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DIRECTORATE-GENERAL
CLIMATE ACTION
Directorate A – International and Climate Strategy
CLIMA.A.3 - Monitoring, Reporting, Verification

# Guidance Document

## The Monitoring and Reporting Regulation – General guidance for Aircraft Operators

**MRR Guidance document No. 2**

**Version of 16 July 2012**

This document is part of a series of documents provided by the Commission services for supporting the implementation of Commission Regulation (EU) No. 601/2012 of 21 June 2012 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council[1].

The guidance represents the views of the Commission services at the time of publication. It is not legally binding.

This guidance document takes into account the discussions within meetings of the informal Technical Working Group on the Monitoring and Reporting Regulation under the WGIII of the Climate Change Committee (CCC), as well as written comments received from stakeholders and experts from Member States. This guidance document was unanimously endorsed by the representatives of the Member States at the meeting of the Climate Change Committee on 11 July 2012.

All guidance documents and templates can be downloaded from the documentation section of the Commission's website at the following address: **http://ec.europa.eu/clima/policies/ets/monitoring/index_en.htm**.

[1] **http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:181:0030:0104:EN:PDF**

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# 1 SUMMARY

Monitoring and reporting of emissions is a cornerstone of the EU ETS[2] (the Union Emissions Trading Scheme). Following the revision of the EU ETS Directive in 2009, updated rules for monitoring and reporting have been laid down in an EU Regulation (the Monitoring and Reporting Regulation, hereinafter the "MRR"). Together with a new Regulation for verification of emissions and accreditation of verifiers (the "AVR"), the MRR replaces the Monitoring and Reporting Guidelines (MRG 2007). The MRR is applicable from the third trading period onwards (that is for emissions from 1 January 2013).

This guidance document is the first of a series of guidance documents and electronic templates provided by the Commission services to support the EU-wide harmonised implementation of the MRR. It gives an introduction to the EU ETS compliance system, the concepts used for monitoring and reporting of emissions and tonne-kilometre data of aircraft operators, and then describes in more detail the requirements laid down in the MRR for the possible monitoring approaches. This guidance does not add to the mandatory requirements of the MRR, but it is aimed at assisting in more correct interpretation and facilitated implementation.

This guidance document represents the views of the Commission services at the time of publication. It is not legally binding.

Note that this document does not cover requirements for stationary installations. Operators of installations in search of guidance on monitoring and reporting in the EU ETS are invited to consult guidance document No. 1.

## 1.1 Where should I start reading?

This document has been developed to guide readers who are new to the EU ETS as well as those who are already familiar with the EU ETS. The later group should in particular pay attention to sections which are marked with a "NEW" sign throughout the document (for a list of guiding symbols see section 2.2). Section 1.2 of this summary will serve as useful starting point.

Readers with little experience of the EU ETS and its MRV (Monitoring, Reporting and Verification) system should read in particular chapter 4 (about the EU ETS compliance cycle) and chapter 5 (concepts and approaches). All readers who need to monitor aviation activities and therefore who have to develop (or update) a monitoring plan, are advised to check chapter 6 on monitoring plans.


Aircraft operators who qualify as "small emitters" (for definition see section **5.6.1**) should look for the "small" icon.

[2] For an explanation of acronyms and for references of legislative texts please see the annex of this document.

## 1.2 What is new in the MRR?

New!

The M&R Regulation has been developed with view to enhancing EU-wide harmonisation of approaches beyond that already achieved by Member State implementation of MRG 2007. It also takes into account several best practices found in the Member States. Therefore, a reader may sometimes be already familiar with the approach presented here, whereas the same approach will be new to a reader from another Member State. Readers who want to focus in particular on new elements of the MRR when reading this guidance should especially note the following changes compared to the MRG 2007:

- The MRR is an EU Regulation. Thus, the requirements contained therein are directly applicable in all EU Member States.
- The central role of the monitoring plan (MP) for the whole MRV system has been further emphasised. For development of a new monitoring plan or for revision of an existing MP, section 6.1 will be helpful.
- Important clarifications have been introduced regarding the role of written procedures, which supplement the MP with various details, but which are kept separate from the MP in order to facilitate their more frequent maintenance and implementation. This is described in section 6.2.
- The MRR has also introduced new rules for the process of updating the monitoring plan, as discussed in section 6.5. Furthermore the principle of continuous improvement of the MP has been strengthened by the MRR, including a requirement to react to recommendations of the verifier (see section 6.6).
- Further requirements in the context of the monitoring plan concern "supporting documents" which must be submitted to the competent authority together with the monitoring plan. These are evidence for meeting the required tiers and the risk assessment necessary to establish an appropriate control system concerning the data flows of the aircraft operator (see section 6.4).
- When selecting a particular monitoring approach, and when deciding upon possible improvements thereof, the concept of avoiding unreasonable costs is crucial. The MRR has added clarification concerning interpretation of unreasonable costs (see section 7.1).
- The MRR uses the same definition for biomass, biofuels and bioliquids as the Directive on Renewable Energy Sources (RES-D). Consequently, the sustainability criteria established by the RES-D must be applied where relevant in order to apply an emission factor of zero to such biomass. Note that this topic is covered in detail in a separate guidance document (see section 2.3 for where to find other guidance documents).

- The interplay with verification, as regulated by the new A&V Regulation (Regulation on verification in the EU ETS and accreditation of verifiers), has been significantly improved. In particular, the rules for the data flow and control activities of aircraft operators have been elaborated, as shown in section 6.3, and the improvement principle establishes a feedback loop from the verifier's findings to the aircraft operator's monitoring plan.

# 2 INTRODUCTION

## 2.1 About this document

This document has been written to support the M&R Regulation, by explaining its requirements in a non-legislative language. For some more specific technical issues, further guidance documents are available. The set of guidance documents is further complemented by electronic templates[3] for information to be submitted by aircraft operators to the competent authority. However, it should always be remembered that the Regulation is the primary requirement.

This document interprets the Regulation regarding requirements for aircraft operators. It builds on guidance developed in 2009 for the start of inclusion of aviation activities in the EU ETS, developed by the Netherlands and the UK under the aviation task force of the EU ETS Compliance Forum. It also takes into account the valuable input from the task forces on monitoring and on aviation established under the EU ETS Compliance Forum, and from the informal technical working group (TWG) of Member State experts established under the working group 3 of the Climate Change Committee.

## 2.2 How to use this document

Where article numbers are given in this document without further specification, they always refer to the M&R Regulation. For acronyms, references to legislative texts and links to further important documents, please see the Annex.


This document only refers to emissions starting from 2013. Although most of the concepts have been used in the MRG 2007 before, this document does not give a detailed comparison to the MRG 2007. Instead, a symbol (such as in the margin here) indicates where changes to requirements compared to the MRG have taken place, or where concepts have not been used in the MRG before.

This symbol points to important hints for aircraft operators and competent authorities.


This indicator is used where significant simplifications to the general requirements of the MRR are promoted.

The light bulb symbol is used where best practices are presented.


The small emitter symbol is used to guide the reader to topics which are applicable for aircraft operators classified as “small emitters”.

The tools symbol tells the reader that other documents, templates or electronic tools are available from other sources (including those still under development).

[3] Note that Member States may define their own templates, which must contain at least the same information as the Commission’s templates.

The book symbol points to examples given for the topics discussed in the surrounding text.

## 2.3 Where to find further information

All guidance documents and templates provided by the Commission on the basis of the M&R Regulation and the A&V Regulation can be downloaded from the Commission's website at the following address:

**http://ec.europa.eu/clima/policies/ets/monitoring/index_en.htm**

The following documents are provided[4]:

- Guidance document No. 1: "The Monitoring and Reporting Regulation – General guidance for installations". This document outlines the principles and monitoring approaches of the MRR relevant for stationary installations.
- Guidance document No. 2: "The Monitoring and Reporting Regulation – General guidance for aircraft operators" (this document).
- Guidance document No. 3: "Biomass issues in the EU ETS": This document discusses the application of sustainability criteria for biomass, as well as the requirements of Articles 38, 39 and 53 of the MRR. This document is relevant for operators of installations as well as for aircraft operators.
- Guidance document No. 4: "Guidance on Uncertainty Assessment". This document for installations gives information on assessing the uncertainty associated with the measurement equipment used, and thus helps the operator to determine whether he can comply with specific tier requirements.
- Guidance document No. 5: "Guidance on Sampling and Analysis" (only for installations). This document deals with the criteria for the use of non-accredited laboratories, development of a sampling plan, and various other related issues concerning the monitoring of emissions in the EU ETS.
- Guidance document No. 6: "Data flow activities and control system". This document discusses possibilities to describe data flow activities for monitoring in the EU ETS, the risk assessment as part of the control system, and examples of control activities. It applies to both, aircraft operators and installations.

The Commission furthermore provides the following electronic templates[5]:

- Template No. 1: Monitoring plan for the emissions of stationary installations
- Template No. 2: Monitoring plan for the emissions of aircraft operators

[4] This list is at the current stage non-exhaustive. Further documents may be added later.
[5] This list is at the current stage non-exhaustive. Further templates may be added later.

- Template No. 3: Monitoring plan for the tonne-kilometre data of aircraft operators
- Template No. 4: Annual emissions report of stationary installations
- Template No. 5: Annual emissions report of aircraft operators
- Template No. 6: Tonne-kilometre data report of aircraft operators

Besides these documents dedicated to the MRR, a separate set of guidance documents on the A&V Regulation is available under the same address. Furthermore, the Commission has provided guidance on the scope of the EU ETS for aircraft operators:

**http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009D0450:EN:NOT**

A huge amount of information for aircraft operators is also found on DG CLIMA's website dedicated to the EU ETS for aviation (Especially under the tabs "Documentation" and "FAQ"):
**http://ec.europa.eu/clima/policies/transport/aviation/index_en.htm**

All EU legislation is found on EUR-Lex: **http://eur-lex.europa.eu/**

The most important legislation is furthermore listed in the Annex of this document.

Also competent authorities in the Member States may provide useful guidance on their own websites. Aircraft operators should in particular check if the competent authority provides workshops, FAQs, helpdesks etc.

# 3 THE INCLUSION OF AVIATION IN THE EU ETS

## 3.1 Scope of included aviation activities

Annex I of the EU ETS Directive defines the scope of aviation activities included in the EU ETS. The Directive requires that all flights are covered which depart from or arrive in an aerodrome situated in the territory of a Member State to which the Treaty applies[6]. Due to the extension of the EEA agreement[7], "Member State" must be read as "EEA Member State" (i.e. the current 27 EU Member States plus the EEA-EFTA states Norway, Iceland and Liechtenstein). Furthermore Croatia is scheduled to become an EU Member State in 2013. From 1 January 2014 all flights departing from aerodromes in Croatia and all flights arriving at aerodromes in Croatia will be included in the EU ETS.

**Aircraft operators who perform such aviation activities are to participate in the emissions trading scheme, regardless of whether they are based in the EU or EFTA countries or where their operating license has been issued.**

Annex I of the EU ETS Directive also lists several exemptions from the scope of the EU ETS. Exempted are:

- Flights performed by aircraft with a certified maximum take-off mass of less than 5 700 kg. That means in particular that aircraft operators who do not use heavier aircraft are not included in the EU ETS.
- *Commercial air transport operators*[8] operating either:
  - fewer than 243 flights per period for three consecutive four-month periods, or
  - flights with total annual emissions lower than 10 000 tonnes $CO_2$ per year.

  Where the thresholds of this "*de minimis* rule" are exceeded, all flights of that aircraft operator (if not excluded due to the other exemptions) during the whole calendar year are included in the EU ETS.

  Clarifications: Aircraft operators who do not have an air operator's certificate[9] (AOC) are non-commercial operators. The four-month periods are: January to April; May to August; September to December. The local time of departure of the flight determines in which four-month period that flight shall be taken into account for deciding whether the aircraft operator falls above or below the exemption thresholds of the de minimis rule.

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[6] The following overseas territories belong to the "territory to which the Treaty applies": Guadeloupe, French Guiana, Martinique, Réunion, the Azores, Madeira, the Canary Islands, Åland Islands.

[7] See Annex for legislative reference.

[8] Article 3(p) of the EU ETS Directive defines: *'commercial air transport operator' means an operator that, for remuneration, provides scheduled or non-scheduled air transport services to the public for the carriage of passengers, freight or mail.*

[9] Outside the EU other terms for such certificates may be in use.

Further clarifications are given in the Commission's guidance on the interpretation of aviation activities listed in Annex I of the EU ETS Directive[10].

- The following types of flights are also excluded from the EU ETS:
  - flights between aerodromes that are both not situated in an EEA Member State;
  - flights on official mission, of a reigning Monarch and his immediate family, of heads of state, heads of government and government ministers, of a country other than a Member State;
  - military flights performed by military aircraft;
  - flights related to search and rescue, fire fighting flights, humanitarian flights and medical service flights;
  - flights performed exclusively under visual flight rules;
  - circular flights (departing and arriving at the same airport without an intermediate stop);
  - training flights;
  - flights performed exclusively for the purpose of scientific research;
  - flights performed in the framework of public service obligations.

