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**Addendum**

**KEY ASPECTS RELATED TO HFC-23 BY-PRODUCT CONTROL TECHNOLOGIES:  
PRELIMINARY DATA TO CLOSE HCFC-22 PRODUCTION SWING PLANTS**

This document is being issued to:

- **Add** the following paragraphs after paragraph 13:

13 (bis). Subsequent to the issuance of document UNEP/OzL.Pro/ExCom/80/56, the Government of India, through the World Bank, submitted preliminary data on the four HCFC-22 production swing plants in the country. As the information is considered confidential, only aggregated data is provided in the present document.

13 (ter). The four swing plants are 100 per cent locally owned and produce HCFC-22 for domestic ODS use, for feedstock use, and for export. The production lines were established between 1968 and 1989 and have a capacity ranging from 1,900 mt/year to 25,000 mt/year. The HCFC-22 production at the four lines ranged between 39 per cent and 103 per cent of the production capacity between 2014 and 2016. The production process for HCFC-22 uses hydrogen fluoride (HF) and  $\text{HCCl}_3$  as raw materials, though some of the enterprises produce some or all of the HF from fluorospar. The HFC-23 by-product generation rate varied between 1.96 per cent and an unspecified quantity between two and three per cent. The enterprises employed between 73 and 424 employees.

13 (qua). The Government of India in its prior response to decision 78/5(d) provided the following information:

- (a) There are six HCFC-22 production lines at five enterprises in the country; one of those lines only produces HCFC-22 for feedstock uses. Total production of HCFC-22 in 2015 was 53,314 mt, with an estimated HFC-23 by-product generation of 1,674 mt (3.13 per cent generation rate). Each production line is equipped with an HFC-23 destruction facility;
- (b) Five production lines were funded to destroy HFC-23 under the Clean Development Mechanism (CDM). Currently all HCFC-22 producers are destroying HFC-23 by-product

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at their own cost;

- (c) The Government of India issued an order on 13 October 2016<sup>1</sup> stating that “the production of HCFC-22 for feedstock use will continue beyond 2030,” and directing the five HCFC-22 producers and “any other producers that may be covered by the on-going or anticipated phase-out management plan for the accelerated phase-out of HCFCs” to take the following measures urgently and immediately:
- (i) To destroy HFC-23 produced as a by-product of HCFC-22 through incineration using an efficient and proven technology such as thermal oxidation;
  - (ii) To ensure proper upkeep and maintenance of HFC-23 incineration facility so that their down time is maintained below 10 per cent;
  - (iii) To create and maintain sufficient storage capacity to ensure that all HFC-23 is stored during any authorized shutdown, so that no venting occurs. Under no circumstances HFC-23 shall be vented in the atmosphere;
  - (iv) When reporting the production of ODS under Ozone Depleting Substances rules 2000, to certify the amounts of HFC-23 that were incinerated, used as a feedstock or used for any other purpose on an annual basis;
  - (v) HFC-23 maybe used as feedstock for production of other chemicals;
  - (vi) The State Pollution Control Boards shall ensure compliance with the order while renewing Consent to Operate to the producers or through their regular inspections; additionally, the Central Pollution Control Board shall also ensure compliance with the order; and
- (d) The Government noted the urgency to develop a sustainable, environmentally friendly approach to mitigating HFC-23 by-product on a long-term basis, and highlighted the pitfalls of previous approaches, including the potential for perverse incentives. The Government is of the view that HFC-23 should be controlled through incineration by the producers of HCFC-22 on their own cost as a negative environmental externality both in non-Article 5 and Article 5 countries.

- **Add** the following after paragraph 21:

Agreement for the CFC production in India

21 (bis). At the 29<sup>th</sup> meeting, the Executive Committee approved the Agreement for the India Production Sector at a funding level of US \$82 million; and, at the 54<sup>th</sup> meeting, the Executive Committee approved in principle an additional US \$3.17 million for closing down the CFC production by 1 August 2008, 17 months ahead of the phase-out schedule. The Agreement for the phase-out of CFC production in the country specified that the agreed funding would be the “total funding that would be available to India from the Multilateral Fund for the cessation of production of Group I Annex A CFCs, Group I Annex B CFCs, and eventual cessation of production of Group I Annex C HCFCs as per Montreal Protocol phase-out schedule (including future amendments in schedule, if any) and dismantling of the plants following within 18 months of the cessation of production of ODS unless the plants are otherwise put to use producing substances other than ODS.”

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<sup>1</sup> Order F. No. 10/29/2014-OC.

*Brief analysis of the preliminary data from India*

21 (ter). The molar ratio of the HF to  $\text{HCCl}_3$  at the lines varies between 2.02 and 2.27, indicating that the lines follow the common industry practice of running the reactor with an excess of HF. The ratio of the number of employees per thousand metric tonnes of HCFC-22 produced varied between 7.5 and 99.8.

Costs for destruction of HFC-23

21 (qua). The Secretariat noted that the schedule for closure of the four swing plants is indicated as “under the accelerated Montreal Protocol schedule.” Upon a request for clarification, the World Bank confirmed that the four swing plants intend to follow the requirement of the Montreal Protocol; however, no specific plans or closure date have been made.

21 (quin). The Secretariat recalled that in addition to the four HCFC-22 production swing lines, there are a further two lines producing HCFC-22 in the country that are not swing lines; one of those lines only produces HCFC-22 for feedstock uses, while the other line also produces HCFC-22 for controlled uses. The Secretariat asked whether it was the Government’s intention for the four HCFC-22 production lines to close while the other two lines that are not swing plants would continue operating. The World Bank confirmed that the four swing lines would comply with the accelerated HCFC phase-out agreed by the Parties in 2007, and indicated that further decisions would be based on the ongoing discussions in the Executive Committee.

