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EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Seventy-fifth Meeting
Montreal, 16-20 November 2015

STATUS REPORTS AND REPORTS ON PROJECTS WITH SPECIFIC REPORTING REQUIREMENTS

1. This section addresses the projects and activities for which specific reports were requested in previous meetings and those requiring the Executive Committee attention. These reports are arranged in the following parts:

Part I:	Financial audit reports for the halon, CFC production, foam, process agent II, solvent and CFC refrigeration servicing sectors in China
Part II:	Accelerated CFC production phase-out project in India Phase-out in consumption and production of CTC in India
Part III:	Temporary use of a high-global warming potential (GWP) technology by enterprises that had been converted to a low-GWP technology
Part IV:	Global: Low-cost options for the use of hydrocarbons in the manufacture of polyurethane (PU) foams. An assessment for the application in Multilateral Fund projects in Egypt
Part V:	Compliance Assistance Programme on the UN Office of Internal Oversight Services (OIOS) Audit

2. Each part contains a brief description on progress, and the Secretariat's comments and recommendations.

PART I: FINANCIAL AUDIT REPORTS FOR THE HALON, CFC PRODUCTION, FOAM, PROCESS AGENT II, SOLVENT AND CFC REFRIGERATION SERVICING SECTORS IN CHINA

Background

3. In line with the decisions 71/12(b), 72/13 and 73/20 (b), the Government of China submitted through the relevant bilateral and implementing agencies annual progress reports, audit reports, and interest accrued during the implementation of the CFC production, halon, PU foam, process agent II, refrigeration servicing sector and solvent sector plans to the 75th meeting.

Planned budgets and progress reports

4. Table 1 presents the information provided with respect to funding as at 31 December 2009, the balance reported to the 73rd meeting as at 31 December 2013, disbursement since 2013, income, information on the reallocation of funding among budget items, the latest balance as at 30 June 2015 and the planned completion dates per sector.

Table 1: Planned budgets for the use of remaining funds, progress reports, and completion dates

Item	Agency	Activity	Funding as at 31 December 2009 (US$)	Balance as at 31 December 2013 (US$)	Disbursement	Additional Income	Reallocation	Balance as at 30 June 2015	Planned completion date
CFC production		**Total approved: US $150,000,000**							
1	World Bank	Recruitment for technical support, and organization of technology workshop on alternatives, etc.	500,000	110,678	-53,064	67,347	-124,961	0	2014
2	World Bank	ODS import & export management MIS	500,000	45,590	-45,590	0	0	0	2015
3	World Bank	Research and development on ODS alternatives	4,200,000	2,453,398	-480,713	0	248,638	2,221,324	2016
4	World Bank	Supervision and management	0	313,379	0	0	-123,678	189,701	2018
5	World Bank	Operation cost for China Compliance Centre (CCC)	3,300,000	N/p	0	0	0	0	N/p
Total			**8,500,000**	**2,923,044**	**-579,367**	**67,347**	**0**	**2,411,025**	
Halon sector		**Total approved: US $62,000,000**							
1	World Bank	CO_2 fire extinguisher penalty	1,200,000	1,200,000	0		-1,200,000	0	2008
2	World Bank	Halon-1301 system manufacture conversion	339,840	339,840	0		-339,840	0	2008-2009
3	World Bank	Closure of the halon-1301 production for controlled consumption	50,000	50,000	0		-50,000	0	2009
4	World Bank	TA activities, training and awareness activities	900,000	793,093	0		-793,093	0	2008-2010
5	World Bank	Halon sector closure activities, PCR, audits, verifications	300,000	269,157	0		-269,157	0	2009-2010
6	World Bank	Central and provincial halon banking and management activities	7,405,800	8,055,773	-30,198		-8,025,575	0	2008-2015
7	World Bank	Supervision, management, and technical assistance	1,500,000	1,500,000	-30,199		699,466	2,169,267	2018
8	World Bank	Halon 1211 stock maintenance and leakage prevention	0	0	0	0	1,500,000	1,500,000	2016
9	World Bank	Halon banking management center establishment and operation	0	0	0	0	1,000,000	1,000,000	2016
10	World Bank	Establishment and capacity building for halon 1301 recycling center	0	0	0	0	1,000,000	1,000,000	2016
11	World Bank	Upgrade and improve halon 1211 recycling demonstration center	0	0	0	0	300,000	300,000	2016