  For more details on these exemptions see the Commission's guidance on the interpretation of aviation activities listed in Annex I of the EU ETS Directive (for reference see footnote No. 10). That guidance gives information on the use of CRCO exemption codes[11] for identifying these exemptions using flight plans.

When an aircraft operator is included in the EU ETS, he must ensure that he is able in a reliable manner to identify for all his flights carried out whether they are falling under the EU ETS. This is achieved by including appropriate procedures in the monitoring plan for tracking the aircraft in his fleet (including various leasing options), and for assigning correctly for each flight whether one of the above-mentioned exemptions are applicable.

## 3.2 Aircraft operators

According to the EU ETS Directive (Article 3(o)), an aircraft operator is "*the person who operates an aircraft at the time it performs an aviation activity listed in Annex I [of the EU ETS Directive] or, where that person is not known or is not identified by the owner of the aircraft, the owner of the aircraft*". For the purpose of monitoring and reporting, a unique identification for the aircraft operator is necessary. Article 50(3) of the M&R Regulation defines that those unique aircraft operators are defined by the call sign used for Air Traffic Control (ATC). In general, this is the unique ICAO designator in box 7 of the flight plan (three letter code, which excludes the flight identifier). When the unique ICAO designator

[10] Commission Decision 2009/450/EC of 8 June 2009 on the detailed interpretation of the aviation activities listed in Annex I to Directive 2003/87/EC of the European Parliament and of the Council, 2009/450/EC.
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:149:0069:0072:EN:PDF

[11] Codes used by Eurocontrol's Central Route Charges Office (CRCO) for identification of route charges exemption.

is not available, the aircraft operator will be identified by the registration marking of the aircraft, which should then be used as a call sign for ATC purposes in the flight plan. Usually the registration marking will concern the owner of the aircraft.

Note: Wherever this guidance uses the term “ICAO designator” it should be read as above, including the aircraft registration markings entered in box 7 of the flight plan if the ICAO designator is not available.

The use of the ICAO designator does not necessarily imply that an aircraft operator is commercially or operationally responsible for a particular flight. This depends in most cases on the type of commercial arrangements between carriers in the aviation sector. Whether code sharing, dry leasing or wet leasing, long or short term leasing is applied by an aircraft operator has no bearing on identifying the aircraft operator.

A daughter company does not have to carry out its own monitoring and reporting (i.e. submit a monitoring plan and annual emission reports) if all flights of the daughter company are performed under the unique ICAO designator of the parent company or another daughter company. The parent or sister company will in that case be the aircraft operator for flights performed by the daughter company and all flights will have to be covered in the monitoring plan and reports of the parent or sister company. An aircraft operator having two Air Operator Certificates but only having one unique ICAO designator should submit one monitoring plan. In case of doubt, Eurocontrol data on payment of route charges will be a useful tool to check assignment of the unique ICAO designator in box 7 of the flight plan to individual aircraft operators within the meaning in the EU ETS.

## 3.3 Administering Member States

As has been discussed in sections 3.1 and 3.2, non-EU aircraft operators are included in the EU ETS equally as EU (and EEA) aircraft operators. In order to ensure an efficient implementation of the EU ETS Directive, each aircraft operator is assigned to one and only one administering Member State (Article 18a of the Directive):

- In the case of an aircraft operator with a valid operating licence granted by a Member State in accordance with the provisions of Council Regulation (EEC) No 2407/92, the Member State which granted the operating licence;
- In all other cases, the Member State with the greatest estimated attributed aviation emissions from flights performed by that aircraft operator in the base year. Those estimated attributed emissions are calculated by Eurocontrol.

The European Commission has to publish a list (or updates thereof) of aircraft operators and their assigned administering Member States each year before 1 February. The latest version of that list (in the form of a Commission Regulation) can be found on the Commission’s website[12]. That list contains for each aircraft operator identified by Eurocontrol:

- Its “unique identifier” (identical to the CRCO Identification Number used for invoicing route charges);

[12] http://ec.europa.eu/clima/policies/transport/aviation/operators/index_en.htm

- The name of the aircraft operator;
- The aircraft operator's state of origin; and
- The administering EEA state.

The unique identifier is also very important for identifying the aircraft operator's monitoring plans and emission reports and (if applicable) tonne-kilometre reports.

For aircraft operators who start operation of aviation activities which fall under the EU ETS, but are not yet contained in the above-mentioned list, the Commission regularly updates a "prior compliance list", which gives an indication of the most likely administering Member State well before the next regular operator list is published. The prior compliance list can be found under

http://ec.europa.eu/clima/policies/transport/aviation/operators/docs/prior_compliance_list_en.pdf.

Furthermore Eurocontrol and the Commission are interested in improving the data quality of those lists. In particular aircraft which may belong (sometimes) to a specific aircraft operator but are also operated outside that aircraft operator's business, or which are (sometimes, but not always) managed by service companies, should be notified to Eurocontrol. For further instructions please see

http://ec.europa.eu/clima/policies/transport/aviation/operators/index_en.htm

Knowing the administering Member State is important for aircraft operators, because the national law of the administering Member State applies. Note that the general legal framework of the EU ETS is the same in all Member States, based on the EU ETS Directive. However, there may be some differences in some details such as deadlines or administrative fines applied. The M&R Regulation and A&V Regulation are directly applicable in all Member States.

The administering Member State also assigns the competent authority in line with its national legislation. Any reference to "competent authority" made in this document should be read as the appropriately designated authority or authorities in the aircraft operator's assigned administering Member State.

## 3.4 Relevance of tonne-kilometre data

Each aircraft operator has to monitor his annual emissions from activities falling under the EU ETS. However, the MRR and this guidance document also discuss the voluntary monitoring of "tonne-kilometre" data (also referred to as "t-km" data). Only when the aircraft operator applies for free allocation of allowances, does a verified t-km data report have to be attached.

Tonne-kilometre data have to be monitored for the relevant "monitoring years" only. These are:

- The year 2010 for free allocation for the years 2012 to 2020 (applications filed in 2011; see Article 3e(1) of the EU ETS Directive);

- The year ending 24 months before the start of the next trading period. This means that for allocations from 2021 onwards, the monitoring must be done in 2018, and the application filed by 31 March 2019.
- For applications from the "special reserve"[13] (Article 3f of the EU ETS Directive): The second year of the trading period has to be monitored if an aircraft operator wants to file an application for allocation from the special reserve. These are 2014, 2022 etc.

The Commission calculates a benchmark (allowances per t-km) after having received all relevant t-km data from the Member States, for allowing the Member States to calculate the allocation to aircraft operators.

For more details on the application for free allowances, please contact your competent authority.

[13] Such applications may be filed by aircraft operators who

(a) start performing an aviation activity falling within Annex I after the monitoring year for which tonne-kilometre data was submitted for "normal" allocation; or

(b) whose tonne-kilometre data increases by an average of more than 18 % annually between the monitoring year for which tonne-kilometre data was submitted and the second calendar year of that trading period;

and whose activity under point (a), or additional activity under point (b), is not in whole or in part a continuation of an aviation activity previously performed by another aircraft operator.

The Commission may provide further guidance on the detailed rules on the operation of the special reserve (Article 3f of the EU ETS Directive).

# 4 THE EU ETS COMPLIANCE CYCLE

## 4.1 Importance of MRV in the EU ETS

Monitoring, reporting and verification (MRV) of emissions play a key role in the credibility of any emission trading system. Without MRV, compliance would lack transparency and be much more difficult to track, and enforcement compromised. This holds true also for the Union Emission Trading Scheme (EU ETS). It is the complete, consistent, accurate and transparent monitoring, reporting and verification system that creates trust in emissions trading. Only in this way can it be ensured that operators and aircraft operators meet their obligation to surrender sufficient allowances.

This observation is based on the twofold nature of the EU ETS: On the one hand it is a market based instrument. It has allowed a significant market to evolve, in which market participants want to know the monetary value of the allowances they get allocated, they trade and they have to surrender. On the other hand it is an instrument for achieving an environmental benefit. But in contrast to other environmental legislation, the goal is not to be achieved by individuals, but the whole group of EU ETS participants having to achieve the goal jointly. This requires a considerable level of fairness between participants, ensured by a solid MRV system. The competent authorities' oversight activities contribute significantly to ensuring that the goal set by the cap is reached, meaning that the anticipated emission reductions are delivered in practice. It is therefore the responsibility of the competent authorities together with the accreditation bodies to protect the integrity of the EU ETS by supervising the well-functioning of the MRV system.

Both, carbon market participants and competent authorities want to have assurance that one tonne $CO_2$ equivalent emitted finds its equivalent of one tonne reported (for the purpose of one allowance to be surrendered). This principle has become known already from the early days of the EU ETS as the proverbial postulation: **"A tonne must be a tonne!"**

In order to ensure that this is achieved in a robust, transparent, verifiable and yet cost effective way, the EU ETS Directive[14] provides a solid basis for a good monitoring, reporting and verification system. This is achieved by Articles 14 and 15 in connection with Annexes IV and V of the EU ETS Directive. Based on Article 14, the Commission has provided the "M&R Regulation[15]" (MRR), which replaces the well-known Monitoring and Reporting Guidelines (MRG 2007) for emissions starting from 1 January 2013.

However, it has always been recognised by the Commission as well as by Member States that a complex and technical legislation such as the MRR needs to be supported by further guidance, in order to ensure harmonised implemen-

[14] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC; most recently amended by Directive 2009/29/EC, making it the so-called "revised EU ETS Directive".

[15] Commission Regulation (EU) No. 601/2012 of 21 June 2012 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council. Download: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:181:0030:0104:EN:PDF .

tation throughout all Member States, and for paving the way to smooth compliance through pragmatic approaches wherever possible.

Furthermore a Regulation for verification and accreditation of verifiers has been provided (the "A&V Regulation"[16]), for which a separate series of guidance documents is being developed by the Commission.

## 4.2 Overview of the compliance cycle

The annual process of monitoring, reporting, verification of emissions and the competent authority's procedure for accepting emission reports are often referred to as the "compliance cycle". Figure 1 shows the main elements of this cycle.

On the right side of the picture there is the "main cycle": The aircraft operator monitors the emissions throughout the year. After the end of the calendar year (within three months[17]) he must prepare the annual emissions report (AER), seek verification and submit the verified report to the competent authority (CA). The latter must correlate with the surrender of allowances in the Registry system[18]. Here the principle "a tonne must be a tonne" translates into "a tonne must be an allowance", i.e. at this point the market value of the allowance is correlated with the costs of meeting the environmental goal of the EU ETS. Thereafter the monitoring goes on, as shown in the picture. More precisely, the monitoring continues without any stop at the end of the year.

The monitoring process needs a firm basis. Resulting data must be sufficiently robust for creating trust in the reliability of the ETS, including the fairness of the surrender obligation, and it must be consistent throughout the years. Therefore the aircraft operator must ensure that the monitoring methodology is documented in writing, and cannot be changed arbitrarily. In the case of the EU ETS, this written methodology is called the Monitoring Plan (MP) of the aircraft operator (see Figure 1). It is a requirement for aircraft operators under Article 3g of the EU ETS Directive.

The figure also shows that the monitoring plan, although very specific for an individual aircraft operator, must follow the requirements of the EU-wide applicable legislation, in particular the Monitoring and Reporting Regulation. As a result, the MRV system of the EU ETS is able to square the circle between strict EU-wide rules providing reliability and preventing arbitrary and undue simplifications, and allowing for sufficient flexibility for the circumstances of individual aircraft operators.

[16] Commission Regulation (EU) No 600/2012 of 21 June 2012 on the verification of greenhouse gas emission reports and tonne-kilometre reports and the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council. Download under **http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:181:0001:0029:EN:PDF** .

[17] According to national legislation, this period may be shorter, see footnote 22.

[18] For the purpose of simplification, the surrender of allowances has not been included in the picture. Similarly, the picture also ignores the processes of allocation and trading of allowances.

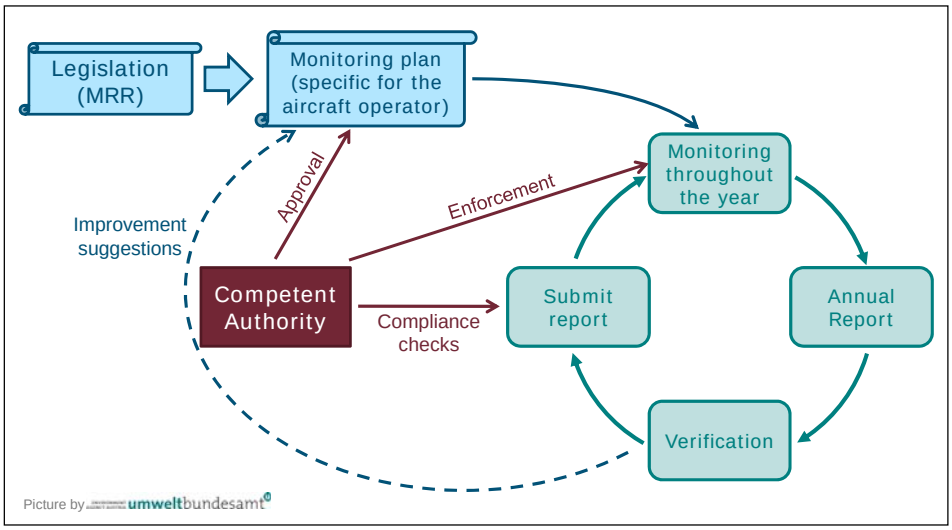


*Figure 1: Principle of the EU ETS compliance cycle*

Figure 1 also shows some key responsibilities of the competent authority. It has to supervise the compliance of aircraft operators. As the first step, the CA has to approve every monitoring plan before it is applied. This means that the monitoring plans developed by the aircraft operator are checked for compliance with the MRR's requirements. Where the aircraft operator makes use of simplified approaches allowed by the MRR, this must be justified by the aircraft operator, for example, based on the grounds of technical feasibility or unreasonable costs, where otherwise required higher tiers cannot be achieved.

