

## Annex IX

### TERMS OF REFERENCE (TOR) FOR THE TECHNICAL AUDIT OF HCFC PRODUCTION IN ARTICLE 5 COUNTRIES

#### Background

1. The Montreal Protocol on Substances that Deplete the Ozone Layer and its Montreal Amendment advanced the phase-out schedule of HCFCs in 2007 by its signatory countries, although a distinction has been made in the schedule between developed and developing countries. The developing countries (the Article 5 countries in the language of the Protocol) are required to freeze the production and consumption of such chemicals in 2013 at the average level, between 2009 and 2010. They are subsequently required to reduce the levels of production and consumption in a number of phases until complete phase-out has been achieved in 2040. The Multilateral Fund for the Implementation of the Montreal Protocol was established in 1991 as part of the London Amendment to assist Article 5 countries in complying with the control schedule of the Montreal Protocol. Up until 2009, the Fund has successfully assisted over 140 countries in phasing out the production and consumption of CFCs, halons, the controlled use and production of CTC and methyl bromide and other ozone depleting substances in accordance with the control schedule of the Montreal Protocol. The assistance of the Fund is primarily to cover the incremental costs associated with the transition from employing ozone-depleting to ozone-friendly technologies.

2. Funding of the phase-out of the production of ODS has been done through first, independently auditing the ODS production sector of the concerned country. These audits examine the relevant national and sectoral policies; collect data on ODS-producing plants with respect to their technological sophistication, status quo, designed and actual used capacity, production history, cost of production, and other relevant data. The purpose of the audit is to establish a factual basis for the Executive Committee (the management body of the Multilateral Fund) to consider the funding requests proposed by the respective Article 5 countries. For ensuring consistency of conducting such audits across countries, the Executive Committee adopted the terms of reference for technical audits in 1995 as a general guide to auditing ODS production. These terms of reference were subsequently amended and further developed as necessary to accommodate the specific needs associated with auditing the production of different ODS.

3. The terms of reference contained in this document are designed for auditing of the production of HCFCs, which include HCFC-141b, HCFC-142b, HCFC-123, and HCFC-22 or any applicable HCFC. While the TOR requires the auditing to follow the procedure and cover the ground that are standard to the auditing of the production of other ODS, there are several issues that are specific to the HCFC production. Among these are the impact of the clean development mechanism (CDM) on the HCFC-22 production and the impact of the phase-out of HCFC-22 production on the down-stream industries (such as the production of TFE/PTFE). TFE, the direct reaction product of HCFC-22, is not just used to make PTFE polymer, but also has been used to make HFC-125 which is one component for making R410a, a blend for making an air conditioning agent.

4. With regard to the CDM impact, one key question is whether the CDM credits awarded for reducing HFC-23 emission (a gas controlled by the Kyoto Protocol) provide a perverse incentive to produce HCFC-22, since HFC-23 is a by-product of HCFC-22 production. If it could be established that the high HCFC-22 production was not driven either by the demand for feedstock for TFE/PTFE or refrigeration purposes, it might be due to the financial reward of the CDM credits. A technical audit might provide some insight into this issue. It is expected that to clearly understand the workings of the CDM the audit would collect national and individual plant data from the field, place them in the global context for a supply and demand analysis, and assess the impact of the CDM on an individual company, as well as on national and global situations.

5. With respect to the impact of phasing out HCFC production on downstream industries, the key is the extent to which HCFC-22 production could be absorbed as feedstock for PTFE production, regardless of its final use. Converting HCFC-22 from its use as a refrigerant (a controlled use under the Montreal Protocol) to being used as feedstock (a non-controlled application) would result in a win-win situation. Plants could continue to produce, but with no adverse impact on the environment, since HCFC-22 is completely transformed in the process of being used as feedstock. It is also possible that some plants could be converted from HCFC-22 production (using chloroform) to HFC-32 production (using methylene chloride). Since there is no plant closure, there might only be a need for compensation for the cost of conversion and no need for compensation for plant closure by the Multilateral Fund (MLF).