Item	Agency	Activity	Funding as at 31 December 2009 (US$)	Balance as at 31 December 2013 (US$)	Disbursement	Additional Income	Reallocation	Balance as at 30 June 2015	Planned completion date
12	World Bank	Develop management information system for halon banking	0	0	0	0	300,000	300,000	2016
13	World Bank	Inventory investigation and registration of halon users nationwide	0	0	0	0	2,000,000	2,000,000	2016
14	World Bank	Operation cost for collection transportation, recycling and reclamation	0	0	0	0	2,000,000	2,000,000	2018
15	World Bank	Disposal costs of contaminated halon and residue	0	0	0	0	1,408,397	1,408,397	2016-2018
16	World Bank	Establishment of overall ODS MIS	0	0	0	0	500,000	500,000	2018
Total			**11,695,640**	**12,207,863**	**-60,397**	**0**	**30,198**	**12,177,664**	
Process agent II		**Total approved: S $46,500,000**							
1	World Bank	On-going phase-out contract		39,252	0	0	-39,252	0	N/p
2	World Bank	Capacity Building for Local EPBs		2,410,000	-1,687,797	0	590,000	1,312,203	2017
3	World Bank	CTC residue Disposal		5,700,000	0	0	51,544	5,751,544	2018
4	World Bank	Research on ODS substitution and development of trends of alternative technologies		1,500,000	-83,201	0	-500,000	916,799	2018
5	World Bank	Monitoring, management and post evaluation		402,292	0	0	-102,292	300,000	2018
Total			**N/p**	**10,051,544**	**-1,770,998**	**0**	**0**	**8,280,545**	
PU foam		**Total approved: US $53,846,000**							
1	World Bank	Screening and evaluation of CFC-free substitutes and development of new substitutes	2,660,000	1,570,000	-257,952	0	0	1,312,048	2016
2	World Bank	Additional provincial foam activities (capacity building for 11 provinces)	3,100,000	2,640,000	-1,084,704	0	0	1,555,296	2016
3	World Bank	Technical service for the foam enterprise for better application of new alternatives	1,400,000	1,400,000	-271,985	0	0	1,128,015	2016
4	World Bank	Continue monitoring of CFC phase-out in the foam sector	1,050,000	1,050,000	-165,773	0	0	884,227	2017-2018
5	World Bank	Project monitoring and management		706,414	-26,541	0	0	679,873	2017-2018
Total			**8,210,000**	**7,366,414**	**-1,806,954**	**0**	**0**	**5,559,460**	
Refrigeration servicing		**Total approved: US $7,884,853**							
1	Japan, UNEP and UNIDO	Training programme		500,000	0	0	0	500,000	2016
2	Japan, UNEP and UNIDO	Evaluation effects for training program		150,000	0	0	0	150,000	2017

