Protocol
2E1: HFC 23 EMISSIONS DURING HCFC 22 PRODUCTION

IPCC Category:	2E1
NFR Code:	n.a.
NOSE Code:	n.a.
NACE Code 2008	2011

FOREWORD

Under the Kyoto Protocol, the Netherlands is required to set up and maintain a national system to monitor its greenhouse gas emissions. One of the elements of this system is a transparent and verifiable description of the methods and processes used in this monitoring system. These methods must meet international guideline criteria, which have been defined by the United Nations (UN) and the European Union (EU).

The Netherlands meets the aforementioned requirement, for example, by defining a series of Monitoring Protocols, which describe the methods and work processes used to determine greenhouse gas emissions and the amounts of carbon sinks available. Protocols have been written for about 40 greenhouse gas sources or sinks. This document describes the protocol for one of these sources or sinks.

The protocols have been compiled in close collaboration with experts from various sectors of society in the Netherlands, particularly experts from the Emissions Registration (ER). The ER is a collaborative group that includes institutions such as CBS, WUR, RIVM and PBL. Until 31 December 2009 this was coordinated by PBL (Planbureau for the Leefomgeving, or the Netherlands Environmental Assessment Agency), but on 1 January 2010 this coordination task was taken over by RIVM (the Netherlands institute for public health and the environment). Other institutions that have contributed to the protocols include NL Agency; Ministry of Agriculture, Nature and Food Quality; and the Ministry of VROM (Housing, Spatial Planning and the Environment).

1 SCOPE AND SIGNIFICANCE OF EMISSION SOURCES/ACTIVITIES

1.1 Scope and definition

This protocol describes the methodology and working processes for determining the HFC 23 (trifluoromethane, CHF_3) emissions that are released during the industrial production of HCFC 22 (chlorodifluoromethane, $CHC1F_2$). These emissions are reported under IPCC category 2E1, and relate to SBI (industrial) code 2011.

It is generally accepted that HFC 23 is produced as a by-product when manufacturing HCFC 22. It is also known that emissions from this source amount to 4% of the production of HCFC 22, if no reduction measures are taken. HCFC 22 is primarily used as an intermediate product during the manufacture of synthetic polymers and, in some cases, a blend may be used as cooling agent or cleaner.

The Netherlands has only one manufacturer of HCFC 22, which produces HCFC 22 as a raw material for the manufacture of fluoropolymers (Teflon®) and also sells it as a cooling agent. The latter will be phased out in 2010, when HCFC 22 will only be produced for the company’s internal manufacturing processes.

1.2 Significance and influences

1.2.1 Contribution to total national emissions

The HFC 23 emissions from the production of HCFC 22 (chlorodifluoromethane, $CHC1F_2$) contribute less than 0.5% to the total annual greenhouse gas emissions produced by the Netherlands.

1.2.2 Developments that infuence emissions

Since 1998 the HFC 23 emissions produced as a result of HCFC 22 production have been reduced by using a Thermal Converter (TC), which consists of a combustion chamber, a quench chamber and a rinsing tower. The destruction efficiency of this TC is over 99,99% [1]**.** However, the TC is not used throughout the entire year due to necessary maintenance to the combustion chamber. During maintenance work the untreated HFC 23 emissions are released freely into the atmosphere. The company is attempting to improve the TC's 'up-time' (i.e. the amount of time in operation)**.** Since 2001 these maintenance tasks to the combustion chamber have been reduced through technical improvements, thus increasing the up-time from 84% in 2000, to around 95% in 2001. In 2003 a reserve combustion chamber was also installed, thus better guaranteeing that this improved up-time can be maintained.

2 METHOD, EMISSION FACTORS AND ACTIVITY DATA

2.1 Calculation method

The following formula is used to calculate HFC 23 emissions by the HCFC industry in the Netherlands:

HFC 23 emissions
=
*concentration of HFC 23 in untreated flow * [1 – (Destruction factor TC * Corporate time factor TC)]*

The HFC 23 load in the untreated flow is determined by measurements (taken almost daily).
The TC's corporate time factor 'up-time' is registered by the manufacturer, and indicates the amount (in %) of production time that the TC has been operating at the HCFC 22 plant.
The destruction factor of the (TC) reduction measure. This figure (99.99%) is determined by the manufacturer, and is based on measurements taken. Reports may be viewed at the manufacturer's premises.