It is furthermore the responsibility of the competent authority to carry out checks on the annual emission reports, as appropriate. This includes spot checks on the already verified reports, but also cross-checks with figures entered in the verified emissions table of the registry system, and checking that sufficient allowances have been surrendered.

However, the compliance cycle has a wider perspective. As Figure 1 shows, there is a second cycle. This is the regular review of the monitoring plan, for which the verification report may provide valuable input. Besides, the aircraft operator is required to continuously strive for further improving the monitoring methodology.

## 4.3 The importance of the monitoring plan

From the previous section it becomes apparent, that the approved monitoring plan is the most important document for every aircraft operator participating in the EU ETS. Like a recipe for a cook and like the management handbook for a certified quality management system, it serves as manual for the aircraft operator's tasks. Therefore it should be written in a way that allows all, particularly new staff to immediately follow the instructions. It must also allow the CA to understand quickly the aircraft operator's monitoring activities. Finally, the MP is *the* guide for the verifier against which the aircraft operator's emission report is to be judged.

Typical elements of a monitoring plan include the following activities of the aircraft operator (applicability depends on the specific circumstances):

- Data collection (metering data, invoices, flight logs,...);
- Description of calculations and formulae to be used;
- Control activities (e.g. four eyes principle for data collection);
- Data archiving (including protection against manipulation);
- Regular identification of improvement possibilities.

However, monitoring plans must be drafted carefully (→ chapter 6), so that administrative burden is minimised. Since the MP is to be approved by the competent authority, it goes without saying that also changes of the MP are only allowed with the consent of the CA. The M&R Regulation reduces the administrative efforts here by allowing two approaches which should already be taken into account when drafting monitoring plans:


- Only changes which are "significant" need the approval by the CA (Article 15 of the MRR, see section 6.5 below);
- Monitoring activities which are not crucial in every detail, and which by their nature tend to be frequently amended as found necessary, may be put into "written procedures", which are mentioned and described briefly in the MP, but the detail of which are not considered part of the approved MP. The relationship between monitoring plan and written procedures is described in more detail in section 6.2.

Because of the importance of the monitoring plan, the Commission is also providing templates for monitoring plans. Some Member States might have provided customized templates based on the Commission's templates, other Member States use a dedicated (usually web-based) electronic reporting system (that must also meet at least stated Commission requirements). Before developing a monitoring plan, aircraft operators are therefore advised to check their competent authority's website or make direct contact with the CA for finding out the concrete requirements for submitting a monitoring plan. National legislation of the administering Member State may also state specific requirements.

## 4.4 Milestones and deadlines

### 4.4.1 The annual compliance cycle

The EU ETS compliance cycle is built around the requirement that monitoring is always related to the calendar year[19], as shown in Table 1 and Figure 2.

The monitoring plan should be approved by the competent authority before the start of the first year for which emissions are to be reported (i.e. the first year of the trading period, such as 2013). However, for new aircraft operators, Article 51 of the MRR requires the monitoring plans to be submitted to the competent authority at the latest four months before he commences aviation activities covered by the EU ETS.

In practice this is often difficult to achieve (sometimes aircraft operators do not know very far in advance that they will operate flights to destinations in the EEA). Furthermore some aircraft operators will not know early enough which Member State will be their administering MS (see section 3.3). Therefore, Article 51 allows the following derogations:

- An aircraft operator that performs an aviation activity covered by the EU ETS for the first time that could not be foreseen four months in advance, shall submit a monitoring plan to the competent authority *without undue delay, but no later than six weeks after performance of that activity*. A justification must be attached.
- Where the administering Member State is not known in advance, the aircraft operator shall without undue delay submit the monitoring plan when information on the competent authority of the administering Member State becomes available (i.e. when the aircraft operator appears on the "prior compliance list", he should contact that Member States' competent authority, and at the latest when the regular aircraft operator list is published by the Commission, see section 3.3)

Aircraft operators have three months[20] after the end of the year to finalise the emission reports and to get them verified by an accredited verifier in accordance with the A&V Regulation. Thereafter aircraft operators have to surrender the corresponding amount of allowances. Subject to national legislation, the competent authority of the administering MS may or shall perform (spot) checks on the reports received, and must determine a conservative estimate of the emissions, if the aircraft operator fails to submit an emissions report, or where a report has been submitted, but it is either not compliant with the MRR or not (positively) verified in accordance with the A&V Regulation (Article 70(1) of the MRR). When the CA detects any kind of errors in the submitted reports, corrections to the verified emissions figure may be a result. Note that for such corrections no deadline is given by EU legislation. However, there may be some requirement given in national legislation.

[19] Article 12(3) of the MRR defines: '*reporting period' means one calendar year during which emissions have to be monitored and reported* […].

[20] According to national legislation, this period may be shorter, see footnote 22.

*Table 1: Common timeline of the annual EU ETS compliance cycle for emissions in year N.*

| When? | Who? | What? |
|---|---|---|
| 1 January N | | Start of monitoring period |
| By 28 February N | CA | Allocation of allowances for free (if applicable) on the aircraft operator's account in the Registry |
| 31 December N | | End of monitoring period |
| Before 1 February N+1 | European Commission | Update and publish a list of aircraft operators specifying the administering Member State for each aircraft operator |
| by 31 March[21] N+1 | Verifier | Finish verification and issue verification report to operator |
| By 31 March[22] N+1 | Aircraft operator | Submit *verified* annual emissions report |
| By 31 March N+1 | Aircraft operator / Verifier[23] | Enter verified emissions figure in the verified emissions table of the Registry |
| March – April N+1 | CA | Subject to national legislation, possible spot checks of submitted annual emissions reports. Require corrections by aircraft operator, if applicable. N.B. Subject to national legislation, there is no obligation for CAs to provide assistance or acceptance of aircraft operator reports either before or after 30 April). |
| By 30 April N+1 | Aircraft operator | Surrender allowances (amount corresponding to verified annual emissions) in Registry system |
| By 30 June N+1 | Aircraft operator | Submit report on possible improvements of the MP, if applicable[24] |
| (No specified deadline) | CA | Carry out further checks on submitted annual emissions reports, where considered necessary or as may be required by national legislation; require changes of the emissions data and surrender of additional allowances, if applicable (in accordance with administering Member State legislation. |

Figure 2 also suggests indicative timings for the verification process. Experience has shown that the availability of verifiers may be a bottleneck in some Member States, especially if the whole verification process is performed in the first three months of the year. However, several parts of the verification process can be performed well before the end of the reporting year. Therefore the advice to the aircraft operator is to contract a verifier early in the reporting year, ideally soon after the previous report has been submitted in March. The verifier

[21] Footnote 22 applies here as well.

[22] According to Article 67(1), competent authorities may require operators or aircraft operators to submit the verified annual emission report earlier than by 31 March, but by 28 February at the earliest.

[23] This may be regulated differently in the Member States.

[24] For aircraft operators only the improvement reports in accordance with Article 69(4) of the MRR are relevant, i.e. the ones to be submitted in the year where a verifier reports improvement recommendations. The CA may set a different deadline, but no later than 30 September of that year.

is then able to plan and perform much of the required work throughout the rest of the year, leaving only the final checks and the issuing of the verification report for the first quarter of the following year.

Finally, it has to be mentioned that further requirements apply which are not listed here. In particular, as discussed in section 6.5, the aircraft operator has to update the monitoring plan throughout the year where relevant, and the competent authority has to assess and approve it where relevant.

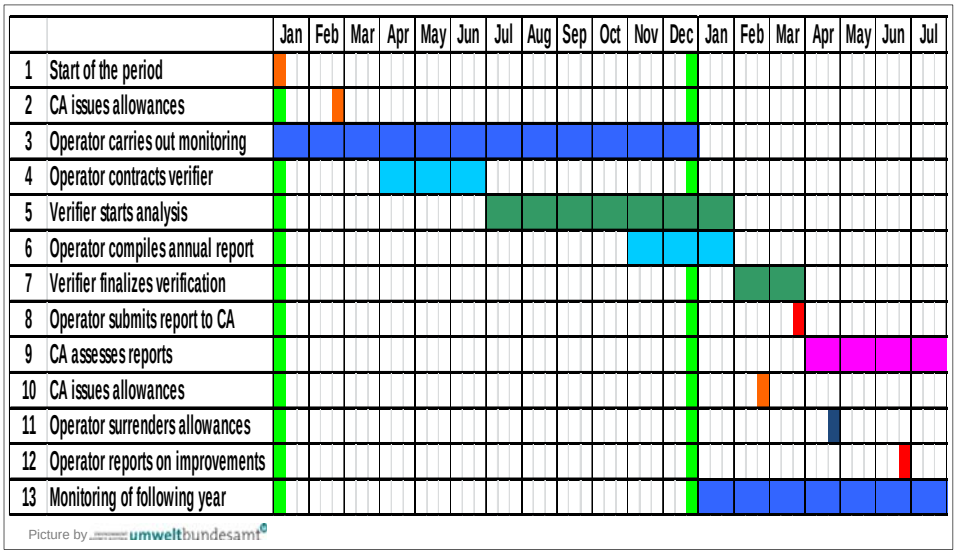


*Figure 2: Example timeline for the EU ETS compliance cycle. "Operator" should be read as "aircraft operator".*

### 4.4.2 Preparing for the third trading period

In order to make the compliance cycle work, the monitoring plans of all aircraft operators need to be approved by the competent authority before the start of the monitoring period. For new participants in the EU ETS, the MP must be approved before the start of operations, or without undue delay after receiving certainty about the administering Member State (see section 4.4.1). For the start of the third trading phase the transition from MRG 2007 to the application of the MRR requires that the monitoring plans of all aircraft operators be revised and adapted to the new requirements. Based on experience from previous ETS phases, such a general revision process may require several months and should be well prepared. For the purpose of providing additional guidance, a (legally non-binding) timeline is presented here. Relatively long timescales are assumed, as required for the most complex aircraft operators, as follows: Firstly, preparation of the monitoring plan by the aircraft operators can take up to several months, depending on the complexity of their operations. However, for simple aircraft operators, the monitoring plan may be compiled within a few working days.

Because the CA will also need a few weeks or months for assessing all submitted MPs (depending on current workload) and because aircraft operators will

then need some weeks for finally implementing the new approved MP, it can be envisaged that the CA should start early with workshops and other information for aircraft operators as considered appropriate. This especially concerns 2012 (the year before the MRR is to be applied). Aircraft operators in turn should prepare the new monitoring plans early enough for submission of MPs by the middle of the year, but at the latest by end of September[25]. An example timeline is shown in Table 2.

*Table 2: Model timeline for preparing the EU ETS compliance cycle for the start of the new trading period. Note that deadlines may significantly differ according to the Member States.*

| When? | Who? | What? |
|---|---|---|
| May – Sept. 2012 | Aircraft Operator | Check existing MP for required updates, or develop new MP, as applicable |
| July – Sept. 2012 | CA | Suggested deadline for receiving new or updated MP from operators |
| July – Dec. 2012 | CA | Check and approve MPs |
| Oct. – Dec. 2012 | Aircraft operator | Prepare for implementation of approved MP |
| 1 January 2013 | | Start of monitoring period using the new MRR requirements |

## 4.5 Roles and responsibilities

The different responsibilities of the aircraft operators, verifiers and competent authorities are shown in Figure 3, taking into account the activities mentioned in the previous sections. For the purpose of completeness, also the accreditation body is included. The picture clearly shows the high level of control which is efficiently built into the MRV system. The monitoring and reporting is the main responsibility of the aircraft operators (who are also responsible for hiring the verifier and for providing all relevant information to the verifier). The CA approves the monitoring plans, receives and checks the emission reports and may make corrections to the verified emissions figure where errors are detected. Thus, the CA is in control over the final result. Finally, the verifier is ultimately answerable to the accreditation body[26]. Note that based on Article 65 of the A&V Regulation, Member States must also monitor the performance of their national accreditation bodies, thereby fully ensuring the integrity of the EU ETS system of MRV and accreditation.

[25] Note that the concrete deadlines set by competent authorities in the Member States may differ from this assumption.

[26] The A&V Regulation also allows in exceptional cases verifiers (if natural persons) to be certified and supervised by a national authority appointed by that Member State (in accordance with AVR Article 54).