6. However, there are difficulties associated with achieving this win-win situation. These difficulties relate to segments of the TFE markets, demand from the various global market segments, and availability of technology for PTFE production. These challenges should be examined carefully to determine to what extent they are real, and whether they prevent switching HCFC-22 production completely to feedstock production. It is also important to know whether these difficulties can be overcome and, if so, at what cost.

7. While these are policy-related and macro-level issues, questions and leads are included in the TOR to guide the consultants implementing the audit to collect the relevant data and provide the analysis. It is hoped that they will provide useful input to the Executive Committee to encourage a thorough discussion of these issues.

### **Objective of the technical audit**

8. The objective of the technical audit is to provide a factual basis for:

- (a) Preparing and finalizing the sector plan by a producing country for phasing out the production of HCFCs in the country; and
- (b) Enabling the Executive Committee's review and funding decisions with respect to the sector plan.

### **Scope of the audit**

#### Overall Consideration

9. The results of the technical audit should provide a wide enough scope for considering various options for the elimination of HCFC production in a producing country, including the closure of production facilities, the production of ODS substitutes, conversion to feedstock production, and other possibilities.

#### Data Collection and Assessment

10. Where applicable, data should be collected over the past three to five years, except for HCFC plants with approved CDM projects, for which data for three years before and three years after the approval of the CDM projects should be collected. Specifically, the audit should cover:

#### *Capacity*

- (a) Assess the ability to produce HCFCs under sustainable conditions for a full year and the potential capacity of individual plants, and total country production capacity. Where levels of actual production are significantly lower than capacity, explanations are needed (for example, lack of demand, power or feedstock shortages, maintenance, technical failure to operate at full capacity);

- (b) Assess the potential for conversion of individual sites to non-ODS production. For CFC/HCFC-22 swing plants, actual production levels should be stated, along with the capacity of each plant, if operated: a) for CFC-11 and CFC-12 only, and b) for HCFC-22 only (subject to further analysis and verification, including detailed process calculations if necessary. Data should be collected for such analysis and rule out sites for expansion, conversion and/or revamp based on factors such as space limitation or limited access to raw materials);
- (c) Assess the impact of the credits from the CDM on HCFC-22 production by establishing data on:
  - Time (month/year) of approval of the CDM project;
  - Level of HFC-23 produced per year for the past 3 years, where applicable;
  - Individual plant and national HCFC-22 production history, based on site production and storage records and from plant and national sales records, including imports/exports;
  - Sales data, including volume, and unit prices of products, taxes and subsidies, and profit margin of sales; and
- (d) Assess site and national availability and cost of raw materials (such as size and location of plants).

*Production history and profitability*

- (a) Assess individual plant and national production history based on site production and storage records and from plant and national sales records, including imports/exports;
- (b) Establish site-specific economics of production data, including volume and unit costs of raw materials, energy and utilities, by-product credits, maintenance costs, transportation costs, distribution costs, operating labour (number of workers and applicable labour law), plant overhead, taxes and insurance, depreciation, and general and administrative costs; and
- (c) Establish sales data, including volume and unit prices of products, taxes and subsidies, profit margin of sales.

*Assessing HCFC production for controlled and feedstock applications*

- (a) Collect data over the past five years on the distribution of HCFC sales for controlled use and feedstock use;
- (b) Collect data over the past five years on the imports and exports of HCFC for controlled use and feedstock use;
- (c) Assess the potential of each plant producing HCFC entirely for feedstock application;
- (d) Identify the hurdles that prevent a plant from producing entirely for feedstock; and

- (e) Assess options for overcoming such hurdles and the cost scenarios for the different options.

*Assessing HCFC-141b and HCFC-142b*

11. Whilst HCFC-141b is used entirely as an emissive foam blowing agent and to a more limited extent, as a solvent, HCFC-141b is also used, besides its vital XPS foam use, to make the important fluoropolymers, polyvinylidene fluoride PVDF, and fluoroelastomer. HCFC-142b can be made deliberately from HFC152a. Key questions to assess HCFC-141b and HCFC-142b include:

- (a) Do you make HCFC-141b, HCFC-142b, HFC-143a? In what capacity, since when, by what technology (feedstock)?
- (b) What level of product is exported, and what level is used domestically from 2005 to the present year?
- (c) What are the applications by volume by year?
- (d) Can you convert your plant to HCFC-142b, and/or do you already make HCFC-142b as a co-product?
- (e) In this case can you completely eliminate HCFC-141b production but still make HCFC-142b?
- (f) Do you sell HCFC-142b to the PVDF sector? What amount? Can you manage your plant to the explicit volume demands on the PVDF sector?
- (g) If you make HCFC-142b deliberately from HFC152a, how much do you produce? What are the uses? How much is controlled (foam) versus non-controlled (feedstock)?
- (h) If you make HCFC-142b by this route, what is the impact on HFC152a production if you must abandon the controlled (XPS) uses of HCFC-142b?
- (i) Do you export HCFC-142b for intermediate/feedstock applications?

*Technology employed*

- (a) Establish the age and source of technology employed at individual plants (locally developed or imported), material of construction of main process vessels (such as the main hydrofluorination reactor);
- (b) Assess maintenance expenditures of individual plants;
- (c) Assess de-bottlenecking (most recent); and
- (d) Assess the residual life and residue value of each plant.

*Other relevant data*

- (a) Collect and assess data on cost of capital, inflation rate and other relevant national economic data;
- (b) Collect data on supply and demand for HCFCs and their substitutes;

- (c) Collect data on national production of HF and other raw materials necessary for the production of HCFC substitutes; and
- (d) Assess the status and availability of national technology for HCFC substitutes, together with their estimated production costs and possible scale of production over the next five years.

#### Data analysis

12. Data collected from the desk review and the field visits will be sorted, interpreted and analyzed for likely sector strategies of phasing out the HCFC production in the country, including plant closures, ODS substitutes production, and other possibilities. Under plant closures, the data should be organized in order to facilitate the identification of parameters such as, the baseline production level and the actual capacity of the plant, maximum and residual life of the plant, unit prices of HCFCs, profit margin of sales, and relevant national economic parameters. Under ODS substitute production, data should be presented to clearly indicate the supply and demand for the substitutes, technological readiness and estimate of conversion costs for applicable sites, and the economic feasibility and achievable capacities.

13. Data should be made available in a spreadsheet format suitable to allow manipulations to test the sensitivities of certain parameters.

#### **Responsibilities of the audit team**

14. The audit team should be responsible to the Chief Officer of the Multilateral Fund Secretariat and accomplish the following tasks:

- (a) Prepare a detailed work plan covering the entire audit exercise, including the methodology for assessing the impact of the CDM on HCFC production;
- (b) Screen the preliminary data from the production sector and other relevant data submitted by the country concerned, identify the gaps in those data, and design a questionnaire for collecting supplementary data, to be dispatched to plants in the country concerned before a field visit;
- (c) Based on the preliminary data from the country and the location of the plants, propose a field visit schedule, which should include a representative sampling of the plants in the country in terms of size, technology sophistication, capacity covered, and sound economics;
- (d) Implement the field visit schedule with local support from the national focal point designated by the host country;
- (e) Prepare the draft audit report, with analysis and interpretation of the data collected from the field visit; and
- (f) Based on comments on the draft report, prepare the final draft report to the Executive Committee.

### **Qualifications**

15. Qualifications include:

- (a) Prior relevant experience working in developing countries (preferably in the country concerned);
- (b) Expertise in fluorocarbon technology, process and plant operations and financial accounting; and
- (c) A sound knowledge of the CDM programme and its global activities.

### **Local Expertise**

16. There should be participation of local expertise in the audit. However, the exact field of expertise (whether technical or financial) should be determined by the contracting firm on the basis of needs of the audit.

### **Deliverables**

17. The deliverables include:

- (a) A detailed work plan, covering:
  - Methodology for assessing impact of the CDM on HCFC production;
  - Assessment of adequacy of existing data and identification of missing “links”;
  - A questionnaire designed for collecting additional data;
  - A schedule of field visit to a representative sample of the HCFC producing industries in the country concerned in terms of size, location, technology level and other relevant factors;
- (b) Mid-term progress report on field visit;
- (c) Report of field visit;
- (d) Draft technical audit report; and
- (e) Final draft technical audit report.

-----