51603	DIN 51603-5 (Minimum requirements for heating oil) DIN 51900 (Calorific value) DIN 51757, DIN EN ISO 12185 (Density) DIN EN 24260, DIN 51400-11 (Sulphur)
Carbon content	See net calorific value	Analysis using chromatography or elemental analysis	DIN EN ISO 22854, DIN 51425 (Gas chromatography); Analogous to DIN ISO 10694 (Elemental analysis)
Biomass fraction (biogenic carbon content)	-	-	-
Emission factor	Supplier's information or own calculation based on net calorific value and carbon content analyses	Calculation as weighted annual average for the same batch	$EF = \frac{C_{total} * 3,664}{NCV}$

### Other liquid fuels

Fuel	Data source	Analysis method	
		Method	Standards
Net calorific value	Supplier's information and/or own analysis	Analysis using bomb calorimeter	Analogous to DIN 51900 (Net calorific value)
Carbon content	See net calorific value	Analysis using chromatography or elemental analysis	DIN EN ISO 14517, DIN 51425 (Gas chromatography) Analogous to DIN ISO 10694 (Elemental analysis)
Biomass fraction (biogenic carbon content)	See net calorific value	C14-Method Alternative: estimation methods, see Art. 39 MRR	Analogous to DIN EN 15440, Analysis regulations of (RAL-GZ 724)
Emission factor	Own calculation based on net calorific value and carbon content analyses, taking into account biomass carbon content if applicable	Calculation as weighted annual average for the same batch	$EF = \frac{C_{total} * 3,664}{NCV}$ <sup>35</sup>

<sup>35</sup> When source streams with biomass fraction are used, both the emission factor (based on the total carbon content) and the biomass fraction (biomass carbon content based on the total carbon content) are indicated in FMS.

## Analysis of solid fuels

### Coal, lignite and refining products<sup>36</sup>

Fuel	Data source	Analysis method	
		Method	Standards
Net calorific value	Supplier's information and/or own analysis	Analysis using bomb calorimeter	DIN 51900 (Calorific value)
Carbon content	See calorific value	Elemental analysis or Radmacher-Hoverath analysis	ISO 29541 (Elemental analysis) DIN 51721 (Radmacher-Hoverath)
Biomass fraction (biomass carbon content)	-	-	-
Emission factor	Supplier's information or own calculation based on calorific value and carbon content analyses	Calculation as weighted annual average for the same batch	$EF = \frac{C_{total} * 3,664}{NCV}$

### Other solid fuels

Fuel	Data source	Analysis method	
		Method	Standards
Net calorific value	Supplier's information and/or own analysis	Analysis using bomb calorimeter	Solid fuels: DIN 51900 Solid secondary fuels: DIN EN 15400 Solid biofuels: DIN EN 14918
Carbon content	See net calorific value	Elemental analysis or Radmacher-Hoverath analysis	Solid mineral fuels: ISO 29541 Solid fuels: DIN 51732 (Elemental analysis), DIN 51721 (Radmacher-Hoverath) Solid secondary fuels: DIN EN 15407 (Elemental analysis) Solid biofuels: DIN EN 15104 (Elemental analysis)
Biomass fraction (biogenic carbon content)	See net calorific value	Selective dissolution method (SDM)C14-Method Alternative: estimation method, see Art. 39 MRR	Solid secondary fuels: DIN EN 15440, Analysis regulations of BGS (RAL-GZ 724) (SDM), DIN EN 15440
Emission factor	Own calculation based on net calorific value and carbon content analyses, taking into account biomass carbon content if applicable	Calculation as weighted annual average for the same batch	$EF = \frac{C_{total} * 3,664}{NCV}$ <sup>37</sup>

<sup>36</sup> This umbrella term includes solid refining products of coals and lignites such as lignite briquettes, lignite dust, fluidised bed coal and coal coke.

<sup>37</sup> When source streams with biomass fraction are used, both the emission factor (based on the total carbon content) and the biomass fraction (biomass carbon content based on the total carbon content) are indicated in FMS.



## ANNEX 4: Standard Factors (DEHSt List)

### Standard factors as per Art. 31 (1) c) MRR for emission factors, net calorific values and carbon content

a) Fuel	Emission factor	Calorific value		t C/t	t C/1000 Nm <sup>3</sup>
	t CO <sub>2</sub> /GJ	GJ/t	GJ/1000 Nm <sup>3</sup>		
Waste tyres (biomass carbon content 27 %)	0.088	28.2		0.677	
Anthracite (heat generation)	0.098	31.5		0.843	
Lignite briquette, Lusatia	0.101	19.4		0.535	
Lignite briquette, Rhineland	0.099	19.7		0.532	
Lignite dust, Lusatia	0.099	21.6		0.584	
Lignite dust, Middle Germany	0.098	19.1		0.511	
Lignite dust, Rhineland	0.098	22.0		0.589	
Diesel oil	0.0741	42.6		0.862	
Natural gas, Altmark	0.056		11.7		0.179
Natural gas H	0.056		36.0		0.550
Natural gas L	0.056		33.0		0.504
Liquid gas (100 % propane)	0.0647	46.3		0.817	
Liquid gas (100 % butane)	0.0663	45.7		0.827	
Coal seam/coal mine methane	0.055		17.8		0.267
Heating oil EL, DIN 51603, Part 1	0.0741	42.6 <sup>38</sup>		0.862	
Heating oil S, DIN 51603, Part 3	0.0809	39.5		0.872	
Raw lignite, Helmstedt	0.099	10.2		0.276	
Raw lignite, Lusatia	0.113	8.8		0.270	
Raw lignite, Middle Germany	0.104	10.7		0.304	
Raw lignite, Rhineland	0.114	8.9		0.277	
Coal coke	0.105	27.6		0.791	
High-grade coal, Germany	0.093	28.3		0.718	
High-grade coal import, Australia	0.095	25.4		0.659	
High-grade coal import, China	0.095	25.5		0.661	
High-grade coal import, Indonesia	0.095	25.3		0.657	
High-grade coal import, Canada	0.095	26.1		0.677	
High-grade coal import, Columbia	0.094	25.2		0.647	
High-grade coal import, Poland	0.094	27.5		0.706	
High-grade coal import, Russia	0.095	25.6		0.664	
High-grade coal import, Norway	0.094	28.6		0.734	
High-grade coal import, South Africa	0.096	25.2		0.661	
High-grade coal import, USA	0.094	27.8		0.713	