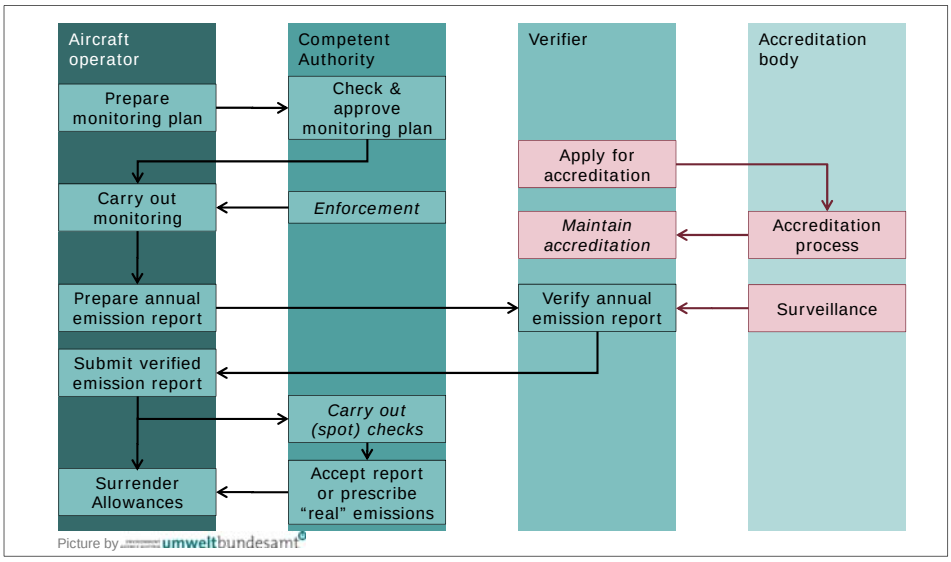


*Figure 3: Overview of responsibilities of the main actors in the EU ETS. Regarding "Accreditation body" see also footnote 26.*

# 5 CONCEPTS AND APPROACHES

This chapter is dedicated to explaining the most important terms and concepts needed for developing a monitoring plan.

## 5.1 Underlying principles

Articles 5 to 9 of the MRR outline the guiding principles which the aircraft operators have to follow when fulfilling their obligations. These are:

- **Completeness** (Article 5): The completeness of emission sources and source streams is at the very core of the EU ETS monitoring principles. This is why the aircraft operator has to implement a procedure for keeping track of his fleet, i.e. all aircraft carrying out activities covered by the EU ETS, including leased-in aircraft, in order to ensure completeness of the emissions monitored.
- **Consistency and comparability** (Article 6(1)): Time series[27] of data need to be consistent throughout the years. Arbitrary changes of monitoring methodologies are prohibited. This is why the monitoring plan has to be approved by the competent authority, such as also significant changes to the MP.
- **Transparency** (Article 6(2)): All data collection, compilation and calculation must be made in a transparent way. This means that the data itself, the methods for obtaining and using them (in other words: the whole data flow) have to be documented transparently, and all relevant information has to be securely stored and retained allowing for sufficient access by authorised third parties. In particular, the verifier and the competent authority must be allowed access to this information.
  It is worth mentioning that transparency is in the own interest of the aircraft operator: It facilitates transfer of responsibilities between existing and new staff and reduces the likelihood of errors and omissions. In turn this reduces the risk of over-surrendering, or under-surrendering and penalties. Without transparency, the verification activities are more onerous and time-consuming.
  Furthermore Article 66 of the MRR specifies that relevant data is to be stored for 10 years. The minimum data to be retained is listed in Annex IX of the MRR.
- **Accuracy** (Article (7)): Aircraft operators have to take care that data is accurate, i.e. neither systematically nor knowingly inaccurate. Due diligence is required by aircraft operators, striving for the highest achievable accuracy. As the next point shows, “highest achievable” may be read as where it is technically feasible and “without incurring unreasonable costs”.
- **Integrity of methodology** (Article 8): This principle is at the very heart of any MRV system. The MRR mentions it explicitly and adds some elements that are needed for good monitoring:

[27] This does not imply a requirement to produce time series of data, but assumes that the aircraft operator, verifier or competent authority may use time series as a means of consistency checks.

- The monitoring methodology and the data management must allow the verifier to achieve "reasonable assurance[28]" on the emissions report, i.e. the monitoring must be able to endure a quite intensive test;
- Data shall be free from material[29] misstatements and avoid bias;
- The data shall provide a credible and balanced account of an aircraft operator's emissions.
- When looking for greater accuracy, aircraft operators may balance the benefit against additional costs. They shall aim for "highest achievable accuracy, unless this is technically not feasible or would lead to unreasonable costs".

- **Continuous improvement** (Article 9): In addition to the requirement of Article 69, which requires the aircraft operator to submit reports on improvement possibilities if appropriate, this principle also is the foundation for the operator's duty of responding to the verifier's recommendations (see also Figure 1 on page 16).

## 5.2 Source streams and emission sources

The MRR uses some terms for appropriately covering some concepts which apply to installations as well as aircraft operators. For aircraft operators the following two terms might need some interpretation:

- **Emission source:** The M&R Regulation defines (Article 3(5)): "'emission source' means a separately identifiable part of an installation or a process within an installation, from which relevant greenhouse gases are emitted or, for aviation activities, an individual aircraft". For ensuring the completeness of monitoring, the aircraft operator must ensure that he always tracks the completeness of his emission sources, i.e. the fleet of aircraft currently operating, including leased-in aircraft.
- **Source streams**[30]: From aircraft operator's view this term simply concerns "fuel". Where an aircraft operator only uses one type of fuel, as is typically the case at the present time, he has only one source stream. However, different types of fuel constitute different source streams.

## 5.3 The tier system

The EU ETS system for monitoring and reporting provides for a building block system of monitoring methodologies. Each parameter needed for the determi-

[28] Article 3(18) of the A&V Regulation defines: "*'reasonable assurance' means a high but not absolute level of assurance, expressed positively in the verification opinion, as to whether the operator's or aircraft operator's report subject to verification is free from material misstatement.*" For more details on the definition this term, see guidance documents on the A&V guidance. Section 2.3 provides a link to those documents.

[29] See footnote 28.

[30] MRR Article 3(4): 'source stream' means any of the following:
(a) a specific fuel type, raw material or product giving rise to emissions of relevant greenhouse gases at one or more emission sources as a result of its consumption or production;
(b) a specific fuel type, raw material or product containing carbon and included in the calculation of greenhouse gas emissions using a mass balance methodology"

nation of emissions can be determined by different "data quality levels". These "data quality levels" are called "tiers"[31]. In general it can be said that a tier with a lower number represents a method with lower requirements and less accurate than a higher tier. For aircraft operators there are only a few parameters for which a selection from tiers is possible:

- Fuel consumption;
- Emission factors;
- Mass of passengers (as part of the payload required regarding t-km data).

## 5.4 Monitoring approaches for emissions

### 5.4.1 General approach

Aircraft operators determine $CO_2$ emissions using a simplified version of the standard methodology for combustion emissions[32], using the following formula:

$$Em = AD \cdot EF \qquad (1)$$

Where:

*Em* ..... Emissions [t $CO_2$]

*AD*..... Activity data (=amount of fuel consumed) [t]

*EF* ..... Emission factor [t $CO_2$/t fuel]

Note that unlike installations, aircraft operators always report the activity data as tonnes of fuel, not based on the calorific value. However, for consistency reasons, the Net Calorific Value (NCV) of the fuel has to be reported as a memo-item.

This calculation is to be carried out in principle for each individual flight. For reporting purposes, all fuel consumptions of the same type of fuel can be summed up. However, for the annual emissions report an aggregation of emissions per aerodrome pair and per country of departure and arrival is also to be prepared. Aircraft operators should ensure that their electronic data processing systems are capable of ensuring those aggregations.

### 5.4.2 Definition of a 'flight'

The guidelines in Commission Decision 2009/450/EC define: "*The term 'flight' means one flight sector that is a flight or one of a series of flights which commences at a parking place of the aircraft and terminates at a parking place of the aircraft.*" In simpler wording, this means "from one block-off to the next block-off" (Method A), or "from one block-on to the next block-on" (Method B).

Note that the fuel consumption of the auxiliary power unit (if any) is included consistently in both monitoring methods (see section 5.4.3). For avoiding data gaps or double counting, it is important to use consistently for each aircraft only either Method A or Method B.

[31] Article 3(8) of the MRR defines: 'tier' means a set requirement used for determining activity data, calculation factors, annual emission and annual average hourly emission, as well as for payload.

[32] For more information see guidance document No. 1 (general guidance for installations).

### 5.4.3 Amount of fuel consumed

The M&R Regulation allows two different approaches (Method A and Method B, see section 1 of Annex III of the MRR) for determining fuel consumption of a flight which is covered by the EU ETS (flight N):

**Method A**[33]: The operator shall use the following formula:

$$F_{N,A} = T_N - T_{N+1} + U_{N+1} \quad (2)$$

Where:

$F_{N,A}$..... Fuel consumed for the flight under consideration (=flight N) determined using method A [t]

$T_N$..... Amount of fuel contained in aircraft tanks once fuel uplift for the flight under consideration (=flight N) is complete [t]

$T_{N+1}$ ..... Amount of fuel contained in aircraft tanks once fuel uplift for the subsequent flight (=flight N+1) is complete [t]

$U_{N+1}$..... Fuel uplift for the subsequent flight (=flight N+1) [t]

**Method B**[34]: The operator shall use the following formula:

$$F_{N,B} = R_{N-1} - R_N + U_N \quad (3)$$

Where:

$F_{N,B}$..... Fuel consumed for the flight under consideration (=flight N) determined using method B [t]

$R_{N-1}$..... Amount of fuel remaining in aircraft tanks at the end of the previous flight (=flight N–1), i.e. at block-on before the flight under consideration, expressed in [t]

$R_N$..... Amount of fuel remaining in aircraft tanks at the end of the flight under consideration (=flight N), i.e. at block-on after the flight, expressed in [t]

$U_N$..... Fuel uplift for the flight considered, expressed in [t]

For ensuring completeness of the data, it is important to note that not only data generated during the duty of the one flight's crew is needed, but also data generated from the subsequent flight (Method A) or the previous flight (Method B). This is in particular important when a non-ETS flight is followed by an ETS flight, or vice versa. For avoiding data gaps it is therefore recommended that (depending on the Method applied), the amount of fuel remaining in the tank after the flight or the amount of fuel in the tank after fuel uplift is *always*

[33] Section 1 of Annex III of the MRR: "*Actual fuel consumption for each flight [t] = Amount of fuel contained in aircraft tanks once fuel uplift for the flight is complete [t] – Amount of fuel contained in aircraft tanks once fuel uplift for subsequent flight is complete [t] + Fuel uplift for that subsequent flight [t]*"

[34] Section 1 of Annex III of the MRR: "*Actual fuel consumption for each flight [t] = Amount of fuel remaining in aircraft tanks at block-on at the end of the previous flight [t] + Fuel uplift for the flight [t] - Amount of fuel contained in tanks at block-on at the end of the flight [t]*"

recorded on flights of aircraft which are used for EU ETS flights. For the same reasons, fuel uplift data for *all* flights of those aircraft should be collected, before deciding which flights are covered by the EU ETS (see section 3.1)

**Treatment of special situations:**

**Method A**: Where no fuel uplift for the flight or subsequent flight takes place, the amount of fuel contained in aircraft tanks ($T_N$ or $T_{N+1}$) shall be determined at block-off for the flight or subsequent flight.

In exceptional cases the variable $T_{N+1}$ cannot be determined. This is the case when an aircraft performs activities other than a flight, including undergoing major maintenance involving the emptying of the tanks, after the flight to be monitored. In such case the aircraft operator may substitute the quantity "$T_{N+1} + U_{n+1}$" with the 'Amount of fuel remaining in tanks at the start of the subsequent activity[35] of the aircraft', as recorded by technical logs.

**Method B**: For simplification, the moment of block-on may be considered equivalent to the moment of engine shut down.

Where an aircraft does not perform a flight previous to the flight for which fuel consumption is being monitored (e.g. if the flight follows a major revision or maintenance), the aircraft operator may substitute the quantity $R_{N-1}$ with the 'Amount of fuel remaining in aircraft tanks at the end of the previous activity of the aircraft', as recorded by technical logs.

### 5.4.4 Comparing Method A and B

The difference between Method A and B can best be explained by the following example highlighted in the figure below which shows that Method A has different end and starting points for the monitoring of the fuel consumption compared to Method B.

Figure 4 shows the changes of the fuel level in the aircraft tank and highlights which measurements have to be taken for calculating fuel consumption with Method A or B. Measurements "A" are taken after the fuel uplift. Measurements "B" are taken on block-on at the end of the previous flight or engine shut down.

[35] This is the activity which is not a flight.