Item	Agency	Activity	Funding as at 31 December 2009 (US$)	Balance as at 31 December 2013 (US$)	Disbursement	Additional Income	Reallocation	Balance as at 30 June 2015	Planned completion date
3	Japan, UNEP and UNIDO	ODS treatment		900,000	0	0	0	900,000	2017
4	Japan, UNEP and UNIDO	Data survey		170,000	0	0	30,000	200,000	2016
5	UNIDO	Monitoring and management		95,846	0	0	-30,000	65,846	2017
6	Japan, UNEP and UNIDO	Ongoing Contracts		949,329	-654,903	0	0	294,426	N/p
Total			**746,313**	**2,765,175**	**-654,903**	**0**	**0**	**2,110,272**	
Solvent sector		**Total approved: US $52,000,000**							
1	UNDP	Combating ODS illegal activities: capacity building for 10 local customs offices		2,100,000	-1,441,850	0	0	658,150	2017
2	UNDP	Capacity building for ODS related personnel at 14 provinces		3,400,000	-1,427,500	0	0	1,972,500	2017
3	UNDP	Public awareness and publicity activities		700,000	-110,947	0	0	589,053	2017
4	UNDP	Policy research and publication		200,000	0	0	0	200,000	2017
5	UNDP	Alternative technology assessment and research		1,060,000	-149,758	0	300,000	910,242	2016
6	UNDP	Electronic file management system		400,000	0	0	0	400,000	2017
7	UNDP	Project management and monitoring		577,043	-177,682	0	0	399,360	2018
Total			**12,712,381**	**8,437,043**	**-3,307,736**	**0**	**300,000**	**5,129,306**	

* Adjustment due to estimates having been submitted in the financial audit report provided to the 73rd meeting.

5. Financial audits were conducted by Daxin Chartered Public Accounts according to national standards. The audit opinion was that the grant and expenditures statements were in compliance with the Chinese accounting standards and have been fairly and justly presented in all material with respect to 1 January 2010 to 30 June 2015 by the Foreign Economic Cooperation Office/Ministry of Environmental Protection (FECO/MEP) in China. The auditors confirmed the balances as at 30 June 2015 that are presented in Table 1.

CFC production sector

6. An estimated US $579,367 was disbursed since the last progress report. The Government of China indicated that it had received US $67,347 from the 2013 feedstock investigations as a "loan" until the HCFC production phase-out management plan (HPPMP) was approved. This was a temporary "loan" from the CFC production sector plan to pay for the HCFC feedstock investigation. The dedicated data transmission system between ODS Import/Export Management Office and the Customs has been established. Funds were reallocated from the recruitment for technical support and supervision and management to the research and development of ODS alternatives leaving a balance of US $2.2 million for this activity and US $189,701 for supervision and management. A total of 13 activities have been selected to assess the technical viability of adopting and applying low-carbon ODS alternative technologies in the applications where CFCs and halons were used. The programme includes surveys of the current situation and capacity in China to conduct analytical and laboratory methods and standards to determine performance of new low-carbon ODS alternatives in refrigeration, air-conditioning, solvent, and fire-fighting applications where CFCs and halon were used initially. An additional US $700,000 is committed to finance new research and development on low-carbon ODS alternative technologies.

Halon sector

7. An estimated US $60,397 was disbursed since the last progress report. The policy research to assess the hazardous waste nature of halon recycling to overcome the previously reported project implementation obstacle of not being able to transport halon for recycling due to halon classification as a hazardous waste, has been completed. The technical assistance proved that it was not a hazardous waste but that the output of halon recycling could be a hazardous waste. However, despite the study results, the provincial Environment Protection Bureaus (EPBs) are not yet in a position to agree to treat recycled halon as non-hazardous waste. FECO is undertaking further consultations with the provincial EPBs to address this issue.

8. The Government of China provided a work plan for the remaining balance of funds which has been reallocated to specific activities as indicated in Table 1. It plans to complete most activities in 2016 with ongoing efforts to sustain halon banking until 2018 in line with decision 73/20. The plan involves programmes and centers for halon banking, inventories, and management of halon banking, and inventory including technical assistance for revisions of fire protection standards, training and workshops to ensure the sustainability of the halon bank, halon feedstock use and the prevention of illegal production.

Process agent II

9. The balances indicated in the audited report for the process agent II sector (US $8,671,174) do not correspond to the balances allocated in the progress report (US $8,280,545). It was explained that one payment was counted twice (US $390,000) in the progress report (the first disbursement for capacity building of the local EPBs), but that the balance should have been the same as is in the audit report.