<sup>38</sup> According to DIN 51603 part 1, the net calorific value of 42.6 GJ/t is related to a density of 860 t/1000m<sup>3</sup>

a) Fuel	Emission factor	Calorific value		t C/t	t C/1000 Nm <sup>3</sup>
High-grade coal import, Venezuela	0.093	27.8		0.706	
Fluidised bed lignite, Lusatia	0.101	19.4		0.535	
Fluidised bed lignite, Rhineland	0.098	21.6		0.579	
Polystyrene (foamed)	0.085	39.8		0.923	
Electrode burn-off/anode material				0.980	
Crude oil				0.932	
Tar				0.883	

b) Material	Emission factor				
	t CO <sub>2</sub> /t Material				
Cement clinker	0,525				

The 100 % values listed here shall be used for technically pure substances.  
Mass-based parameters should be determined from the individual components for mixtures of several substances.

## ANNEX 5: Legal Metrology in Germany

The following overview of the maximum permissible error, maximum permissible error in service and validity of verified instruments has been compiled in cooperation with the Physikalisch-Technische Bundesanstalt (National Metrology Institute). The validity of verification starts according to the new Measuring and Verification Ordinance (MessEV) with the day of placing on the market (for conformity-assessed measuring instruments) or the verification (for verified measuring instruments). For validities of verification which lasts one year or more, this ends at the end of the year in which the deadline ends mathematically. That means that for example for a non-automatic scale verified on 12/07/2016 the validity of verification ends at the end of 2019 (3-year validity of validation), on 31.12.2019.

### Maximum permissible error and maximum permissible error in service, and validity of verification pursuant to Measuring and Verification Ordinance<sup>1)</sup> for selected measuring instruments

Instrument type	EU-Regulation	Maximum permissible error	Maximum permissible error in service	Validity of verification	Reference	
Belt weigher (automatic scale)	2014/32/EU	ACI 0.5 ACI 1 ACI <sup>2)</sup>	0.25 % 0.5 % 1.0 %	ACI 0.5 ACI 1 ACI <sup>2)</sup>	0.5 % 1.0 % 2.0 %	2 years MI-006; Chap. I and V REA-Doc. Nr. 5.11
Lorry scale (non-automatic scale of ACI. III, Lorry scale)	2014/31/EU	Load: m ≤ 500 e <sup>3)</sup> 500 < m ≤ 2000 e m > 2000 e	0.5 e 1.0 e 1.5 e	Last: m ≤ 500 e <sup>3)</sup> 500 < m ≤ 2000 e m > 2000 e	1.0 e 2.0 e 3.0 e	2 years 3 years if maximum load ≥ 3.000 kg Annex I, REA-Doc. Nr. 2.3
Wagon weighbridge (automatic scale)	2014/32/EU	ACI 0.2 ACI 0.5 ACI <sup>2)</sup>	0.1 % 0.25 % 0.5 %	ACI 0.2 ACI 0.5 ACI <sup>2)</sup>	0.2 % 0.5 % 1.0 %	2 years 3 years if maximum load ≥ 3.000 kg MI-006, Chap. I und VI REA-Doc. Nr. 5.26
Gas meters: Cl. 1.0: Rotary gas meter, Turbine gas meter, Ultrasonic flow meter, Vortex flowmeter, Coriolis meter	2014/32/EU	Cl. 1.0 Characteristic curve correction in meter or in volume conversion device 0.4 %	1.0 %	Cl. 1.0 The maximum permissible error in service remains formally unchanged, however MU is reduced in the application	2.0 %	8, 12 or 16 years <sup>4)</sup> For series or comparative measurements with different measurement principles: unlimited MI-002; Teil I REA-Dok. Nr. 5.26
Gas meters: Cl. 1.5: Bellows meter, Ultrasonic gas meter, Domestic Bellows meter	2014/32/EU	Cl. 1.5	1.5 %	Cl. 1.5	3.0 %	8, 12, 16 years <sup>6)</sup> , 8 years, extension using random sampling technique possible MI-002 Part I REA-Doc. Nr. 5.26