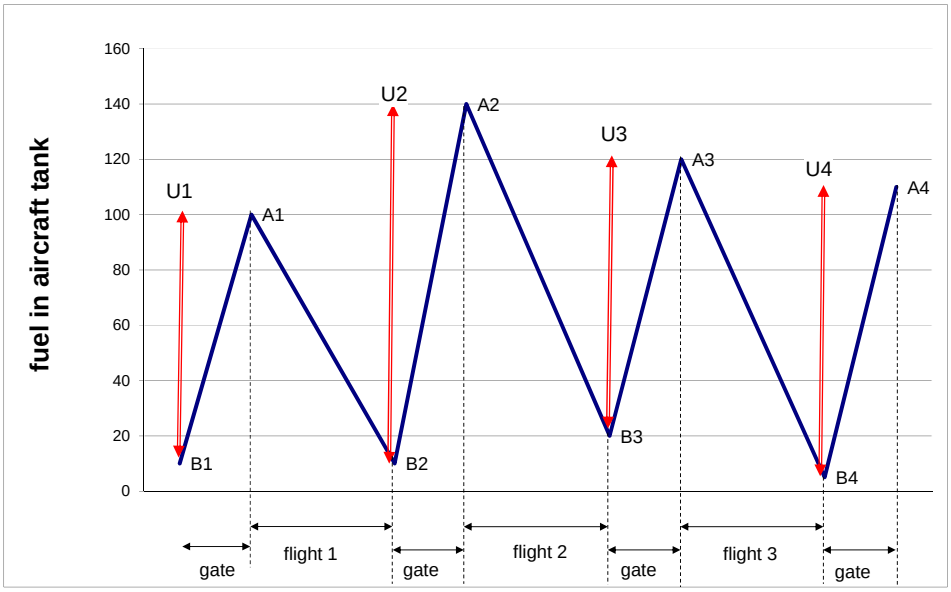


*Figure 4: Illustration of the two monitoring methods for fuel consumption of aircraft operators. For explanation please see the main text. (Picture by PriceWaterhouseCoopers[36])*

In this example the fuel consumption according to Method A and according to Method B respectively would be calculated in the following manner:

| | Method A | Method B |
|---|---|---|
| Fuel consumption flight 1 | A1 – A2 + U2 | B1 + U1 – B2 |
| Fuel consumption flight 2 | A2 - A3 + U3 | B2 + U2 – B3 |
| Fuel consumption flight 3 | A3 – A4 + U4 | B3 + U3 – B4 |

In both methods subsequent EU ETS flights are monitored without time gap between the flights. When monitoring the fuel consumption of a flight, the data from the previous flight and subsequent flights have to be available and taken into account, even if non-EU ETS activities are concerned.

### 5.4.5 Tiers for fuel consumption

For the fuel consumption, the MRR defines two different tiers (section 2 of Annex III of the MRR):

- Tier 1: The maximum uncertainty regarding the overall amount of fuel in tonnes consumed by an aircraft operator over the reporting period is equal or less than ±5.0%.

[36] Guidance for the Aviation Industry, commissioned by the Dutch government, 2009.

- Tier 2: The maximum uncertainty regarding the overall amount of fuel in tonnes consumed by an aircraft operator over the reporting period is equal or less than ±2.5%.

For the topic of uncertainty assessment please see section 6.4.

In principle, aircraft operators shall apply tier 2 (Article 52(5)). However, tier 1 may be applied:

- for all source streams of aircraft operators, if the aircraft operator's annual average reported emissions in the previous trading period have been equal or less than 50 000 t fossil $CO_2$ per year; and
- by all operators for all "minor" source streams[37].

Where reported emissions are not available or no longer applicable for this categorisation, the aircraft operator may use a conservative estimate or projection to determine the average annual emissions.

### 5.4.6 Density

If the amount of fuel uplift or the amount of fuel remaining in the tanks is determined in units of volume (litres, US gallons or $m^3$), these values have to be converted to mass values by using actual density values. The following formula shall be used:

$$\boxed{M = V \cdot \rho \cdot f} \qquad (4)$$

Where:

$M$..... Mass of fuel [t]

$V$ ..... Volume of fuel, expressed as litres [L]

$\rho$..... (Actual) Density, expressed as [kg/L]. "Actual density" means density determined for the applicable temperature.

$f$..... Correction factor for making units consistent. If $\rho$ is expressed as [kg/L], the value of $f$ is 1t/1000kg. If $V$ or $\rho$ are expressed using non-SI units, such as gallons, lb/gal etc., appropriate values for the conversion factor $f$ must be used[38].

This formula and appropriate actual density values must also be used when invoices from fuel suppliers are used to determine the fuel uplift and the fuel supplier has measured the fuel uplift as volume.

The options for determining the fuel density are the following:

- actual density of fuel in tanks measured using on-board measurement systems;
- actual density of each fuel uplift as recorded on the fuel invoice or delivery note;

[37] These are source streams which jointly correspond to less than 5 000 t fossil $CO_2$ per year, or less than 10%, up to a maximum contribution of 100 000 t fossil $CO_2$ per year, whichever is highest in terms of absolute value.

[38] For the definition of the SI system of units (the "metric system"), see http://www.bipm.org/en/si/. Conversion factors to US units can be found on the website of the U.S. National Institute of Standards and Technology (NIST), in particular under http://www.nist.gov/pml/wmd/pubs/upload/AppC-12-hb44-final.pdf

- If none of the above is available, a standard density of 0.8 kg/litre is used (subject to approval by the competent authority, Article 52(6)).

The use of temperature-density correlations tables is not an option any more.

In some airports the fuel density is not determined per fuel supply. In those situations a daily average value of the fuel density may be available. It is recommended that the aircraft operator should conclude a suitable agreement with the fuel supplier or another service company at the aerodrome for regular transmission of those data.

### 5.4.7 Emission factors

In general the aviation sector uses only a few types of – highly standardised – fuels. For the most commonly used fuels (Jet kerosene (Jet A1 or Jet A), Jet gasoline (Jet B) and Aviation gasoline (AvGas)), the MRR contains default values for the emission factor (Section 3 of Annex III of the MRR). For other fuels the emission factor has to be determined in accordance with Article 32, i.e. by laboratory analyses (see guidance documents No. 1 and 5). However, the required information (carbon content / emission factor and net calorific value) may also be taken from purchasing records provided by the fuel supplier, provided that they have been derived based on internationally accepted standards (Article 52(8)).

Note that for reporting purposes, the use of the default values listed in Annex III of the MRR is considered tier 1, while use of other emission factors is considered tier 2.

### 5.4.8 Biofuels

*Note: This section should not be read without also checking the simplified proposal in section 5.4.9.*

New!

Where biofuels are used, the emission factor is determined from the preliminary emission factor and the biomass fraction of the fuel:

$$EF = EF_{pre} \cdot (1 - BF) \quad (5)$$

Where:

*EF* ..... Emission factor;

$EF_{pre}$ .... Preliminary emission factor (i.e. the emission factor if assumed that the fuel is completely from fossil origin, see Article 3(35));

*BF* ..... biomass fraction [dimensionless], i.e. the percentage of carbon contained in the fuel which is considered biomass.

Note that the emission factor of biomass as defined by the MRR is zero. The above formula ensures that fuels containing a defined quantity of biofuel are correctly taken into account.

**In order for biofuels to be zero-rated (i.e. for applying an emission factor of zero), the biofuel must satisfy the sustainability criteria defined by the RES Directive[39].**

**Guidance document No. 3 (Biomass issues in the EU ETS) describes in detail how those criteria apply, and under which conditions purchase records may be used for obtaining the required information.**

### 5.4.9 Attribution of (bio-)fuel to flights

If for subsequent flights different types of fuel are uplifted (in particular biofuels of different biomass fractions, and fossil fuels), and the aircraft does not carry out exclusively EU ETS flights, the different fuels should be attributed to the different flights as much corresponding to real fuel consumption as possible. This is in particular important where double counting of the same amount of biofuel is to be avoided under different GHG emission reduction schemes. For this purpose, the following principle recommendation is given:

- The fuel uplift should always be assigned to the flight following that uplift.

  Note: Where Method A is used, this means that in addition to the usual data also the fuel uplift *before* the flight must be recorded. However, this means an additional effort only in case of an EU ETS flight following a non-ETS flight.
- It is assumed that usually significantly more fuel is consumed during the flight than remains in the tank. For mixed biofuels it can be usually assumed as a simplification that the fuel remaining in the tank is fossil fuel.

However, this proposed approach seems rather demanding (in addition to providing evidence on sustainability criteria). Therefore a more pragmatic approach is given here as well:

**Simplified approach for accounting of biofuels**


Under Article 53, the competent authority shall allow the aircraft operator to use an estimation method for the biomass amount consumed based on purchase records, provided that such methodology is based on the Commission's guidelines to facilitate consistent application in all Member States.

Please see guidance document No. 3 (biomass issues in the EU ETS) for more details.

When using such methodology, the aircraft operator may deviate from the "per flight" approach outlined above and in section 5.4.8. Instead, the aircraft operator should split each fuel purchase into two virtual fuel quantities, one representing the fossil fuel, to which the appropriate default emission factor should be applied, and one source stream representing the biofuel. Note that any biofuel, for which the sustainability criteria cannot be demonstrated, must be accounted for as fossil fuel. Those two fuels are then aggregated separately for reporting.

[39] "Renewable Energy Sources Directive, i.e. Directive 2009/28/EC on the promotion of the use of energy from renewable sources. A full reference is given in the Annex, section 7.4

The aircraft operator has to demonstrate two important criteria in the proposed methodology:

- Firstly, the total amount of biofuel claimed must not exceed the total fuel usage of that aircraft operator for EU ETS flights departing from the aerodromes at which the biofuel is purchased. Where purchase records serve as data source, the aircraft operator must demonstrate that the figure of biofuel accounted for under the EU ETS does not exceed the total quantity of biofuel physically purchased minus the total quantity of biofuel physically sold to third parties at this aerodrome.
- Secondly, the aggregated biomass fraction in the fuel claimed must not exceed the amount of biomass for which proof for meeting the sustainability criteria is provided.

## 5.5 Monitoring approaches for tonne-kilometre data

Tonne-kilometres[40] shall be calculated for each flight covered by the EU ETS using the equation:

$$\boxed{TKM = D \cdot PL = D \cdot \left((F + M) + (P + B)\right)} \quad (6)$$

Where:

*TKM* .... *Tonne-kilometres [t·km]*

*D* ..... Distance expressed as [km][41]

*PL* ..... Mass of Payload expressed as tonnes

*F*..... Mass of freight expressed as tonnes

*M*..... Mass of mail expressed as tonnes

*P* ..... Mass of passengers expressed as tonnes

*B* ..... Mass of checked baggage expressed as tonnes.

The distance is defined by Article 3(44) and calculated as

$$\boxed{D = GCD + 95km} \quad (7)$$

Where:

*D* ..... Distance expressed as [km]

*GCD*.... Great circle distance expressed as [km]

[40] Note that the tonne-kilometres as defined by the M&R Regulation are usually *not* identical to the "*revenue* t-km" which are often monitored for the aircraft operator's internal purposes.

[41] If distance is available in nautical miles, note the conversion factor of 1mi = 1.852km (see http://www.nist.gov/pml/wmd/pubs/upload/AppC-12-hb44-final.pdf).

### 5.5.1 Distance

According to section 4 of Annex III of the MRR, the Great Circle Distance shall be the shortest distance between any two points on the surface of the Earth, which shall be approximated using the system referred to in Article 3.7.1.1 of Annex 15 to the Chicago Convention (WGS[42] 84).

The latitude and longitude of aerodromes shall be taken either from aerodrome location data published in Aeronautical Information Publications (AIP) in compliance with Annex 15 of the Chicago Convention or from a source using AIP data.

Distances calculated by software or by a third party may also be used, provided that the calculation methodology is based on the formula set out in this section, AIP data and WGS 84 requirements.

Note: GCD is to be calculated on ground level, not flight level.

### 5.5.2 Payload

According to Article 3(47) of the MRR, "*'payload' means the total mass of freight, mail, passengers and baggage carried onboard the aircraft during a flight*".

#### 5.5.2.1 Mail and freight

Article 56(3) requires: "*The aircraft operator shall determine the mass of freight and mail on the basis of the actual or standard mass contained in the mass and balance documentation for the relevant flights.*

*Aircraft operators not required to have a mass and balance documentation shall propose in the monitoring plan a suitable methodology for determining the mass of freight and mail, while excluding the tare weight of all pallets and containers that are not payload and the service weight.*"

Care must be taken in particular to avoid double counting, e.g. of baggage which is already part of the passenger calculation (see 5.5.2.2).

#### 5.5.2.2 Passengers and (checked) baggage

Article 56(4) allows two options (tiers) for determining the mass of passengers (including their baggage):

- Tier 1: use of a default value of 100 kg for each passenger including their checked baggage;
- Tier 2: use of the mass for passengers and checked baggage contained in the mass and balance documentation for each flight.

The tier selected shall apply to all flights in the monitoring years (see section 3.4).

[42] WGS 84 means the World Geodetic System, as described e.g. in http://en.wikipedia.org/wiki/World_Geodetic_System

## 5.6 Small emitters

### 5.6.1 Eligibility as small emitter


Aircraft operators operating fewer than 243 flights per period for three consecutive four-month periods and aircraft operators operating flights with total annual emissions lower than 25 000 tonnes $CO_2$ per year shall be considered small emitters (Article 54(1)). For these, special simplifications of the MRV system are applicable in order to reduce administrative costs.

For determination of the threshold, the annual *verified* emissions of the previous reporting year should be used, with exclusion of $CO_2$ stemming from biomass. Where no verified emissions are available (e.g. because the aircraft operator is new to the EU ETS), a conservative estimate should be used concerning the projected emissions, or an estimate using the tool described in section 5.6.2.