10. An estimated US $1,770,998 was disbursed since the last progress report, for capacity building for six provincial EPBs where CTC and other ODS producers are located. Activities include *inter alia* law enforcement, registration of dealers, data collection, and verification.

11. The two enterprises covered by the closure contracts have stopped the use of CTC and most of the project funds have been disbursed except for the last contract where obligations have not been fully met as the final reports have not been presented, leaving a balance of US $39,252. However, for one enterprise, the facility has already been dismantled and the other enterprise has retrofitted its production to produce another chemical.

12. The other disbursements for the process agent sector were associated with the research and development on ODS alternatives where five contracts to evaluate future demand for CTC and associated leakage and assess the environmental impact of CTC emissions were signed and paid by June 2015. This includes surveys of HFCs and other chemical products whose raw material require CTC as a building block. Research projects are planned to review and evaluate substitutes and alternatives technologies in the production, foam and refrigeration sectors.

13. The Government indicated that it had reallocated funds from the sub-budgets of ongoing projects, research and development on ODS alternatives and monitoring mostly for capacity building as well as US $51,544 to the CTC residue disposal sub-budget.

14. No funds were disbursed for the CTC residue disposal. The Government plans to select a hazardous waste disposal center in provinces where CTC was produced as a by-product. However, transportation, disposal and management of hazardous wastes must comply with non-ODS regulations. A technical team visited CTC residue producers, an incinerator, and local EPBs to conduct a feasibility analysis of options for handling CTC residue.

PU foam

15. An estimated US $1,806,954 was disbursed since the last progress reports. Funds were used against all budget items and no funds were reallocated to other activities. The Government reported last year the ten contracts were signed for research on foam blowing agents with zero ODP and low-global warming potential (GWP), and low-GWP pre-blended polyol formulations containing to optimize the stability and performance of polyols and improve the thermal conductivity of the foam. A standard for detecting CFC in foam products will be developed to ensure sustainability of CFC phase-out. All activities are ongoing. Technical issues that arise will be summarized at the end of the research activities.

16. Activities with foam enterprises in 11 provinces have been implemented to ensure the sustainability of the CFC phase-out through training, site visits, enforcement inspections and public awareness, four contracts have been signed with four systems houses working on the trial and testing of new formulations for their downstream enterprises. Under the fourth budget item of continued monitoring of CFC phase-out, EPBs of four provinces (Hebei, Henan, Shandong and Tianjin) visited the chemical dealers, systems houses and foam enterprises colleting sample of blowing agents, pre-blended polyols and foam produced to ensure that CFCs are not being used. The Government had organized training meetings, and technical workshops, and cooperated with financial and technical experts to conduct on-site verification missions.

CFC refrigeration servicing sector

17. An estimated US $654,903 was disbursed since the last progress reports, for ongoing contracts leaving a balance of US $2,110,272. Eight servicing technicians training centers in vocational schools were established and operational, having trained 853 technicians/trainers and 245 students studying to become technicians. A contract is to be signed for an evaluation of the effectiveness of the training programme. Equipment will be purchased for the household appliances dismantling and CFC recovery and recycling stations as part of the ODS treatment budget. A survey is still planned for recovering CFCs from ship dismantling stations. The Secretariat enquired if the survey would also address halon recovery. UNIDO indicated that it was unclear whether halon were available or the recovery units capable to handle

halon. The Executive Committee may wish to encourage the Government of China to collect information where available on halon recovery as part of its collection of CFC recovery in its visits to ship dismantling centers.

18. The total amount approved for the sector for three implementing agencies (Japan, UNEP and UNIDO) was US $7,882,412 excluding agency fees but the progress report indicated that China received US $7,817,100. UNIDO indicated that the difference of US $65,312 had been disbursed by the implementing agencies for internal experts and their travel and a study tour.