Instrument type	EU-Regulation	Maximum permissible error	Maximum permissible error in service	Validity of verification	Reference
Temperature conversion gas meter	2014/32/EU	Cl. 1.0 Cl. 1.5	Cl. 1.0 Cl. 1.5	8, 12, 16 years <sup>5)</sup>	MI-002 Part I REA-Doc. Nr. 5.27
		1.5 % 2.0 %	3.0 % 4.0 %		
		Further increase of maximum permissible errors if exceeding the basic temperature range of 30 °C (0.5% each 10 °C)			
Transducers for differential-pressure gas meters:		There are no maximum permissible errors for differential pressure gas meters. An uncertainty assessment in metrological practice takes place according to the requirements of DIN EN ISO 5167.		2 years without a filter 4 years with a filter	REA-Doc. Nr. 5.30
		0.3 % (of final value)			
Pressure differential					
Density (operational state)		0.5 %			
Density (standard state)		0.5 %			
Static pressure for density measurement		0.5 %			
Flow coefficient C		1.2 %			
Temperature		0.5 C			
Calorific value meters		0.8 % (of upper full scale)		1 year	REA-Doc. Nr. 10.1, 10.2, 10.3, 10.4
Condition volume conversion device	2014/32/EU	1.0 % <sup>6)7)</sup>		5 years	MI-002 Part II
Temperature volume conversion device	2014/32/EU	0.7 % <sup>7)</sup>		5 years	REA-Doc. Nr. 5.31
Density volume conversion device		1.0 % <sup>7)</sup>		5 years	MI-002 Part II
Calorific value volume conversion device		1.0 % <sup>7)</sup>		5 years	REA-Doc. Nr. 5.31

Instrument type	EU-Regulation	Maximum permissible error	Maximum permissible error in service	Validity of verification	Reference
Measuring instruments for flowing liquids except for water (EU liquid measuring systems) – except for liquefied industrial gases	2014/32/EU	Cl. 0.5 Cl. 1.0	Cl. 0.5 Cl. 1.0	2 years	MI-005 REA-Doc. Nr. 5.18
Storage container (e.g. heating oil tank)		0.5 %	1 % but not less than 1 % of the smallest volume	12 years <sup>8)</sup> if completely measured earlier than 5 years after conformity assessment/ verification: not limited	REA-Doc. Nr. 5.13
Transport measuring vessel (measuring element for determining the volume in a stationary position)		0.5 %	1 %	2 years	REA-Doc. Nr. 5.10
Transport measuring vessel with electronic level indication (tank truck, static volume determination)			0.5 %	2 years	REA-Doc. Nr. 5.15
Transport measuring instruments for storage containers		0.5 °C	1 °C <sup>9)</sup>	2 years; 6 years if temperature display <sup>7)</sup> is periodically verified by official review	REA-Doc. Nr. 3.4

## Abbreviations/Explanations of Annex 5

- ▶ Directives 2014/32/EU (MID) and 2014/31/EU (NAWID) lay down essential requirements for the placing on the market of measuring instruments, including maximum permissible errors. The conformity of the measuring instruments with the directive must be proved by means of labeling in accordance with European directives and a declaration of conformity from the manufacturer. Measuring instruments may be verified after the validity of verification has expired as far as they are meeting the essential requirements including maximum permissible errors valid at the time of their placing on the market. REA: regulation committee
- ▶ REA: regulation committee
- ▶ Maximum permissible errors must be met when placing the product on the market (§ 7 MessEV) and when verification is performed (§ 37 MessEG). For measuring instruments of Directives 2014/32/EU (MID) and 2014/31/EU (NAWID) they are adopted from these directives. For the other measuring instruments (nationally regulated), they are taken from regulations and technical specifications for measuring instruments set up by the regulation committee (REA) (see § 46 MessEG). The REA publishes these rules in its rules document. The rules document is published in the Federal Gazette. (Also available at [www.rea.ptb.de](http://www.rea.ptb.de), „Documents and references“ (“Dokumente und Fundstellen”)).
- ▶ Maximum permissible errors in service must be complied with during use of measuring instruments (§ 22 MessEV). They are usually twice the maximum permissible error, unless otherwise specified by the regulation committee (published in the rules document). The use of measuring instruments is not regulated by EU directives.
- ▶ Validity of verification is 2 years, unless otherwise specified in Annex 7 to the MessEV (see § 34 MessEV).
- ▶ ACL./Cl.: Accuracy class/Class

<sup>1)</sup> Measuring and Verification Ordinance (MessEV) of 11 December 2014 (BGBl. I S. 2010, 2011) as amended by Art. 1 of the Regulation of 10 August 2017 (BGBl. I S. 3098).

<sup>2)</sup> Only applicable for applications determined by the regulation committee (see rules document for the particular instrument number)

<sup>3)</sup>  $e$  is the verification scale interval (in case of commercial scales equal to the scale interval value). A percental indication to uncertainty can be derived from a verification scale interval, when the indication to the verification scale interval (in the units of mass) with the average result of a single weighing (in the same units of mass) will be set in relation.

<sup>4)</sup> The validity of verification depends on the instrument's size (see Annex 7 MessEV).

<sup>5)</sup> Characteristic curve correction according to OIML R 137.

<sup>6)</sup> Data for compound instruments equipped with a volume conversion device (VCD): if there is a correction of the characteristic curve in the VCD, the maximum permissible error of the connected gas meter decreases from 1 % to 0.4 %.

<sup>7)</sup> In the case of reference conditions: 0.5 %; obviously irrelevant here.