For assessing whether less than 243 flights per period are operated, the four month periods are January to April, May to August and September to December. The time of departure of the flights measured in Coordinated Universal Time determines in which four month-period a flight has to be taken into account. The flights exempted by Annex I of the EU ETS Directive (see section 3.1) are not to be included in assessing the number of flights or the total amount of annual emissions.


A special situation then arises if the aircraft operator's emissions exceed the threshold. In that case it is necessary to revise the monitoring plan and submit a new one to the CA, for which the simplifications for small emitters are not applied any more. However, the wording of Article 54(4) suggests that the aircraft operator should be allowed to continue using the small emitter tool provided that the aircraft operator can demonstrate to the competent authority that the threshold has not been exceeded in the previous five years and will not be exceeded again. Thus, high emissions or a larger number of flights in one single year out of five years may be tolerable. However, if the threshold is exceeded again in one of the following five years, that exception will not be applicable any more.


### 5.6.2 Use of the small emitter tool

Article 54 of the MRR allows small emitters to "*estimate the fuel consumption using tools implemented by Eurocontrol or another relevant organisation, which can process all relevant air traffic information corresponding to that available to Eurocontrol and avoid any underestimations of emissions*" if such tool has been approved by the Commission. At the time of writing this guidance the small emitter tool by Eurocontrol is the only tool approved[43] by the Commission. It is found at

**http://www.eurocontrol.int/articles/small-emitters-tool**

[43] For the approval see Commission Regulation (EU) No. 606/2010, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:175:0025:0026:EN:PDF

Using this tool the aircraft operator can estimate the fuel consumption based on the distance of the flight and the aircraft type used. This fuel consumption can then be used instead of a value determined in accordance with section 5.4.3, for calculating the emissions in accordance with equation (1) in section 5.4.1. For the emission factor, a small emitter will usually use a default value from Annex III of the MRR. However, if biofuels or other unconventional fuels are used, sections 5.4.7 and 5.4.8 apply.

Notes:

- A more sophisticated tool, although not free of charge, is the "EU ETS support facility" (see section 5.8).
- There is no obligation to use the small emitter tool. Any small emitter is allowed to use the standard monitoring methodology instead, if the aircraft operator wishes to have more accurate emissions data. However, a consequence of using the small emitter tool is the strong simplification of the monitoring plan (which is taken into account in the Commission's monitoring plan templates).
- The simplified procedures for small emitters only apply to emissions reporting. The requirements for monitoring and reporting tonne-kilometre data by small emitters are the same as for other aircraft operators.


## 5.7 Allowed methodology for data gaps

The aircraft operator's monitoring plan, including the associated written procedures should be sufficiently robust to avoid data gaps in general. However, if nevertheless data gaps occur in emissions data, the aircraft operator shall use surrogate data for the respective time period. For this purpose he will use a calculation method defined already in the monitoring plan (Article 65(2)). That Article allows in particular that the same tool as for small emitters (see section 5.6.2) may be used for this purpose, including for non-small emitters.

## 5.8 The EU ETS support facility


A further development, which exceeds the possibilities of the small emitter tool (see section 5.6.2), is the "EU ETS support facility", another tool provided by Eurocontrol, which can be used by aircraft operators on a voluntary basis. It can be found at:

**http://www.eurocontrol.int/articles/ets-support-facility**

This tool was originally designed for competent authorities and has now been made available also for aircraft operators[44], and if they wish so, also for their verifiers. According to Eurocontrol's website, the tool delivers:

[44] Note that charges set by Eurocontrol apply for the use of this support facility. Its use is purely voluntary.

- **a draft annual emissions report**, presenting what the aircraft operator's report would be if based on the flight data information available to Eurocontrol and on the fuel burn and $CO_2$ emissions estimated by Eurocontrol by applying the same methodology as used in the Eurocontrol small emitters tool. This draft report is provided in the form of an Excel file compliant with the reporting format definition of the Commssion's templates. This report includes also the "kilometres" data for the airport pairs contained in the report (for the tonne-kilometre verification);
- a text file in a comma separated file (csv) format containing **the list of the flights attributed to the Aircraft Operator and operating in the ETS area** (both included and exempted fights) with details allowing the identification of the flight and the reasons for its inclusion, exemption, the attribution to the operator, and the "kilometre" data (departure airport, destination airport, departure date and time, call sign, aircraft registration mark – if available –, flown distance, applicable route charge exemption – if any –, estimated fuel consumption, estimated $CO_2$ emissions, possible ETS exemption as determined by Eurocontrol) upon which the Aircraft Operator's draft annual emissions report is built.

The support facility can be used as follows:

- Small emitters can use it for generating their draft annual emissions report as further simplification beyond the small emitter tool.
- Other aircraft operators and service companies can use it for corroborating the result of their monitoring, including for checking the list of included aircraft and flights.
- Aircraft operators can make the data available to their verifiers, for a similar purpose.

Note that there is no requirement in the MRR for using the support facility, but it may be a potential means to reduce compliance costs and verification costs.

# 6 THE MONITORING PLAN

## 6.1 Developing a monitoring plan

When developing a monitoring plan, aircraft operators should follow some guiding principles:

- Knowing in detail the situation of their operations, aircraft operators should make the monitoring methodology as simple as possible. This is achieved by attempting to use the most reliable data sources, robust metering instruments, short data flows, and effective control procedures.
- Aircraft operators should imagine their annual emission report from verifier's perspective. What would a verifier ask about how the data has been compiled? How can the data flow be made transparent? Which controls prevent errors, misrepresentations, omissions?
- Because aircraft operators usually undergo technical changes (not only regarding their fleet) over the years, monitoring plans must be considered living documents to a certain extent. In order to minimise administrative burden, aircraft operators should be careful which elements must be laid down in the monitoring plan itself, and what can be covered under written procedures supplementing the MP.

**Important note**: The monitoring plan always has to reflect the methodology and tiers actually applied, not the minimum requirements. The general principle is that aircraft operators should attempt to improve their monitoring systems wherever possible.


Small operators (for definition see section 5.6.1) may apply significantly simplified monitoring methodologies for emissions (see section 5.6.2). If an aircraft operator is approved to use this simplification, then the monitoring plan also follows reduced requirements.

## 6.2 Procedures and the monitoring plan

The monitoring plan should ensure that the aircraft operator carries out all the monitoring activities consistently over the years, like according to a recipe book. In order to prevent incompleteness, or arbitrary changes by the aircraft operator, the competent authority's approval is required. However, there are always elements in the monitoring activities, which are less crucial, or which may change frequently.

The M&R Regulation provides a useful tool for such situations: Such monitoring activities may (or even shall) be put into "written procedures"[45], which are mentioned and described briefly in the MP, but are not considered part of the MP. These procedures are tightly linked to, but not part of the monitoring plan. They must be just described in the MP with such level of detail that the CA can understand the content of the procedure, and can reasonably assume that a full

[45] Article 11(1) 2nd sub-paragraph: "The monitoring plan shall be supplemented by written procedures which the operator or aircraft operator establishes, documents, implements and maintains for activities under the monitoring plan, as appropriate."

documentation of the procedure is maintained and implemented by the aircraft operator. The full text of the procedure would be delivered to the competent authority only upon request. The aircraft operator shall also make procedures available for the purposes of verification (Article 12(2)). As a result, the aircraft operator has the full responsibility for the procedure. This gives him the flexibility to make amendments to the procedure whenever needed, without requiring update of the monitoring plan, as long as the procedure's content stays within the limitations of its description laid down in the monitoring plan.

The MRR contains several elements which are by default expected to be put into written procedures, such as:

- Tracking the completeness of the list of emission sources (aircraft operated) over the reporting year;
- Defining the monitoring methodology for additional aircraft types;
- Monitoring the completeness of the list of flights operated under the unique ICAO designator by aerodrome pair;
- Determining whether flights are covered by Annex I of the EU ETS Directive, ensuring completeness and avoiding double counting;
- Monitoring fuel consumption per flight, in both owned and leased-in aircraft;
- Determining the density used for fuel uplifts and fuel in tanks, in both owned and leased-in aircraft (operated under your ICAO designator);
- Ensuring that the total uncertainty of fuel measurements will comply with the requirements of the selected tier;
- Cross checks between uplift quantities from invoices and uplifts from on-board devices;
- Determination of emissions factor, net calorific value and biomass content of alternative fuels;
- Monitoring aerodrome location information;
- Determining the Great Circle Distance between aerodrome pairs;
- Monitoring the number of passengers on a flight;
- Monitoring the mass of freight and mail on a flight;
- Managing responsibilities and competency of personnel;
- Data flow and control procedures (→ section 6.3);
- Quality assurance measures;
- Estimation method for substitution data where data gaps have been found;
- Regular review of the monitoring plan for its appropriateness (including uncertainty analysis where relevant).

The MRR furthermore outlines how the procedure must be described in the Monitoring plan. Note that for aircraft operators with simple operations also the procedures will usually be very simple and straightforward. Where the procedure is very simple, it may be useful to use the procedure text immediately as "description" of the procedure as required for the monitoring plan.

Table 3 outlines the necessary elements of information required to be put into the monitoring plan for each procedure (Article 12(2)), and gives an example for procedures.

*Table 3: Example related to the management of staff: Descriptions of a written procedure as required in the monitoring plan.*

| Item according to Article 12(2) | Possible content (examples) |
|---|---|
| Title of the procedure | ETS personnel management |
| Traceable and verifiable reference for identification of the procedure | ETS 01-P |
| Post or department responsible for implementing the procedure and the post or department responsible for the management of the related data (if different) | HSEQ deputy head of unit |
| Brief description of the procedure[46] | • Responsible person maintains a list of personnel involved in ETS data management<br>• Responsible person holds at least one meeting per year with each involved person, at least 4 meetings with key staff as defined in the annex of the procedure; Aim: Identification of training needs<br>• Responsible person manages internal and external training according to identified needs. |
| Location of relevant records and information | Hardcopy: HSEQ Office, shelf 27/9, Folder identified "ETS 01-P".<br>Electronically: "P:\ETS_MRV\manag\ETS_01-P.xls" |
| Name of the computerised system used, where applicable | N.A. (Normal network drives) |
| List of EN standards or other standards applied, where relevant | N.A. |

## 6.3 Data flow and control system

Monitoring of emissions data is more than just reading instruments or fuel invoices. It is of utmost importance to ensure that data are produced, collected, processed and stored in a controlled way. Therefore the aircraft operator must define instructions for "who takes data from where and does what with the data". These "data flow activities" (Article 57) form part of the monitoring plan (or are laid down in written procedures, where appropriate (see section 6.2). A

[46] This description is required to be sufficient clear to allow the operator, the competent authority and the verifier to understand the essential parameters and operations performed.

data flow diagram is often a useful tool for analysing and/or setting up data flow procedures. Examples for data flow activities include reading from instruments, aggregating data, calculating the emissions from various parameters, and storing all relevant information for later use.

New!

As human beings (and often different information technology systems) are involved, mistakes in these activities can be expected. The M&R Regulation therefore requires the aircraft operator to establish an effective control system (Article 58). This consists of two elements:

- a risk assessment, and
- control activities for mitigating the risks identified.

"Risk" is a parameter which takes into account both, the probability of an incident and its impact. In terms if emission monitoring, the risk refers to the probability of a misstatement (omission, misrepresentation or error) being made, and its impact in terms of annual emissions figure.

When the aircraft operator carries out a risk assessment, he analyses for each point in the data flow needed for the monitoring of the emissions of all his aviation activities as far as covered by the EU ETS, whether there would be a risk of misstatements. Usually this risk is expressed by qualitative parameters (low, medium, high) rather than by trying to assign exact figures. He furthermore assesses potential reasons for misstatements (such as paper copies being transported from one department to another, where delays may occur, or copy & paste errors may be introduced), and identifies which measures might reduce the found risks, e.g. sending data electronically and storing a paper copy in the first department; search for duplicates or data gaps in spreadsheets, control check by an independent person ("four eyes principle")…

Measures identified to reduce risks are implemented. The risk assessment is then re-evaluated with the new (reduced) risks, until the aircraft operator considers that the remaining risks are sufficiently low for being able to produce an annual emissions report which is free from material misstatement(s)[47].

New!

The control activities are laid down in written procedures and referenced in the monitoring plan. The results of the risk assessment (taking into account the control activities) are submitted as supporting documentation to the competent authority when approval of the monitoring plan is requested by the aircraft operator.

Aircraft operators are required to establish and maintain written procedures related to control activities for at least (Article 58(3)):

(a) quality assurance of the measurement equipment;

(b) quality assurance of the information technology system used for data flow activities, including process control computer technology;

(c) segregation of duties in the data flow activities and control activities as well as management of necessary competencies;

[47] The aircraft operator should strive to produce "error-free" emission reports (Article 7: Aircraft operators "shall exercise due diligence to ensure that the calculation and measurement of emissions exhibit the highest achievable accuracy"). However, verification cannot produce 100% assurance. Instead, verification aims at providing a reasonable level of assurance that the report is free from material misstatements. For further information see the relevant guidance document on the A&V Regulation.

(d) internal reviews and validation of data;

(e) corrections and corrective action;

(f) control of out-sourced processes;

(g) keeping records and documentation including the management of document versions.