21 (sex). The Secretariat further recalled that as part of the information the Government of India submitted in line with decision 78/5, the Government shared a copy of order F. No. 10/29/2014-OC that was issued on 13 October 2016 that noted that the production of HCFC-22 for feedstock use will continue beyond 2030 and is expected to grow and reach one million tonnes by 2035, and directing the five HCFC-22 producers and any other producers that may be covered by the on-going or anticipated phase-out management plan for the accelerated phase-out of HCFCs to urgently and immediately undertake a number of actions related to HFC-23 produced as a by-product of HCFC-22 production. The World Bank confirmed that all lines, including the HCFC-22 production swing lines, are currently incinerating their HFC-23 by-product, and will still be subject to the requirements of the Government’s order until they cease producing HCFC-22, including to destroy HFC-23 produced as a by-product of HCFC-22 production through incineration using an efficient and proven technology such as thermal oxidation, and under no circumstances HFC-23 shall be vented in the atmosphere.

21 (sept). Based on the information available, the Secretariat is not in a position to identify the most cost-effective option for compensation for the enterprises to enable India to comply with the HFC-23 by-product control obligations of the Kigali Amendment. In particular, the Secretariat is unable to provide an analysis of the break-even point between closure and continued operation of the HFC-23 destruction facility as that break-even point will depend on the level of production, which in turn will depend on when the HCFC-22 swing lines would close. For reference, the information provided in the CDM monitoring reports indicates:

- (a) The weighted average HFC-23 by-product generation rate at the four swing lines varied between 2.83 and 3.32, and three of the lines achieved minimum by-product generation rates of 1.61 per cent or lower. It is unclear whether this low by-product generation rate was temporary or whether process improvements or other factors might have led to the reduced generation rate;
- (b) The incremental cost of consumables and waste for the four swing lines varied between US \$0.27/kg and US \$0.87/kg of HFC-23 destroyed (see Annex I); and

- (c) Three of the swing lines recovered HF from the destruction facility; however, the level of revenue from the sale of that recovered HF, if any, is not clear.

- **Add** the following paragraph and Tables 1 and 2 to Annex I:

11. A summary of the Secretariat's analysis of data from the CDM of the four HCFC-22 production swing lines in India is presented in Tables 1 and 2 below.

**Table 1. Key characteristics and calculated incremental costs of the reported consumables and waste from four HFC-23 destruction projects under the CDM at HCFC-22 swing lines in India**

Plant	Number of		Fuel	HF recovered	w (%)		Incremental cost of consumables and waste (US \$/kg of HFC-23)
	Reports	Line(s) in project			Weighted Average	Minimum	
Chemplast Sanmar	26	1	Compressed air and hydrogen	yes*	3.03	1.58	0.25
Navin Fluorine International	23	1	Air, steam and natural gas	yes*	3.32	3.11	0.87
SRF	28	1	Hydrogen and oxygen	yes*	2.95	1.50	0.45
Gujarat Fluorochemicals Limited	47	1	Air, steam and natural gas	yes*	2.83	1.62	0.47

\* Use of chemicals for neutralization is included in monitoring reports

**Table 2. Use and cost of consumables and waste at four HFC-23 facilities under the CDM at HCFC-22 swing lines in India**

Plant	Fuel 1				Fuel 2				Electricity		Sludge		Neutralizing agent 1			Neutralizing agent 2			ICRCW (US \$/kg HFC-23)	Other <sup>2</sup>		
	Type	Unit	Use (unit/kg HFC-23)	Cost (US \$/ kg HFC-23)	Type	Unit	Use (unit/kg HFC-23)	Cost (US \$/kg HFC-23)	Electricity (kWh/kg HFC-23)	Cost (US \$/ kg HFC-23)	Sludge (mt/kg HFC-23)	Cost (US \$/ kg HFC-23)	Type	Use (kg/kg HFC-23)	Cost (US \$/kg HFC-23)	Type	Use (kg/kg HFC-23)	Cost (US \$/kg HFC-23)		Other	Units	Value
Chemplast Sanmar	Hydrogen	Nm <sup>3</sup>	3.77	0.16	C.air <sup>3</sup>	m <sup>3</sup>	8.00	0.04	0.51	0.05	n/a	-	NaOH	0.004	0.002	Na <sub>2</sub> SO <sub>3</sub>	0.002	0.000	<b>0.25</b>	n/a	n/a	-
Navin Fluorine International	Natural gas	Nm <sup>3</sup>	0.69	0.35	Steam	kg	0.85	0.03	3.44	0.34	0.0016	0.08	Ca(OH) <sub>2</sub>	0.64	0.06	NaOH	0.02	0.01	<b>0.87</b>	Recovered HF	kg/kg of HFC-23	0.55
SRF	Hydrogen	Nm <sup>3</sup>	0.74	0.03	Oxygen	Nm <sup>3</sup>	0.48	0.32	0.98	0.10	n/a	-	Ca(OH) <sub>2</sub>	0.03	0.003	n/a	n/a	-	<b>0.45</b>	Recovered HF	kg/kg of HFC-23	5.54
Gujarat Fluorochemicals Limited	Natural gas	kg	0.15	0.11	Steam	kg	2.94	0.12	1.82	0.18	n/a	-	NaOH	0.15	0.06	n/a	n/a	-	<b>0.47</b>	Recovered HF	kg/kg of HFC-23	3.32

<sup>2</sup> The potential revenue from selling HF was not accounted in the ICRWC calculation.

<sup>3</sup> Compressed air.