<sup>8)</sup> see Annex 7 MessEV

<sup>9)</sup> A percental indication to uncertainty can be derived from a value for the temperature, when the indication for the temperature (in the unit of degree Celsius) with the average result of a single measurement (in the same units of degree Celsius) will be set in relation.



## ANNEX 6: Parameters Influencing Uncertainty in Determining Source Stream Quantity Using Certain Types of Measuring Instruments

### Measuring instruments for gaseous/liquid substances

Instruments according to OIML R137 and OIML R117 are suitable for compliance with tier 4, provided that they were built according to class 1.0 standards. Influencing parameters must then not exceed the limits in the table below. For instruments of higher classes (e.g. class 1.5), the maximum deviations increase proportional to the class of the instrument.

No	Influencing parameter	Maximum deviation for measuring instruments manufactured according to OIML R137
1	Range of flow rate	1 % $Q_{\max} \dots Q_t$ 2 % $Q_t \dots Q_{\min}$
2	Medium's temperature	0.5 % deviation compared to reference conditions
3	Medium's pressure	0.5 % deviation compared to reference conditions
4	Type of medium (influence of density, viscosity etc.)	0.3 % deviation compared to reference conditions
5	Intake turbulence	0.35 % deviation compared to reference conditions
6	Ambient conditions: Temperature range	< 0.2 % deviation compared to reference conditions exceeding $Q_t$
7	Long-term stability (drift within the calibration cycle)	< 0.5 %

In addition to the influencing parameters 1 to 7 in the above table, other influencing parameters should also be considered for certain types of instruments. The possible deviation in the table below can be neglected if it has been proved that the influencing parameters are tackled with appropriate countermeasures (see column 4).

Instrument type	Influencing parameter	Potential deviation	Validation possibilities or countermeasures	Evidence
Turbine gas meter	Operating mode: (intermittent flow, pulsations)	Up to 5 %	Using proper operating mode, avoiding pulsations (e.g. by appropriate control devices)	Checking control devices and load
Rotary piston gas meter	Resonance, soiling	Up to 3 % Strong negative deviations in the lower range of flow rate	Resonance damper, start-up filter	Inspection of resonance noise Review of the QM documentation for frequent failures
Diaphragm gas meter	Correct determination of relevant pressure and temperature	Up to 2 %	Volume conversion device	
Differential pressure measuring instrument (orifice, venturi nozzle, dynamic pressure probes)	Damage to the form, pipe roughness, stability of pressure differential sensors	Up to 5 %	Adhering to ISO 5167 requirement (0 % additional uncertainty)	Inspections
Ultrasonic flow meter	Strong noise disturbance	Up to 2 %, temporary failure	Reducing noise disturbance	Checking log files
Vortex flow meter	Pulsation	Temporary failure or false measured value	Avoid pulsation	Checking control devices
Coriolis meter	Zero-potential fixture, vibrations in the range of excitation frequency	Zero drift, temporary failure	Installing expansion joints	Regularly check and record zero drift

Instrument type	Influencing parameter	Potential deviation	Validation possibilities or countermeasures	Evidence
Electronic volume conversion device (EVCD)	Gas data at condition volume conversion device	Up to 0.5 %	Regularly updating gas data	Check analysis data
Sensing probes (Pitot tube, Prandtl tube, hot-film probe, vortex probe or ultrasonic lances)	Position, pipe diameter, geometric form (roundness), profile assumptions	Up to 10 %	Adhering to manufacturer's operating requirements	Performing inspections
All flow-measuring devices for measuring liquids	Cavitation, gas inclusions		Using the instrument at a sufficiently high pressure; Using gas separator	

## Measuring instruments for solid fuels

### 1) Non-automatic scales

No.	Influencing parameter	Maximum deviation for measuring instruments manufactured according to OIML R76
1	Ambient conditions: temperature range	Maximum 1.5 verification scale intervals <sup>39</sup>
2	Ambient conditions: moisture	Maximum 1.5 verification scale intervals
3	Electromagnetic compatibility (EMC)	Maximum 1 verification scale interval
4	Slanting position	Maximum 1.5 verification scale intervals
5	Long-term stability (drift within the calibration cycle)	Maximum 3 verification scale intervals

In addition to influencing parameters 1 to 4 in the above table, other influencing parameters must also be considered for certain types of instruments. The deviations listed in the following table may be disregarded if it has been proved that the influencing parameters are tackled with appropriate countermeasures (see Column 4).

Instrument type	Influencing parameters	Potential deviation	Validation possibilities or countermeasures
Lorry scale, Lorry weighing unit	Wind influence	Up to 0.6%	Hall, wind protection
Platform scale	None		
Crane scale	Standstill, wind	Up to 0.4%	Stop weighing in the case of strong wind
Wheel loader scale	Adhesion to shovel	Up to 1 %	Zeroing after each weighing
Tank scale	Wind	Depending on the scale's form	Wind protection, hall

<sup>39</sup> A percental indication to uncertainty allows to be derived from a verification scale interval, when the indication to the verification scale interval (in the units of mass) with the average result of a single weighing (in the same units of mass) will be set in relation.