**Small emitters:** Article 54(3) exempts small emitters (→ section 5.6.1) from submitting a risk assessment when submitting the monitoring plan for approval by the competent authority. However, aircraft operators will still find it useful to carry out a risk assessment for their own purposes. It has the advantage of reducing the risk of under-reporting, under-surrender of allowances and consequential penalties, and also over-reporting and over-surrender.

Note that a dedicated document containing more detailed information on the data flow and control system (including risk analysis) is also planned.

## 6.4 Uncertainty assessment as supporting document

As mentioned in section 5.4.5, the tiers for activity data (i.e. fuel consumption) are expressed using a specified "maximum permissible uncertainty over a reporting period". When submitting a new or updated monitoring plan, the aircraft operator must demonstrate the compliance of his monitoring methodology (in particular of the measuring instruments applied) with those uncertainty levels. Pursuant to Article 12(1), this is done by submitting an uncertainty assessment as supporting document together with the monitoring plan.

Section 7.2 in the Annex of this document gives a short introduction to the concept of uncertainty[48]. It also includes a calculation example. In contrast to stationary installations, the requirements for aircraft operators are relatively modest, as laid down in Article 55:

- The aircraft operator shall identify sources of uncertainty and their associated levels of uncertainty. The aircraft operator shall consider that information when selecting the monitoring methodology.
- Where the aircraft operator determines fuel uplifts using measurement by the fuel supplier, as documented in the fuel delivery notes or invoices for each flight, he shall not be required to provide further proof of the associated uncertainty level.
- Where on-board systems are used for measuring fuel uplift or fuel contained in tanks, the following evidence is to be provided for the level of uncertainty associated with fuel measurements:
  - the aircraft manufacturer's specifications determining uncertainty levels of onboard fuel measurement systems; and
  - evidence of carrying out routine checks of the satisfactory operation of the fuel measurement systems.

[48] Furthermore guidance document No. 4 gives further details. However, that document is addressed to operators of installations in the EU ETS. Under normal circumstances reading that document should not be necessary for aircraft operators.

- uncertainties for all other components of the monitoring methodology may be based on conservative expert judgement taking into account the estimated number of flights within the reporting period.


**Small emitters:** Article 54(3) exempts small emitters (→ section 5.6.1) from submitting an uncertainty assessment when submitting the monitoring plan for approval by the competent authority. Where the small emitter tool (see section 5.6.2 or the EU ETS support facility (see section 5.8) are used, there is no need to carry out an uncertainty assessment.

## 6.5 Keeping the monitoring plan up to date

The monitoring plan must always correspond to the current nature and functioning of the aircraft operator's activities. Where the practical situation of the aircraft operator is modified, e.g. because fuels, measuring equipment, IT systems, or organisation structures (i.e. staff assignments) are changed (where relevant for the monitoring of emissions), the monitoring methodology must be updated (Article 14)[49]. Depending on the nature of the changes, one of the following situations can occur:

- If an element of the monitoring plan itself needs updating, one of the following situations can apply:
  - The change to the monitoring plan is a significant one. This situation is discussed in section 6.5.1. In case of doubt, the aircraft operator has to assume that the change is significant.
  - The change to the monitoring plan is not significant. The procedure described under 6.5.2 applies.
- An element of a written procedure is to be updated. If this doesn't affect the description of the procedure in the monitoring plan, the aircraft operator will carry out the update under his own responsibility without notification to the competent authority.

The same situations may occur as a consequence of the requirement to improve the monitoring methodology continuously (see section 6.6).

The M&R Regulation in Article 16(3) also defines the requirements for record keeping about any monitoring plan updates, such that a complete history of monitoring plan updates is maintained, which allows a fully transparent audit trail, including for the purposes of the verifier.

[49] Article 14(2) lists a minimum of situations in which a monitoring plan update is mandatory: *"(a) new emissions occur due to new activities carried out or due to the use of new fuels or materials not yet contained in the monitoring plan;*
*(b) the change of availability of data, due to the use of new measuring instrument types, sampling methods or analysis methods, or for other reasons, leads to higher accuracy in the determination of emissions;*
*(c) data resulting from the previously applied monitoring methodology has been found incorrect;*
*(d) changing the monitoring plan improves the accuracy of the reported data, unless this is technically not feasible or incurs unreasonable costs;*
*(e) the monitoring plan is not in conformity with the requirements of this Regulation and the competent authority requests the operator or aircraft operator to modify it;*
*(f) it is necessary to respond to the suggestions for improvement of the monitoring plan contained in a verification report."*

For this purpose it is considered best practice for the aircraft operator to make use of a "logbook", in which all non-significant changes to the monitoring plan and to procedures are recorded, as well as all versions of submitted and approved monitoring plans. This must be supplemented with a written procedure for regular assessment of whether the monitoring plan is up to date (Article 14(1) and point 1(c) of section 1 of Annex I).

### 6.5.1 Significant changes

Whenever a significant change to the monitoring plan is necessary, the aircraft operator shall notify the update to the competent authority without undue delay. The competent authority then has to assess whether the change is indeed a significant one. Article 15(4) contains a (non-exhaustive) list of monitoring plan updates which are considered significant[50]. If the change is not significant, the procedure described under 6.5.2 applies. For significant changes, the competent authority thereafter carries out its normal process of approving monitoring plans[51].

The approval process may sometimes need longer than implementing the proposed change of the monitoring plan. Furthermore the competent authority may find the aircraft operator's monitoring plan update incomplete or inappropriate and may require additional amendments of the monitoring plan. Thus, monitoring according to the old monitoring plan may be incomplete or lead to inaccurate results, while the aircraft operator is not sure whether the new monitoring plan will be approved as requested. The MRR provides for a pragmatic approach here:

New!

According to Article 16(1), the aircraft operator shall immediately apply the new monitoring plan where he can reasonably assume that the updated monitoring plan will be approved as proposed. This may apply e.g. when an additional fuel is introduced, which will be monitored using the same tiers as comparable fuels used by the aircraft operator. Where the new monitoring plan is not yet applicable, because the situation of the aircraft operator will change only after the ap-

[50] Article 15(4):
"*4. Significant changes to the monitoring plans of an aircraft operator shall include:*
*(a) with regard to the emission monitoring plan:*
*(i) a change of tiers related to fuel consumption;*
*(ii) a change of emission factor values laid down in the monitoring plan;*
*(iii) a change between calculation methods as laid down in Annex III;*
*(iv) the introduction of new source streams;*
*(v) a change in the categorisation of source streams where a minor source stream changes to a major source stream;*
*(vi) changes in the status of the aircraft operator as a small emitter within the meaning of Article 54(1);*
*(b) with regard to the tonne-kilometre data monitoring plan:*
*(i) a change between a non-commercial and commercial status of the air transport service provided;*
*(ii) a change in the object of the air-transport service, the object being passengers, freight or mail.*"

[51] This process may differ between Member States. The usual procedure will include a completeness check for the information provided, a check for the appropriateness of the new monitoring plan in regard of the changed situation of the aircraft operator, and a check for compliance with the M&R Regulation. The competent authority may also reject the new monitoring plan or require further improvements. The competent authority may also come to the conclusion that the proposed changes are not significant ones.

proval of the monitoring plan by the competent authority, monitoring is to be carried out in accordance with the old monitoring plan until the new one is approved.

Where the aircraft operator is unsure whether the CA will approve the changes, he shall carry out monitoring in parallel using both the new and the updated monitoring plan (Article 16(1)). Upon receiving the approval of the competent authority, the aircraft operator shall use only the data obtained in accordance with the new monitoring plan as approved (Article 16(2)).

### 6.5.2 Non-significant updates of the monitoring plan


While significant updates of the monitoring plan are to be notified without undue delay, the competent authority may allow the aircraft operator to delay the notification of non-significant updates in order to simplify the administrative process (Article 15(1)). Where this is the case and the aircraft operator can reasonably assume that changes to the monitoring plan are non-significant, they may be collected and submitted to the CA once a year (by 31 December), if the competent authority allows this approach.

The final decision on whether a change to the monitoring plan is significant is the responsibility of the competent authority. However, an aircraft operator can reasonably anticipate that decision in many cases:

- Where a change is comparable to one of the cases listed in Article 15(4), the change is significant;
- Where the impact of the proposed monitoring plan change on the overall monitoring methodology or on the risks for error is small, it may be non-significant;
- In case of doubt assume it is a significant change and follow section 6.5.1.


Non-significant changes do not need the approval of the competent authority. However, in order to provide for legal certainty, the competent authority must inform the aircraft operator without undue delay of its decision to consider changes non-significant where the aircraft operator has notified them as significant. Aircraft operators can be expected to appreciate if the competent authority acknowledges receipt of notifications in general.

## 6.6 The improvement principle

While the previous section has dealt with monitoring plan updates which are mandated as consequence of factual changes of the aircraft operators operations, the MRR also requires the aircraft operator to explore possibilities to improve the monitoring methodology for emissions and – where relevant – tonne-kilometre data when the operations themselves are unchanged. For implementing this “improvement principle”, there are two requirements:


- Aircraft operators must take account of the recommendations included in the verification reports (Article 9), and
- Aircraft operators must check regularly on their own initiative, whether the monitoring methodology can be improved (Article 14(1) and Article 69(1)).

Aircraft operators must react to those findings on possible improvements by

- Sending a report on the proposed improvements to the competent authority for approval,
- Updating the monitoring plan as appropriate (using the procedures outlined in sections 6.5.1 and 6.5.2), and
- Implementing the improvements according to the time table proposed in the approved improvement report.

For the improvement report responding to a verifier's recommendations, the deadline is 30 June of the year in which the verification report is issued. The deadline of 30 June may be extended by the competent authority up to 30 September of the same year.

# 7 ANNEX

## 7.1 Unreasonable costs

*Note: This section of the annex is included in this guidance only for completeness reasons. It explains the concept of unreasonable cost, which is not as important for aircraft operators as for operators of stationary installations in the EU ETS. Consequently, this section is taken from guidance document No. 1, and gives also examples for installations.*


Cost effectiveness is an important concept for the MRR. It is generally possible for the (aircraft) operator to get permission from the competent authority to derogate from a specific requirement of the MRR (such as in particular the required tier level), if fully applying the requirement would lead to **unreasonable costs**. Therefore a clear-cut definition for "unreasonable costs" is required. It is found in Article 18 of the M&R Regulation. As outlined below, it is based on a cost/benefit analysis for the requirement under consideration.

Similar derogations may be applicable if a measure is **technically not feasible**. Technical feasibility is not a question of cost/benefit, but whether the (aircraft) operator is able to achieve a certain requirement at all. Article 17 of the MRR requires that an (aircraft) operator provides a justification where he claims something to be technically not feasible. This justification must demonstrate that the (aircraft) operator does not have the resources available to meet the specific requirement within the required time.


When assessing whether costs for a specific measure are reasonable, the costs are to be compared with the benefit it would give. Costs are considered unreasonable where the costs exceed the benefit (Article 18). The detailed description of the cost-benefit analysis is a new element in the MRR.

**Costs:** It is up to the (aircraft) operator to provide a reasonable estimation of the costs involved. Only costs which are additional to those applicable for the alternative scenario should be taken into account. The MRR also requires that the equipment costs are to be assessed using a depreciation period appropriate for the economic lifetime of the equipment. Thus, the annual costs during the lifetime rather than the total equipment costs are to be used in the assessment.

Example (applicable for stationary installations): An old measuring instrument is found to not function properly any more, and is to be exchanged for a new one. The old instrument has allowed reaching an uncertainty of 3% corresponding to tier 2 (±5%) for activity data. Because the operator would have to apply a higher tier anyway, he considers whether a better instrument would incur unreasonable costs. Instrument A costs 40 000 € and leads to an uncertainty of 2.8% (still tier 2), instrument B costs 70 000 €, but allows an uncertainty of 2.1% (tier 3, ±2.5%). Due to the rough environment in the installation, a depreciation period of 5 years is considered appropriate.

The costs to be taken into account for the assessment of unreasonable costs are 30 000 € (i.e. the difference between the two meters) divided by 5 years, i.e. 6 000 €. No cost for the working time should be considered, as the same workload is assumed to be necessary independent from the type of the meter to be installed. Also same maintenance costs can be assumed as approximation.

**Benefit:** As the benefit of e.g. more precise metering is difficult to express in financial values, an assumption is to be made following the MRR. The benefit is considered to be proportionate to an amount of allowances in the order of magnitude of the reduced uncertainty. In order to make this estimation independent from daily price fluctuations, the MRR requires a constant allowance price of 20 € to be applied. For determining the assumed benefit, this allowance price is to be multiplied by an "improvement factor", which is the improvement of uncertainty multiplied by the average annual emissions caused by the respective source stream[52] over the three most recent years[53]. The improvement of uncertainty is the difference between the uncertainty currently achieved[54] and the uncertainty threshold of the tier which would be achieved after the improvement.

Where no direct improvement of the accuracy of emissions data is achieved by an improvement, the improvement factor is always 1%. Article 18(3) lists some of such improvements, e.g. switching from default values to analyses, increasing the number of samples analysed, improving the data flow and control system, etc.

Please note the **minimum threshold** introduced by the MRR: Accumulated improvement costs below 2 000 € per year are always considered reasonable, without assessing the benefit.