Solvent sector

19. In total US $3,307,736 was disbursed since the last progress report, for capacity building and training activities for customs offices and provinces, an international seminar on sustainable ODS; phase-out for four contracts on ODS-free and low-GWP substitutes for metal and electronics applications. UNDP indicated that an additional adjustment was made to the financial report submitted to the 73rd meeting increasing the available balance by US $298,576. The funds were allocated to alternative technology assessment as well as US $1,424 from project management and monitoring.

Interest

20. Table 2 presents the amount of interest collected.

Table 2: Interest reported from sector plans in China (US $)

Sector	1 July 2014 to 30 June 2015	1 January to 30 June 2014	2010-2013	Total
CFC production, halon, process agent II, and PU foam	12,594	1,412	8,350	22,356
Refrigeration servicing	11,856	6,732	54,482	73,070
Solvent	35,298	22,832	N/p	270,398
Total	**59,748**	**30,976**	**N/a**	**365,823**

* Data provided in the last progress report submitted to the 73rd meeting.

21. The level of interest received was US $59,748 since the last progress report. The interest accrued for the solvent sector is significantly higher than that accrued for the other sectors. The Bank explained that its ODS IV projects (including CFC production, halon, process agent II, and PU foam sector plans) are deposited in a special US dollar bank account that was established as agreed by the World Bank and the Ministry of Finance. However, the funds for the solvent sector plan are managed under FECO's RMB account. The interest rate of RMB is much higher than that of the US dollar. Therefore the interest accrued under the solvent sector account is higher than that of the other sectors. The additional accrued interest for the solvent sector of US $270,398 was not added to available funds for the solvent sector. UNDP indicated that FECO was considering the allocation of accrued interest as an integral part of the solvent work plan with details of usage of the accrued interest in future progress reports.

Secretariat's comments

22. There has been significant progress in implementing activities in the different sector plans associated with fund balance; however there remain significant fund available for disbursement. Unutilized funds have been reallocated for other related activities. No implementation delays are indicated as the completion dates remain as the previous progress report. There are several activities associated with low-GWP alternatives including HFC surveys in the work plans of the sector plans.

Secretariat's recommendations

23. The Executive Committee may wish:

(a) To note, with appreciation, the financial audit reports, work plans and progress reports provided for the CFC production, halon, polyurethane (PU) foam, process agent II, refrigeration servicing, and solvent sectors in China, contained in document UNEP/OzL.Pro/ExCom/75/20; and

(b) To encourage the Government of China to collect information where available on halon recovery as part of its collection of CFC recovery in its visits to ship dismantling centers.

PART II: ACCELERATED CFC PRODUCTION PHASE-OUT PROJECT IN INDIA PHASE-OUT IN CONSUMPTION AND PRODUCTION OF CTC IN INDIA

Background

24. The Government of India submitted an official letter to the Secretariat dated 13 May 2015 regarding the completion of the accelerated CFC production phase-out project, implemented with the assistance of the World Bank; and the phase-out in consumption and production of CTC, jointly implemented by the World Bank and the Government of Japan (as its bilateral contribution to the Multilateral Fund). In its letter, the Government indicated *inter alia* that:

(a) India has successfully implemented the CFC production plan resulting in the complete phase-out of the production of CFCs from 1 August 2008, i.e., 17 months ahead of the Montreal Protocol schedule. However, US $1,056,900 (excluding agency support costs) associated with the second tranche of the accelerated CFC production phase-out project has not yet been disbursed to the four producers;

(b) The technical assistance component associated with the CTC phase-out plan was approved at a total funding of US $2 million, out of which the World Bank has disbursed US $1,374,880. Some of the technical assistance activities therefore could not be completed due to non-availability of funds;

(c) There are still outstanding activities associated with the CTC phase-out plan under implementation by the Government of Japan (as bilateral cooperation) with a funding balance of US $813,643; and

(d) In view of the above, the relationship between the Government of India and the industry, which had moved from strength to strength, has been adversely affected.

25. In view of the above, the Government of India requested that the Executive Committee advise the World Bank to release the balance of funds available from the above-mentioned projects.