## 2) Automatic scales

No	Influencing parameter	Maximum deviation for measuring instruments manufactured according to OIML R76
1	Ambient conditions: temperature range	R50: maximum 0.7 % R51: maximum 1.5 verification scale intervals R106: maximum 1.5 scale intervals R107: maximum 1.5 scale intervals
2	Humidity	R50: maximum 0.7 % R51: maximum 1.5 verification scale intervals R106: maximum 1.5 scale intervals R107: maximum 1.5 scale intervals
3	Electromagnetic compatibility (EMC)	For all: maximum 1 (verification) scale interval
4	Tilt position	R50: no requirements, fixed band installation R51: maximum 1.5 verification scale intervals R106: maximum 1.5 scale intervals R107: maximum 1.5 scale intervals
5	Long-term stability (drift within the calibration cycle)	For all: Maximum 3 verification scale intervals

In addition to influencing parameters 1 to 5 in the above table, other influencing parameters must also be considered for certain types of instruments. The deviations listed in the following table may be disregarded if it has been proved that the influencing parameters are tackled with appropriate countermeasures (see Column 4).

Instrument type	Influencing parameters	Potential deviation	Validation possibilities or countermeasures
Belt scale	Adhesion, load slippage on slanting belt	2 %	Horizontal belt scale
Wheel loader scale	Adhesion to shovel	Up to 1 % (of weighing range)	Zeroing after each weighing
Automatic wagon weigh-bridge	Accuracy of the load's position on the load cell(s) ("full draught")	Up to 2%	Using only such scales where the wagons are completely supported by load cell(s) while travelling on the bridge.
Tank scale as automatic scale for totalisation	Wind	Depending on the tank's form	Wind protection, hall
Tank scale	Wind	Depending on the scale's form	Wind protection, hall

The operator shall conduct an individual uncertainty assessment for the belt scales, if the producer didn't provide data to the limitation of operation and the maximum deviation relevant to the influence parameters as well as didn't ensure that the product corresponds to the relevant norms (cf. point 1 in Chapter 6.1.2).

For belt weighers, which were properly calibrated with calibration and test equipment traceable to internationally recognized standards, especially the influencing parameter "long term stability" has to be considered. Annex 7 No. 2. shows an example of an individually derived uncertainty contribution of the influencing parameter "long term stability" (drift).

## ANNEX 7: Examples of the Overall Uncertainty Evidence on not Verified Measuring Devices

### 1) Evidence of manufacturer's specifications and calculation of the overall uncertainty on the example of an ultrasonic meter with 4 signal paths.

No	Influencing parameter	Manufacturer's specification	Maximum deviation	Description of measures for adhering to manufacturer's specifications
1	Range of flow rate	$Q_{b,max} = 1000 \text{ m}^3/\text{h}$ $Q_t = 100 \text{ m}^3/\text{h}$ $Q_{min} = 10 \text{ m}^3/\text{h}$	1 % $Q_{max} \dots Q_t$ 2 % $Q_t \dots Q_{min}$	Average flow rate exceeding $Q_t$ (separation flow rate)
2	Medium's temperature	$T_{min} = -10^\circ\text{C}$ $T_{max} = 35^\circ\text{C}$	0.5 % Deviation compared to reference conditions	The medium is transported in a buried pipeline. The pipeline is thermally insulated between the measuring device and the point where the pipeline leaves the earth.
3	Medium's pressure	$p_{max} = 10 \text{ bar}$ $p_{min} = 0,9 \text{ bar}$	0.5 % Deviation compared to reference conditions	Safety valves guarantee that the pressure remains within specifications.
4	Medium's type	Air, natural gas	0.3 % Deviation compared to reference conditions	Only natural gas is used.
5	Intake turbulence	10-D straight pipe section (after a sharp bend or a tee)	0.35 % Deviation compared to reference conditions	The measuring instrument is installed after a 15-D straight pipe length downstream. The diameter of the inlet pipe is 1 % greater than the diameter of the measuring instrument.
6	Ambient conditions: temperature range	$T_{amb} -10 \dots + 55^\circ\text{C}$	< 0.2 % Deviation compared to reference conditions above $Q_t$	The measuring instrument is installed in an unheated insulated container that is equipped with a fan to the environment when the temperature within the container should rise above $35^\circ\text{C}$ .
7	Long-term stability	Re-calibration (5-year cycle recommended)	< 0.5 %	Requirement which is integrated in the operator's quality management

The calibration is carried out by an accredited institute as by ISO 17025, thereby removing additional uncertainty.

Thus the overall uncertainty becomes:

$$\sqrt{1^2 + 0.5^2 + 0.5^2 + 0.3^2 + 0.35^2 + 0.2^2 + 0.5^2} = 1.42\%$$

### 2) Evidence of the individually derived uncertainty of the „long-term stability“ (drift) influencing parameter and calculation of the overall uncertainty on the example of a belt weigher

In the following it will be described how the uncertainty component of the influencing parameter “drift” can be derived, if the producer did not provide data (evidence for the Point 1 and 2 in the Section 6.1.2). For the quality assurance (assessment of the measurement uncertainty) of the belt weigher two possibilities are available in the practice:

#### a) Calibration:

Calibration of the belt weigher via comparison with a defined source stream quantity, which was weighed with a officially verified measuring device, such as a officially verified truck scale or which was proved by a measuring and test equipment, which uncertainty demonstrates less than 1/3 of the measurement uncertainty of the belt weigher to be calibrated.

b) Other method:

Checking the belt weigher through checking the weighing cell (e.g. by putting or hanging of defined weight or roller chains) and checking the speed of the belt with measuring and test equipment, which uncertainty demonstrates less than 1/3 of the measuring uncertainty of the belt weigher to be checked.

