



## **Greenhouse Gas Emission Reduction Verification Audit**

**for**

**DuPont's Louisville Works Freon®22 Plant**



### **FINAL REPORT**

**Audit Date:**

April 28, 2004

**Audit Location:**

DuPont Louisville Works  
4200 Camp Ground Road  
Louisville, KY 40216  
USA

**Audit Report Date:**

May 11, 2004

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**Confidential information has been removed.**

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## 1. Introduction

This report documents the verification of greenhouse gas emission reductions claimed over the period 1-Jan-2003 through 31-December-2003 as a result of the Freon®23 (HFC-23) abatement project at DuPont's Louisville, Kentucky Freon®22 production facility.

## 2. Statement of Opinion

Based on a review of the relevance, completeness, transparency and accuracy of the relevant GHG information, it is the opinion of ICF Consulting Inc. that;

- The emission reductions are verifiable as activity data relied upon in the quantification of emission reductions is collected, reported and communicated effectively. The relevant data records are maintained and protected, demonstrating historic and ongoing conformance to Emissions Reduction Creation Protocol – DuPont Louisville Works' Emissions Reduction Creation Protocol – Freon®23 Abatement – Rate-based (2002).
- The emission reductions are surplus and represent a reduction not otherwise required.
- The resulting emission reductions are both real and measurable. The methodology applied in the determination of emission reductions is acceptable, in that it draws on methodologies described in the IPCC's Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000), Environment Canada's Greenhouse Gas Emission Measurement and Coverage for Entity Reporting (Environment Canada, 2001) and WRI/WBCSD's The GHG Protocol – a corporate accounting and reporting standard (WRI/WBCSD, 2001) and will result in a conservative estimation of emission reductions.

Therefore based on the verification, ICF Consulting attests that the HFC-23 emission reductions summarized below and claimed in DuPont Louisville Works' Credit Creation Report – 2003 – Rate-based, occurred as a result of the project activity described in DuPont Louisville Works' Emissions Reduction Creation Protocol – Freon®23 Abatement – Rate-based (2002) during the verification period (January 1, 2003 through December 31, 2003).

Year	Emissions Reductions (Mg)
	Carbon Dioxide Equivalent
2003	10,802,352
Total	10,802,352

### 3. Objective

The primary objective of the verification was to provide an independent opinion on the emission reductions of HFC-23 claimed to result from the emission reduction project at DuPont Louisville Works production facility. To this end ICF Consulting Canada, Inc. has examined the accuracy and completeness of current emissions reported and the baseline assumed over the course of the project.

This document is intended to offer the user a high level of assurance about the relevance and reliability (relevance, completeness, consistency, transparency, and accuracy) of the information provided in;

- DuPont Louisville Works' Emissions Reduction Creation Protocol – Freon®23 Abatement – Rate-based (2002),
- DuPont Louisville Works' Credit Creation Report – 2003 – Rate-based

The following description of the background, methodology and data sources is not intended to be all inclusive but to provide adequate background information required to support the objectives of this document. For a detailed description of the sources of the relevant data refer to DuPont Louisville Works' Emissions Reduction Creation Protocol – Freon®23 Abatement – Rate-based (2002).

### 4. Approach

The approach employed by ICF Consulting is aimed at confirming emissions estimates, that is, confirming that the methods used for estimating GHG emissions are sound and consistent with established methodologies and data. Undertaking this form of verification for GHG emissions from process sources requires detailed knowledge of the characteristics of equipment generating GHG emissions, information about equipment, efficiency, and maintenance practices to ensure the equipment is functioning as intended and designed.

Our approach to this verification included:

- An evaluation of data management systems for inventorying GHG emissions including quality assurance and quality control processes;
- A confirmation of the appropriateness of the GHG emissions reduction inventory;
- An evaluation of the uncertainty associated with reported activity data and emission factors,
- A review of gaps identified in historic audits to ensure they are addressed, and
- A confirmation of emissions estimates and reductions.