Sections 2.2 and 2.3 of this protocol provide further information regarding the method used.

The aforementioned method complies with the tier 2 method for HFC 23 emissions during HCFC production, as described in the IPCC Good Practice Guidance (GPG) § 3.8.1 (IPCC, 2001, p. 3.123 onwards).

2.2 Emission factors

The manufacturer has determined the destruction factor of the TC to be 99.99%, based on various measurements. Reports can be viewed at the manufacturer's premises (confidential, not public).

[1] See Section 2.3 of this protocol.

2.3 Activity data

Supplying data via the AER/MJV
The following data are reported in the AER/MJV for each plant:

Corporate time factor (up-time) of the reduction measure (a percentage of the corporate time that the reduction measure was operating in the plant (public information).

The calculated annual emissions load for HFC 23 (kg HFC 23/year) (public information).

The company reports these emissions as part of its annual environmental report, which is submitted to the competent authority for the respective plant before 1 April in the year following the reporting year.

Confidential information
The following information is confidential and can be viewed at the company's premises:

HFC 23 load in the unclean flow (kg HFC 23/year).

Production (tons of HCFC-22)/year).

Statistical information
Not applicable

3 WORKING PROCESSES

Process for estimating (t-1)
If preliminary figures are required at any point, the following process is used to estimate the figure for t-1. The preliminary data for the work package leader are calculated by extrapolating them from the previous years' figures, based on prognoses for the developments in the most important activity data (taken from CBS (Statistics Netherlands) or other statistical sources).

INPUT	PROCESS	OUTPUT	BY WHOM
Preliminary data work package leader (t-1)	Include t-1 data in ER database	ER-db with (t-1) data	Work package leader
	..		
ER-db with (t-1) data	Check emission figures: compare with previous years (trend), modify if required and document everything	ER-db (t-1) with any modified figures	Task force

Process for final determination of (t-2)
The final emission figures (as described in this protocol) are calculated using the following process.

INPUT	PROCESS	OUTPUT	BY WHOM
Emissions figures determined within the company	Report in AER/MJV (annual environmental report)	AER/MJV	Company

AER/MJV	Validate AER/MJV	Validated AER/MJV	Competent Authority (Province)
Validated AER/MJV	Include in FO-I file	FO-I file	FO-I (facilitation organisation-industry)
FOI file	Checking emission figures: - Comparing MJVs with MJVs from previous years (trend) If non-substantiated deviations in MJV text found, contact the Province and/or Company→ If necessary modify emission figures and document everything.	Final data Work package leader (t-2)	Work package leader
Final data Work package leader (t-2)	Include (t-2) data in ER database	ER-db with (t-2) data	Work package leader
ER-db with (t-2) data	Check, and trend analysis of air emissions: explain deviations or modify figures	Final defined emission figures (t-2)	Task forces and PBL experts

4 UNCERTAINTY AND QUALITY

4.1 Estimating uncertainties

A Tier-1 uncertainty analysis is implemented every year before the NIR is submitted by the ER, based on the greenhouse gas inventory and in compliance with IPCC guidelines. The assumptions used and the results thereof are described in a background report to the NIR. In addition to this, where included in the QA/QC programme for the relevant period, extra analyses are implemented regularly in specific situations, which include any updating of the Tier-2 uncertainty analyses.

The Tier-2 uncertainty assessment was last updated in 2006. This assessment showed that a Tier-1 uncertainty assessment is sufficiently reliable and that Tier-2 uncertainty assessments need only be implemented at periodic intervals of around 5 years, unless a major change in an important source is sufficient to require earlier reassessment.