In the following example, the calibration/checking of the belt weigher will be performed by an accredited institution according to ISO 17025 and/or with a measuring and test equipment, which uncertainty demonstrates less than 1/3 of the measuring uncertainty of the measuring device to be calibrated. Therefore, an additional uncertainty component associated with the calibration/checking can be neglected (evidence for Point 3 in Section 6.1.2).

To be able to determine the uncertainty contribution of the influencing parameter “drift” of the measuring device, the results of the reference measurement before as well as after the calibration (see above a)) or checking with “other method” (see above b)) have to be documented. The documentation must contain at least data, which are required in the template of the checking protocol (see published excel file).<sup>40</sup> The evidence of the adjustment of a measuring instruments or measuring systems is not sufficient.

The uncertainty contribution of the influencing parameter “drift” will be calculated as following:

a) Calibration:

Both for the zero-point and for the operating point the uncertainty will be calculated respectively before and after the intervention (provided cleaning, an adjustment or another way of intervention takes place). By implementing the formula 5 in Chapter 6.2.2 the uncertainties will be combined to an uncertainty before intervention and an uncertainty after intervention:

$$U_{\text{before intervention}} = \sqrt{U_{BW\text{zero}_{\text{before intervention}}}^2 + U_{BW\text{operating}_{\text{after intervention}}}^2}$$

$$U_{\text{after intervention}} = \sqrt{U_{BW\text{zero}_{\text{after intervention}}}^2 + U_{BW\text{operating}_{\text{after intervention}}}^2}$$

Where:

$U_{\text{before intervention}}$ : Uncertainty before the intervention

$U_{\text{after intervention}}$ : Uncertainty after the intervention

$U_{BW\text{zero}_{\text{before intervention}}}$ : Uncertainty of the belt weigher’s zero-point before the intervention

$U_{BW\text{operating}_{\text{after intervention}}}$ : Uncertainty of the belt weigher’s operating point before the intervention

$U_{BW\text{zero}_{\text{after intervention}}}$ : Uncertainty of the belt weigher’s zero-point after the intervention

$U_{BW\text{operating}_{\text{after intervention}}}$ : Uncertainty of the belt weigher’s operating point after the intervention

b) Other method:

Both for belt weigher’ zero point, the weighing cell’s operating point and for the belt speed the uncertainty will be calculated before and after intervention (provided cleaning, an adjustment or another art of intervention takes place). By implementing the formula 5 in Section 6.2.2 the uncertainties will be combined to an uncertainty before intervention and an uncertainty after intervention:

$$U_{\text{before intervention}} = \sqrt{U_{BW\text{zero}_{\text{before intervention}}}^2 + U_{WC\text{operating}_{\text{before intervention}}}^2 + U_{\text{Speed}_{\text{before intervention}}}^2}$$

Under the simplified assumption of a linear growth of the drift within the calibration interval, the uncertainty of the influencing parameter “drift” of the belt weigher, is calculated for the calibration interval for a) as well as for b) as following:

40 [https://www.dehst.de/SharedDocs/downloads/DE/stationaere\\_anlagen/Excel\\_Pruefprotokoll.xlsx](https://www.dehst.de/SharedDocs/downloads/DE/stationaere_anlagen/Excel_Pruefprotokoll.xlsx)

$$U_{after\ intervention} = \sqrt{U_{BWzeroafterintervention}^2 + U_{WCoperatingafterintervention}^2 + U_{Speedafterintervention}^2}$$

Where:

$U_{before\ intervention}$ : Uncertainty before the intervention

$U_{after\ intervention}$ : Uncertainty after the intervention

$U_{BWzerobeforeintervention}$ : Uncertainty of the belt weigher's zero-point before the intervention

$U_{WCoperatingbeforeintervention}$ : Uncertainty of the weighing cell's operating point before the intervention

$U_{Speedbeforeintervention}$ : Uncertainty of the tape speed before the intervention

$U_{BWzeroafterintervention}$ : Uncertainty of the belt weigher's zero-point after the intervention

$U_{WCoperatingafterintervention}$ : Uncertainty of the weighing cell's operating point after the intervention

$U_{Speedafterintervention}$ : Uncertainty of the tape speed after the intervention

Under the simplified assumption of a linear growth<sup>41</sup> of the drift within the calibration interval, the uncertainty of the influencing parameter "drift" of the belt weigher, is calculated for the calibration interval for a) as well as for b) as following:

$$U_{Drift} = \frac{|U_{before\ intervention}| + |U_{after\ intervention}|}{2}$$

The determined uncertainty of the influence parameter "drift" has to be referred to the respective reporting year. If as in the example the calibration interval is 2 years, then the uncertainty of the drift for the first reporting year has to be calculated as following:

$$U_{Drift\ year\ 1} = \frac{|U_{after\ intervention}| + |U_{Drift}|}{2}$$

For the second reporting year the uncertainty of the drift has to be calculated by the following formula:

$$U_{Drift\ year\ 2} = \frac{|U_{before\ intervention}| + |U_{Drift}|}{2}$$

Since in this example further uncertainty components are not considered, the uncertainty of the influencing parameter "drift" determined for the respective reporting year represents the overall uncertainty associated with the determination of the source stream quantity using a belt weigher. The calculation of the overall uncertainty is to be delivered together with the annual emissions report.