### 5. Background

The DuPont Louisville Works Production facility produces Freon®22 (HCFC's are regulated under the Montreal Protocol and therefore not subject to the Kyoto Protocol). One of the byproducts in the production process is HFC-23, a greenhouse gas with a global warming potential (GWP) 11,700 times that of carbon dioxide (CO<sub>2</sub>).

In the early 1990's, DuPont publicly committed to reduce its global Greenhouse gas emissions by 40% by the year 2000 and 65% by 2010 using 1990 emissions as a baseline. As a step in meeting this target Louisville Works implemented a 3 component project aimed at reducing HFC-23 emissions. The first component included adjustment to reactor conditions to produce less

HFC-23. The second included improvements to the HFC-23 recovery system's capability. The third component involved the thermal destruction of recovered HFC-23.

The reactor adjustment project included the revision of operating procedures for the Freon®22 reactor and reflux column to reflect the optimum conditions aimed at reducing the production of HFC-23. Operators were notified of these changes and trained to respond to indications outside of the control limits of operation. In addition preventative maintenance was implemented on key instruments including gas chromatographs, flow meters, RTD's, pressure transmitters, weight cells, feed control valves, pressure control valves, brine flow control valves, and steam control valves.

## 6. Methodology

The emissions reductions associated with the project are equal to the reductions associated with the reactor adjustment plus those associated with thermal destruction. The methodology applied is difference of the calculated HFC-23 baseline emissions produced (what the emissions would have been absent the project) the current year and the actual HFC-23 produced the current year, added to the HFC-23 thermally destroyed the current year.

The emission reduction calculation can be summarized as:

$$R = [(Ratio_{preproject}) - (F23_{produced}) / (F22_{produced})] * (F22_{produced}) * (F23 \text{ GWP}) + (F23_{thermally \text{ destroyed}}) * (F23 \text{ TD GWP})$$

Where:

R	=	Total HFC-23 Emission Reduction (current year)
Ratio <sub>preproject</sub>	=	Average Production Ratio for Pre-Project Years
F23 <sub>produced</sub>	=	HFC-23 Produced Current Year
F22 <sub>produced</sub>	=	HCFC-22 Produced Current Year
F23 <sub>thermally destroyed</sub>	=	HFC-23 Thermally Destroyed Current Year
F23 GWP	=	11,700
F23 TD GWP	=	F23 Thermally Destroyed GWP (11,699)

### 6.1 Baseline Calculation

Baseline emissions are determined based on current year HCFC-22 production and a historic average ratio (during pre-project years 1995-1999) of HFC-23 generated to HCFC-22 produced. Data for the ratio is drawn from the average of monthly HFC-23 emissions per HCFC-22 production ratios available on the computer control system.

### 6.2 Current Emissions

HFC-23 production is the product of the flow-rates and HFC-23 concentration of the HCl columns streams.

### **6.3 F23 Emissions Thermally Destroyed (F23 TD GWP) Factor**

The CO<sub>2</sub> equivalent of the HFC-23 emissions destroyed is determined by multiplying the emissions by a net GWP (100 year global warming potential) equivalent. The net GWP is the actual GWP for HFC-23 (11,700) reduced as a result of CO<sub>2</sub> emitted via the combustion of fuel required to heat the HFC-23 and via the process decomposition reaction. The net GWP is therefore 11,699, that is, for each tonne of HFC-23 destroyed and equivalent of 11,699 tonnes of CO<sub>2</sub> equivalent are destroyed.

## **7. Data Sources**

Determination of the emission reduction associated with the HFC-23 abatement project is based on the following data sets:

- HCFC-22 production,
- HFC-23 production, and
- HFC-23 thermally destroyed.

### **7.1 HCFC-22 Production**

HCFC-22 production comes from two data sources; the accounting production numbers and the data acquisition system. The amount of HCFC-22 produced is determined from the HCFC-22 storage tank levels and weighed product shipments (recorded in the data acquisition system) and confirmed by calculations involving the HF feed flow rate.

The main source of uncertainty associated with the HCFC-22 production is related to the scale. On an annual basis the scale is calibrated and certified to be accurate to within 0.5% by a third party. Data from the scale and inventorying of storage tanks is the basis for monthly production reports utilized by management and therefore extensive quality assurance and quality control processes are carried out on reported information used in the calculation of emission reductions including daily operator checks, frequent cycle counts (two per week) and monthly adjustments.