26. In response to the letter from the Government of India, the Secretariat had several discussions with representatives from the Government of Japan and the World Bank on a way forward to disburse the balance available from the CFC production and CTC projects in the most cost-effective and efficient manner, to be presented for consideration by the Executive Committee.

Progress report

27. Based on bilateral discussions with the Government of Japan and the World Bank, and the review of relevant project documents, the Secretariat noted that, *inter alia*:

(a) The CFC producers met all the conditions for the final tranche release several years ago. The World Bank disbursed the funds to the IDBI Bank (financial intermediary in Mumbai), as all the necessary formalities for release to the beneficiary producers had been met. However, not all the funds that were available could be released before the end date of the legal agreement between the Government of India and the World Bank. As a result, the only option available to the World Bank now is to return the funding balance to the Multilateral Fund. As reported by the World Bank, the balance available for the project amounts to US $1,057,000 (i.e., US $739,900 approved at the 67th meeting and US $317,100 approved at the 69th meeting) plus agency supports costs;

(b) The World Bank submitted to the 70th meeting (June 2013) the 2012-2013 work programme of the phase-out in consumption and production of CTC[1], which included several technical assistance activities to ensure the sustainability of the CTC phase-out. The total cost for the technical assistance activities, estimated at US $1,040,736, included a budget for the project management unit (PMU) beyond 2013, and was based on the balance of funds under the technical assistance component and savings from the CTC consumption component;

(c) During its discussion of the 2012-2013 work programme submitted by the World Bank, several Executive Committee members considered that all remaining funds should be returned once CTC phase-out had been completed, while others suggested that remaining funds might be required to ensure the sustainability of the phase-out. Subsequently, the Executive Committee requested the World Bank to submit project completion reports for all activities under the CTC phase-out plan for the consumption and production sectors to the last meeting in 2014; and that expenditure for the implementation of the CTC phase-out plan for India already agreed between the World Bank, India and the counterparts before the present decision would be considered as an existing commitment in the context of sub-paragraph (b)(ii) of decision 70/7[2] (decision 70/18);

(d) After the approval of the 2012-2013 work programme the World Bank implemented some activities up until the end date of the legal agreement between the Government of India and the World Bank. As reported by the World Bank, the balance available for the project amounts to US $750,093 plus agency supports costs. The World Bank further indicated that the balance available did not take into account savings from the consumption component, as these were related to funds that had already been disbursed to the IDBI and committed to end beneficiaries through sub-grant agreements, but subsequently cancelled, making them available for technical assistance activities; and

(e) The Japan bilateral component of the CTC project relates to the 2005 annual programme approved at a total cost of US $2,500,000, with a remaining balance of US $813,643 plus agency support costs.

28. Based on the above facts, the Secretariat suggested the following path forward to disburse the balance available from the CFC production and CTC consumption and production projects:

[1] UNEP/OzL.Pro/ExCom/70/34.

[2] Not to incur any new commitments and to return, by the end of 2013, the fund balances for the CTC phase-out plan in India implemented by the World Bank.

(a) For the accelerated CFC production phase-out project:

(i) Submission by the World Bank of a status report of all the activities undertaken, including financial statements indicating the funds approved, actual funds disbursed and actual balances;

(ii) Return by the World Bank to the Multilateral Fund the balance available to the 75th meeting; and

(iii) Submission by another bilateral or implementing agency of a plan of action with a brief description of the specific activities to be undertaken, indicating their cost and completion date, which should be no later than the last meeting of the Executive Committee in 2016. The World Bank will work closely with the agency selected by the Government of India by providing all necessary information and documentation.