If the determined overall uncertainty doesn't meet the required tier, the calibration/checking interval is to be shortened.

<sup>41</sup> The operator can justify an other fuction (e.g. due to cleaning, maintenance)



## ANNEX 8: Publication Overview

- ▶ [Handbuch zur Nutzung der Virtuellen Poststelle](#) (VPS) (User's manual for the Virtual Post Office (VPS) software)
- ▶ [Benutzerhanbuch für die Software „Überwachungspläne 2013-2020“](#) (User's manual for the software "Monitoring Plans 2013-2020")
- ▶ [FMS - Handbuch für die Software zur Emissionsberichterstattung](#) (User's manual for the software "Emission reports")
- ▶ [Emissionshandelsverordnung \(Verordnung zur Durchführung des Treibhausgas-Emissionshandelsgesetzes in der Handelsperiode 2013 bis 2020; EHV\)](#) (National Monitoring Regulation)
- ▶ [Monitoring-Verordnung und Akkreditierungs- und Verifizierungsverordnung](#) (Monitoring and Reporting Regulation and Accreditation and Verification Regulation)
- ▶ [Treibhausgas-Emissionshandelsgesetz \(TEHG\) vom 21. Juli 2011](#) (Greenhouse Gas Emissions Trading Act (TEHG) of 21 July 2011)
- ▶ [XML Schnittstelle zum Import von Überwachungsplänen](#) (XML interface – monitoring plans)
- ▶ [XML-Schnittstelle zur Emissionsberichterstattung](#) (XML interface – emission reports)
- ▶ [Excel-Arbeitshilfe zur Bestimmung der Analysenhäufigkeit](#) (Excel help for determining the analysis frequency)
- ▶ [Beispielvorlage für einen Probenahmeplan](#) (Example template for a sampling plan)
- ▶ [Beispiel für die Bestimmung der Rohstoff-Menge durch Rückrechnung](#) (Example for determining the raw clay quantity using back-calculation)
- ▶ [LAGA PN 98 \(„Richtlinie für das Vorgehen bei physikalischen, chemischen und biologischen Untersuchungen im Zusammenhang mit der Verwertung/Beseitigung von Abfällen“\)](#) (Guidelines for dealing with physical, chemical and biological tests in connection with waste recovery and disposal)
- ▶ [Arbeitshilfe zur Berechnung der Emissionsfaktoren für Branntkalk und Dolomitkalk aus Analysewerten](#) (Aid to help calculate the emission factors for quicklime and dolomitic lime from analysis values)
- ▶ [Excel-Arbeitshilfe zur Berechnung der Unsicherheit der Lagerdichte](#) (Aid to help calculate the uncertainty of bulk density)

## ANNEX 9: Assessment of Uncertainty Associated with the Determination of Stock Changes

The following consideration is given to the case where the annual quantity of a used source stream is determined through the quantity delivered and the stock changes. The uncertainty analysis for the determination of this quantity must take into account the uncertainty associated with the detection of stock changes when the storage can accommodate at least 5 % of the quantity of substance used per year (Art. 28 Art.(2) MRR). To determine the quantity of the stored solid source stream, a determination of the volume and the storage density<sup>42</sup> of the stored source stream is necessary. Since the storage is managed differently depending on consumption (e.g. summer/winter), market situation (price of the various coals on the world market) and storage arrangements (e.g. crawler/excavator movements in the storage area), the storage density can vary in both time and space. Moisture, drop height and grain size distribution can influence the storage density.

In the following, three possible approaches for determining the uncertainty in the determination of the storage density will be explained. These are simplified evidence procedures in the monitoring plan. The operator can also use a different approach to provide evidence of the uncertainty depending on the conditions of the individual case. The uncertainty of the storage density must first be considered for the reporting year 2016 (i.e. from 01.01.2016)

### Procedure No. 1: Determining the storage density through measuring

At the beginning or end of a reporting year, the operator takes at least 15 samples<sup>43</sup> from the stockpile to determine the local storage density. The number of samples and the sampling locations shall be representative for the storage density of the sampled volume. The sampling procedure must be suitable for the respective stockpile. From the determined values of the local storage density, the storage density is calculated as an arithmetic mean. If the sampling procedure does not significantly change the storage density of the sample, twice (95% confidence interval) the standard deviation of the mean<sup>44</sup> may be used as uncertainty for the determination of the storage density.

If a significant change in storage density can not be ruled out by the sampling procedure, the impact of the sampling procedure shall be included in the uncertainty calculation. In this case, as a simplification, twice the empirical standard deviation<sup>45</sup> of the measured values may be used as the uncertainty of the storage density.

The procedure for determining the storage density, the suitability of the sampling procedure for the stockpile under consideration, the representativeness concerning location and number of incremental samples and the calculation of uncertainty shall be described in the monitoring plan.