- Source-specific uncertainty

The uncertainty estimate-totaal concerns the root of the sum of uncertainty in the data sources used (AD_{onz}) in the square and the uncertainty of the emission factor (EF_{onz}) in the square. The extent of the total uncertainty is here primarily determined by the greatest AD or EF uncertainty.

$$\text{Uncertainty estimate}_{\text{total}} = \sqrt{EF_{onz.}^{2} \quad AD_{onz.}^{2}}$$

The uncertainty estimates concerning the data sources (AD) and emission factors (EF) used, and the total uncertainty estimate, are listed in the following table.

IPCC	Category	Gas	$AD_{onz.}$	$EF_{onz.}$	Uncertainty estimates $_{tot}$
2E	HFC-23 emissions from HCFC-22 manufacture	HFC	10	10	14

Because of confidentiality, only emissions from HFC-23 by-products were reported by the producer. An estimate of activity data and emission factors would be required for a Tier 1 or Tier 2 uncertainty assessment, associated with reported emissions.

For the Tier 1 uncertainty assessment, the uncertainty in HFC emissions from HCFC-22 production was estimated to be about 15%, while from handling activities this was about 50%. The uncertainty in the activity data for these sources was estimated at 10%. The uncertainties in the emission factors for HFC23 from HCFC-22 production and for HFC from handling activities were estimated at 10 and 50%, respectively. These figures were all based on experte judgments [Olivier et al, 2009].

4.2 Quality assurance and quality control (QA/QC)

The ER work package leaders check that:

1. the basic data are well documented and adopted (check for typing errors, use of the correct unit sizes and correct conversion);
2. the calculations have been implemented correctly;
3. assumptions are consistent, also whether specific parameters (e.g. activity data) are used consistently;
4. complete and consistent data sets have been supplied.

Any actions that result from these checks are noted on an ‘action list’. Before defining the data, supervisors check whether the relevant actions on this list, plus the QC checks, have all been completed. Defining the data is carried out by the WEM (working group on emissions monitoring), and confirmed in writing via an e-mail from the institute representatives to the ER project leader at PBL.

The work package leaders fill out a new documentation sheet when adding new data. For reasons of efficiency a minimum level has been set for obligatory documentation, i.e. 5% changes at target group level, and 0.5% at levels concerning the national total. These documentation sheets form part of the trend analysis, as well as the eventual definition of the data set.

The ER work package leaders communicate by e-mail regarding these QC checks, results and actions. They send a printed copy to the ER secretary, who keeps a logbook and compiles these e-mails into an ‘action list’. This shows explicitly that the required checks and corrections have been carried out.

4.3 Verification

In order to check the quality of the emission figures for the sources in this protocol, general QA/QC procedures have been followed that are in line with the IPCC guidelines. These are described further in the QAQC programme used by the National System, and the annual working plans published by the ER.

- Sector-specific QC
No additional specific verification procedures are implemented for the sources defined in this protocol.

4.4 Possibilities for improvement compared to the current calculation method

4.4.1 History
Not applicable

4.4.2 Future
Not applicable

5 REMAINING ASPECTS

5.1 Point source criteria
Not applicable

5.2 Substance profiles
Not applicable

5.3 Regionalisation
Not applicable

5.4 Time-based variations in source strength
Not applicable

6 REFERENCES AND ADDITIONAL INFORMATION

6.1 References
Cadmus, 1998: *Performance Standards for Determining Emissions of HFC-23 from the Production of HCFC-22*, draft final report prepared for USEPA, February 1998.

IPCC, 1997: Revised 1996 IPCC Guidelines for National Greenhouse Gas Emission Inventories, Three volumes: Reference Manual, Reporting Guidelines and Workbook. IPCC/OECD/IEA. IPCC WG1 Technical Support Unit, Hadley Centre, Meteorological Office, Bracknell, UK

IPCC, 2001: Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, IPCC-TSU NGGIP, Japan

Olivier J.G.J., L.J. Brandes and R.A.B. te Molder, 2009 (in print) Uncertainty in the Netherlands' greenhouse gas emissions inventory: Estimate of annual and trend uncertainty for Dutch sources of greenhouse gas emissions using the IPCC Tier 1 approach, PBL-Report 500080013, Bilthoven

6.2 Additional information
Not applicable