New!

Summarizing the above by means of a formula, the costs are considered reasonable, if:

$$C < P \cdot AEm \cdot \left(U_{curr} - U_{new\ tier}\right) \quad (9)$$

Where:

$C$ ..... Costs [€/year]

$P$ ..... specified allowance price = 20 € / t $CO_{2(e)}$

$AEm$ .... Average emissions from related source stream(s) [t $CO_{2(e)}$/year]

$U_{curr}$ ..... Current uncertainty (not the tier) [%]

$U_{new\ tier}$ . Uncertainty threshold of the new tier that can be reached [%]

[52] Where one measuring instrument is used for several source streams, such as a weighbridge, the sum of emissions of all related source streams should be used.

[53] Only the fossil emissions are considered. Where the most average emissions of the most recent three years are not available or not applicable due to technical changes, a conservative estimate is to be used.

[54] Please note that the "real" uncertainty is meant here and not uncertainty threshold of the tier.

Example: For the replacement of meters described above, the benefit of "improvement" for instrument A is zero, as it is a mere replacement maintaining the current tier. It cannot be unreasonable, as the installation cannot be operated without at least this instrument.

In case of instrument B, tier 3 (threshold uncertainty = 2.5 %) can be reached. Thus, the uncertainty improvement is $U_{curr} - U_{new\ tier}$ = 2.8% – 2.5% = 0.3%.

The average annual emissions are AEm = 120 000 t $CO_2$/year. Therefore, the assumed benefit is 0.003 ·120 000 ·20 € =7 200 €. This is higher than the assumed costs (see above). It is therefore not unreasonable to require instrument B installed.

## 7.2 Uncertainty

*Note: This section of the annex is included in this guidance only for completeness reasons. It explains the concept of uncertainty, which is not as important for aircraft operators as for operators of stationary installations in the EU ETS. It is taken from guidance document No. 1.*

When somebody would like to ask the basic question about the quality of the MRV system of any emission trading system, he would probably ask: "How good is the data?" or rather "Can we trust the measurements which produce the emission data?" When determining the quality of measurements, international standards refer to the quantity of "uncertainty". This concept needs some explanation.

There are different terms frequently used in a similar way as uncertainty. However, these are not synonyms, but have their own defined meaning (see also illustration in Figure 5):

- **Accuracy**: This means closeness of agreement between a measured value and the true value of a quantity. If a measurement is accurate, the average of the measurement results is close to the "true" value (which may be e.g. the nominal value of a certified standard material[55]). If a measurement is not accurate, this can sometimes be due to a systematic error. Often this is can be overcome by calibrating and adjustment of instruments.
- **Precision**: This describes the closeness of results of measurements of the same measured quantity under the same conditions, i.e. the same thing is measured several times. It is often quantified as the standard deviation of the values around the average. It reflects the fact that all measurements include a random error, which can be reduced, but not completely eliminated.

[55] Also a standard material, such as e.g. a copy of the kilogram prototype, disposes of an uncertainty due to the production process. Usually this uncertainty will be small compared to the uncertainties later down in its use.

- **Uncertainty**[56]: This term characterizes the range within which the true value is expected to lie with a specified level of confidence. It is the overarching concept which combines precision and assumed accuracy. As shown in Figure 5, measurements can be accurate, but imprecise, or vice versa. The ideal situation is precise and accurate.

If a laboratory assesses and optimizes its methods, it usually has an interest in distinguishing accuracy and precision, as this leads the way to identification of errors and mistakes. It can show such diverse reasons for errors such as the need for maintenance or calibration of instruments, or for better training of staff. However, the final user of the measurement result (in the case of the ETS, this is the operator and the competent authority) simply wants to know how big the interval is (measured average ± uncertainty), within which the true value is probably found.

In the EU ETS, only one value is given for the emissions in the annual emissions report. Only one value is entered in the verified emissions table of the registry. The (aircraft) operator can't surrender "N ± x%" allowances, but only the precise value N. It is therefore clear that it is in everybody's interest to quantify and reduce the uncertainty "x" as far as possible. This is the reason why monitoring plans must be approved by the competent authority, and why (aircraft) operators have to demonstrate compliance with specific tiers, which are related to permissible uncertainties.

More details on the definition of tiers are given in section 5.4.5. The uncertainty analysis which is to be added to the monitoring plan as supporting document (Article 12(1)) is discussed in section 6.4. For more details, a separate guidance document on the assessment of uncertainty in the EU ETS is provided (Guidance document No. 4, see section 2.3).

[56] The MRR defines in Article 3(6): 'uncertainty' means a parameter, associated with the result of the determination of a quantity, that characterises the dispersion of the values that could reasonably be attributed to the particular quantity, including the effects of systematic as well as of random factors, expressed in per cent, and describes a confidence interval around the mean value comprising 95% of inferred values taking into account any asymmetry of the distribution of values.

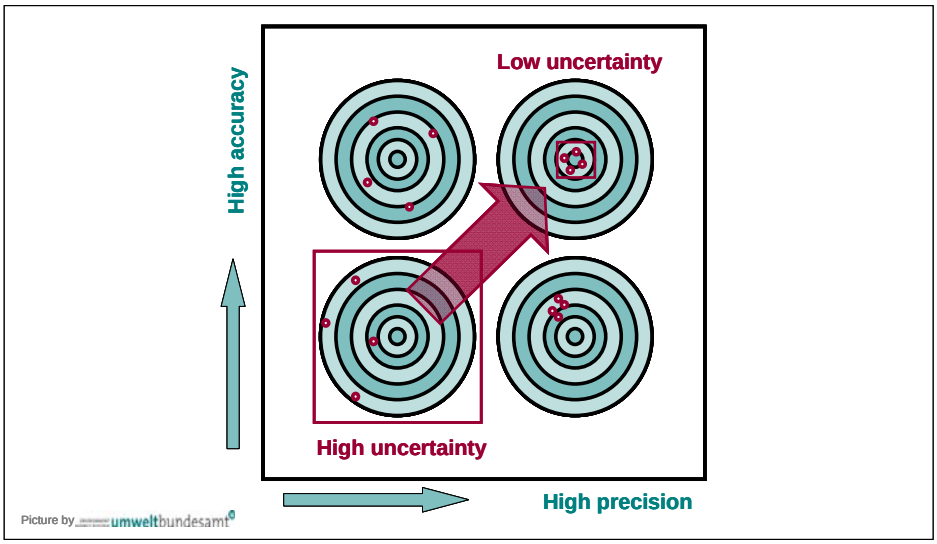


*Figure 5:* *Illustration of the concepts accuracy, precision and uncertainty. The bull's eye represents the assumed true value, the "shots" represent measurement results.*

**Example:** An aircraft operator is operating five aircraft and 500 flights each per year resulting in 2,500 total fuel uplifts in one year. Method A is used for the determination of the fuel consumed.

$$F_N = T_N - T_{N+1} + Up_{N+1}$$

where:

$F_{N,A}$..... Fuel consumed for the flight under consideration (=flight N) determined using method A [t]

$T_N$..... Amount of fuel contained in aircraft tanks once fuel uplift for the flight under consideration (=flight N) is complete [t]

$T_{N+1}$ ..... Amount of fuel contained in aircraft tanks once fuel uplift for the subsequent flight (=flight N+1) is complete [t]

$Up_{N+1}$... Fuel uplift for the subsequent flight (=flight N+1) [t]

The total amount of fuel consumed over the year is then simply the sum of all $F_N$. Assuming that all flights are covered by the ETS, i.e. all flights start or end within the EU, only the fuel contained in the aircraft tank before the first flight and after the last flight are relevant. All other readings in between are mutually cancelled out:

$$\sum_{N=1}^{2500} F_N = \sum_{N=1}^{2500} (T_N - T_{N+1} + Up_{N+1}) = T_1 - T_{2500} + \sum_{N=1}^{2500} Up_{N+1}$$

The amount of fuel contained in the tank and all uplifts will usually be determined by volumetric flow meters. Therefore, each uplift has to be converted into mass amounts by multiplying with the density of the fuel:

$$T_{(tonnes)} = T_{(Volume)} \cdot \rho \qquad Up_{(tonnes)} = Up_{(Volume)} \cdot \rho$$

where:

$\rho$ ..... (actual) density of the fuel

It is assumed that the uncertainty related to the determination of the density is ±3% and that the uncertainty related to the volume of the uplift is ±0.5%. The (relative) uncertainty *u* of the mass of each uplift can be determined as the uncorrelated (i.e. independent) uncertainty of a product[57]:

$$u_{Up,tonnes} = \sqrt{u_{Up,Volume}^2 + u_{density}^2} = \sqrt{0.5\%^2 + 3\%^2} = 3.04\%$$

The relative uncertainty related to the total amount of fuel consumed over the year can be calculated as an uncorrelated (independent) uncertainty of a sum[57]:

$$u_{fuel(year)} = \frac{\sqrt{(U_{T,1})^2 + (U_{T,2500})^2 + (U_{Up,1})^2 + .. + (U_{Up,2500})^2}}{\left|T_1 - T_{2500} + Up_1 + .. + Up_{2500}\right|}$$

where:

*U* ..... absolute uncertainty of the parameter in index

*u* ..... relative uncertainty of the parameter in index

It is assumed that the uncertainty related to the tank level reading is ±0.1m³ and that the amount contained in the tank after each uplift is approximately the same amount, e.g. 8m³. In this example the related uncertainty would be $u_T$ = 1.25%. Therefore, the uncertainty related to the tank level reading is small compared to the uncertainty related to the fuel uplift uncertainty. This simplifies the determination of the relative uncertainty related to the total amount of fuel consumed over the year:

$$u_{fuel(year)} = \frac{\sqrt{2 \cdot (U_{T,1})^2 + 2500 \cdot (U_{Up,1})^2}}{\left|2500 \cdot Up_1\right|} \approx \frac{\sqrt{2500 \cdot (U_{Up,1})^2}}{\left|2500 \cdot Up_1\right|} = \frac{1}{50} \cdot u_{Up,1}$$

$$u_{fuel(year)} = \frac{1}{50} \cdot u_{Up} = \frac{1}{50} \cdot 3.04\% = 0.06\%$$

It can be seen clearly that the more uplifts happen during the year, the lower is the overall uncertainty related to the total amount of fuel consumed. Under the assumption that each uplift is about the same amount having equal uncertainty, the overall (relative) uncertainty is calculated by dividing the (relative) uncertainty of a single uplift by the square root of the total number of uplifts in this year.

Furthermore you may note that the absolute values of the fuel uplifts, the density of the fuel or the size of an aircraft's fuel tank are of no relevance for the determination of the overall (relative) uncertainty under the given assumptions.

It also needs to be noted that the uncertainty related to the tank level readings may not be negligible if many flights of the same aircraft are carried out outside

[57] For further information please see Annex III of Guidance Document 4 on Uncertainty.

the EU ETS, i.e. neither starting nor landing within the EU.

## 7.3 Acronyms

EU ETS.....EU Emission Trading Scheme

MRV.....Monitoring, Reporting and Verification

MRG 2007 ..Monitoring and Reporting Guidelines

MRR.....Monitoring and Reporting Regulation (M&R Regulation)

AVR .....Accreditation and Verification Regulation (A&V Regulation)

MP .....Monitoring Plan

CA .....Competent Authority

AER .....Annual Emissions Report

MS .....Member State(s); In this guidance always meaning "EU or EEA-EFTA Member State"

CRCO .....Eurocontrol's Central Route Charges Office

## 7.4 Legislative texts

**EU ETS Directive**: Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC, most recently amended by Directive 2009/29/EC. Download consolidated version:
**http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2003L0087:20090625:EN:PDF**

**M&R Regulation**: Commission Regulation (EU) No. 601/2012 of 21 June 2012 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council. Download under
**http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:181:0030:0104:EN:PDF**

**A&V Regulation**: Commission Regulation (EU) No. 600/2012 of 21 June 2012 on the verification of greenhouse gas emission reports and tonne-kilometre reports and the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council. Download under
**http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:181:0001:0029:EN:PDF**

**MRG 2007**: Commission Decision 2007/589/EC of 18 July 2007 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council. The download of the consolidated version contains all amendments: MRG for $N_2O$ emitting activities, aviation activities; capture, transport in pipelines and geological storage of $CO_2$, and for the activities and greenhouse gases only included

from 2013 onwards. Download:
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2007D0589:20110921:EN:PDF

**RES Directive**: Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC. Download:
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF

**EEA agreement**: Inclusion of the EU ETS for Aviation in the EEA agreement: Decision of the EEA Joint Committee No 6/2011 of 1 April 2011 amending Annex XX (Environment) to the EEA Agreement:
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:093:0035:0037:EN:PDF

**Scope guidance:** Commission Decision 2009/450/EC of 8 June 2009 on the detailed interpretation of the aviation activities listed in Annex I to Directive 2003/87/EC of the European Parliament and of the Council:
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:149:0069:0072:EN:PDF

**Commission's list of aircraft operators**: For the latest Regulation see:
http://ec.europa.eu/clima/policies/transport/aviation/operators/index_en.htm

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*Note:*

*Chapters 4 and 5 of the old guidance (filling the MP templates) will be provided as an Annex to this guidance in due course.*