### Procedure No. 2: Using standard values

The plant operator uses a plausible standard value for the storage density from the literature or uses a value that is derived from suitable measurements of the storage density of the considered or of a comparable stockpile. In particular, measurements according to procedure No. 1 are suitable, in individual cases also bulk

42 In the literature (for example, according to the Ruhrkohle Manual), the term „bulk density“ is defined as the ratio of the mass of the fuel dumped into a container to the volume of the container. Specifically, this term should not be used because of compaction effects in the storage. It should be noted that the term „storage density“ does not mean the density of the source stream as it is analytically determined, for example, for solid fuels in the laboratory in accordance with DIN 51700

43 Based on the required number of comparative measurements in accordance with DIN EN 14181

44 Determination of the standard deviation of the average

$$s_{\bar{x}} = \frac{s}{\sqrt{n}}$$

45 Determination of the empirical standard deviation

$$s = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X})^2}$$

with

s: empirical standard deviation; n: sample size (number of values);

X<sub>i</sub>: characteristics of the element i of the sample size ; X: average of the sample

densities determined according to DIN 51705.

The suitability of the selected standard value must be justified. In particular, it should be shown that the conditions for which the standard value applies apply to the particular stockpile or that the conditions in the stockpile do not change significantly from one year to the next (e.g. the same types of source stream are stored; feeding and removal facilities have remained the same, etc.).

For literature values, the uncertainty is calculated from the range of variation<sup>46</sup> assigned to the standard value. For standard values derived from measurements, the uncertainty results from twice the standard deviation<sup>47</sup> (95% confidence interval) of the measured values.

**Procedure No. 3: Calculation of the maximum possible uncertainty component of storage density**

The uncertainty in determining the source stream quantity is determined according to Formula 2 in Section 6.2.1. Assuming that the storage facility is completely full at the beginning and end of the reporting year, the formula simplifies to Formula 3 in Section 6.2.1. Since the stock is determined as the product of storage volume and storage density, the uncertainty of the stock is calculated according to the following formula:

**Formula 18: Calculation of the uncertainty of the determination of initial or final stock**

$$U_{\text{storage}} = \sqrt{U_{\text{volume}}^2 + U_{\text{storage density}}^2}$$

$U_{\text{storage}}$ : uncertainty of the determination of initial or final inventory

$U_{\text{volume}}$ : uncertainty of the determination of storage volume

$U_{\text{storage density}}$ : uncertainty of the determination of storage density.

By inserting formula 11 into formula 3 in Section 6.2.1 and solving for  $U_{\text{storage density}}$  an inequality can be derived from which the uncertainty of the storage density at given maximum permitted uncertainty for the consumption quantity (UMRR) can be determined.

**Formula 19: Calculation of the uncertainty of the storage density at given maximum permitted uncertainty for the consumption quantity of the source stream<sup>48</sup>**

$$U_{\text{storage density}} \leq \sqrt{\frac{(U_{\text{MRR}} \cdot x_d)^2 - (U_d \cdot x_d)^2}{2 \cdot x_{\text{storage}}^2} - U_{\text{volume}}^2}$$

$U_{\text{MRR}}$ : maximum permitted uncertainty specified for the consumption quantity of the source stream by MRR

$U_d$ : uncertainty of measurement of the volume delivered

$x_d$ : volume delivered

$x_{\text{storage}}$ : storage volume

If the operator can justify that the uncertainty of the storage density calculated in this way is not exceeded, then

<sup>46</sup> Example: range of variation of the standard value: 0.8 t/m<sup>3</sup> to 1.0 t/m<sup>3</sup>; mean = 0.9 t/m<sup>3</sup>; absolute deviation from the average = ± 0.1 t/m<sup>3</sup>; relative deviation from the average = (0.1 t/m<sup>3</sup>)/(0.9 t/m<sup>3</sup>) = 0.11 = 11% (11% is taken as uncertainty component of storage density)

<sup>47</sup> Determination of the empirical standard deviation

$$s = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X})^2}$$

with

s: empirical standard deviation; n: sample size (number of values);

$X_i$ : characteristics of the element i of the sample size ; $\bar{X}$ : average of the sample

<sup>48</sup> If the expression is negative under the root, it means that the uncertainty of the consumption amount is greater than the permitted uncertainty by MRR, regardless of the uncertainty of the storage density

it is sufficient for demonstrating that the requirement of MRR on the uncertainty of the consumed quantity has been complied with. The approval of a monitoring plan can be based on such reasoning including the above calculation according to Formula 5.

If values of the initial and final stock are known, the following general formula can be used similarly (inserting Formula 11 into Formula 2 and converting to Ustorage density) to obtain a more precise result for the upper limit of the uncertainty of the storage density. In the case of larger stock changes this approach may lead to more accurate results.

**Formula 20: Calculation of the uncertainty of storage density when the initial and final storage inventory is known<sup>49</sup>**

$$U_{storage\ density} \leq \sqrt{\frac{U_{MRR}^2 \cdot (x_d + x_i - x_f)^2 - (U_d \cdot x_d)^2}{x_i^2 + x_f^2}} - U_{vol}^2$$

$x_i$ : initial stock

$x_f$ : final stock

Where provision of evidence is not possible using Formula 12., the operator may alternatively submit the above calculation in accordance with Formula 13 with each emission report and thereby justify that the calculated Ustorage density has been observed during the reporting year<sup>50</sup>. In the event that the uncertainty cannot be adhered to, a conservative correction (see Section 19.4.2) must be made.

<sup>49</sup> If the expression is negative at the root, it means that the uncertainty of the consumption amount is greater than the permitted uncertainty by MRR, regardless of the uncertainty of the stock density

<sup>50</sup> As a support for calculating see published excel tool.



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