### **7.2 HFC-23 Production**

HFC-23 production is the product of the flow-rates of the HCl columns streams overhead and the concentration of HFC-23 in the HCl columns streams overhead. The flow-rates are measured using Vortex shedding type flow meters while the concentration of HFC-23 is measured using a gas chromatograph. The data acquisition system records the flow-rate every 15 seconds and concentration on a one hour cycle between the reactors and then multiplies them together to calculate the HFC-23 produced. Each day a report is generated that includes the total HFC-23 produced for the past 24 hours in each of the two reactors.

Sources of uncertainty related to HCF-23 production include those associated with the Vortex shedding type flow rate meter (Yokogama-make) and the gas chromatograph. Due to the frequency of the computer scan rate (15 seconds) and the accuracy of the Yokogama flow meter (+/-1%) the associated uncertainty is assumed to be very low. The gas chromatograph is tested monthly versus a certified calibrated gas standard on a monthly basis and calibrated when readings are outside of a 5% threshold. Based on conversation with key staff the gas chromatograph is accurate to within 0.5% of full scale for full scale ranges from 2 – 100% when maintained and calibrated. In addition, when the ratio of HCF-23 to HCFC-22 production is outside of normal levels the computer control triggers a corrective action.

### **7.3 HCF-23 Thermally Destroyed**

The amount of HFC-23 that is thermally destroyed is the sum of the HFC-23 shipments loaded for thermal destruction. To determine the amount shipped, the HFC-23 tank trailers are weighed before and after loading to verify the amount of HFC-23 that is loaded. These weight measurements are recorded and then sent to the shipping office.

The main source of uncertainty associated with the HCF-23 shipped for thermal destruction is related to the scale. On an annual basis the scale is calibrated and certified to be accurate to within 0.5% by a third party. The scale weights are confirmed by invoices provided by the entity that carries out the thermal destruction. The HFC-23 gas sent for destruction has been shown to be 99.6% pure based on lab analysis. Therefore the uncertainty associated with HFC-23 sent for thermal destruction is assumed to be very low.

## 8. Relevant Data

The following table summarizes the relevant data and calculated emission reductions associated with the emission reductions claimed over the period 1-Jan-2003 through 31-December-2003 as a result of the Freon®23 (HFC-23) abatement project at DuPont's Louisville, Kentucky Freon®22 production facility.

	1995-1999	2003
<b>HFC-23 Produced (kg)</b>	n/a	
<b>HFC-23 Thermally Destroyed (kg)</b>	0	
<b>HFC-23 Emitted (kg)</b>	n/a	
<b>HCFC-22 Production (kg)</b>	n/a	
<b>HFC-23/HCFC-22 Production Ratio (%)</b>	2.06%	1.37%
<b>F23 GWP</b>		11,700
<b>F-23 Thermally Destroyed net-GWP</b>		11,699
<b>CO<sub>2</sub> Emission Reductions (kg)</b>		<b>10,802,352,174</b>
<b>CO<sub>2</sub> Emission Reductions (tonnes)</b>		<b>10,802,352</b>

## 9. References

**IPCC (2000)**, Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. Available on-line at: <http://www.ipcc-nggip.iges.or.jp/gp/report.htm>

**IPCC WGI (1995)**, Climate change 1995 - The science of climate change: The second assessment report of the Intergovernmental Panel on Climate Change. Houghton JT, Meira Filho LG, Callander BA, Harris N, Kattenberg A, Maskell K, eds. Cambridge University Press, Cambridge, UK

**World Resources Institute / World Business Council for Sustainable Development (2001)**, The Greenhouse Gas Protocol, a corporate accounting and reporting standard. Available on-line at: [www.wbcsd.org](http://www.wbcsd.org)

**World Resources Institute / World Business Council for Sustainable Development (2002)**, The GHG Protocol Initiative – accounting and reporting for project-based greenhouse gas reductions (WRI/WBCSD, 2002). Available on-line at: [www.wbcsd.org](http://www.wbcsd.org)