(b) For the phase-out in consumption and production of CTC:

(i) Submission by the World Bank of a status report of the technical activities undertaken as proposed in the 2012-2013 work programme submitted to the 70th meeting, including financial statements indicating the funds approved and disbursed;

(ii) Return by the World Bank to the Multilateral Fund the balance available to the 75th meeting;

(iii) Submission by another bilateral or implementing agency of a plan of action with the activities to be implemented based on the balance available under the World Bank, indicating completion date, which should be no later than the last meeting of the Executive Committee in 2016. This plan of action should also include the activities that have not yet been implemented by the Government of Japan. The World Bank will work closely with the agency selected by the Government of India by providing all necessary information and documentation; and

(c) Submission of the relevant project completion reports associated with the CFC production and CTC consumption and production projects to the first meeting of the Executive Committee in 2017, on the understanding that any remaining balances will also be returned to that meeting.

29. Further information received by the World Bank indicates that the Government of India has requested that the balance of the funds of the two projects be allocated to UNDP to complete the approved activities in line with the respective agreements it had with the Executive Committee. The World Bank has also reported that UNDP has indicated its agreement to the proposal.

Proposal for the completion of the accelerated CFC production phase-out project

30. UNDP in consultation with the World Bank has submitted the following plan of action to complete the activities associated with the accelerated CFC production phase-out project with the balance available of US $1,057,000:

(a) Administration activities including signature of necessary agreements with the Government and beneficiary CFC producers (December 2015 to February 2016);

(b) Recruitment of a verification team to carry out verification of CFC production cessation, taking into consideration activities by the World Bank and verification reports available with the Government of India (February 2016 – March 2016); and

(c) Release of payment to beneficiary enterprises after endorsement by the Government of India and confirmation through the verification process (March 2016 to May 2016).

31. The project will be operationally completed at the end of June 2016 and financially completed by December 2016. Any funding remaining will be returned to the Multilateral Fund at the first meeting of the Executive Committee in 2017.

Proposal for the completion of the phase-out in consumption and production of CTC

32. UNDP in consultation with the Government of Japan and the World Bank has submitted the following plan of action to complete the activities associated with the phase-out in consumption and production of CTC.

33. The plan of action has been prepared taking into consideration the plan submitted to the 70th meeting, to ensure sustainable CTC phase-out through a combination of capacity building for monitoring and control of CTC and technical support for safe adoption of non-ODS alternatives. The following activities will be implemented from the funding balance of US $750,093 available from the World Bank:

(a) An analysis on the post-conversion market of alternatives to CTC in the consumption sector and their availability, and awareness workshops to disseminate findings and proposed measures for safe use of alternatives (e.g., analysis of alternatives being used for CTC, environmental and health impact of the alternatives, measures for safe use of the alternatives, and development of a user manual for applications of CTC and its alternatives);

(b) Capacity-building for monitoring and control, through training pollution control-board officers at the state and national level; and strengthening monitoring and control of CTC use including data collection and awareness amongst customs and enforcement officers;

(c) Strengthening the monitoring information system to enhance monitoring of CTC production for feedstock use;

(d) Information outreach and knowledge management with regard to the challenges encountered during the phase-out of CTC; systems and processes adopted to ensure phase-out including the regulations that were put in place; innovations including the sector-specific adaptation of tools and techniques to use alternatives; and methodology adopted for phase-out of CTC; and

(e) Project management and reporting, including monitoring and controlling CTC use in feedstock applications would continue up to end of the 2016. The PMU would monitor implementation of the activities to ensure effective completion of proposed activities by the end of 2016.

34. The remaining funds available from the Government of Japan of US $813,643 would be utilized to provide assistance to small and medium sized enterprises (SMEs) in the metal cleaning sector that were not considered earlier, training of SMEs and technical institutions through three pilot demonstration workshops on alternative technologies among users; and verification and certificate of completion for

SMEs supported under the project. UNDP will assist the Government of Japan in finalizing implementation of the remaining activities.

35. The project will be operationally completed at the end of June 2016 and financially completed by December 2016. Any funding remaining will be returned to the Multilateral Fund at the first meeting of the Executive Committee in 2017.

Secretariat comments

36. The Secretariat assisted in the coordination of the Government of Japan, the World Bank and UNDP (as the agency selected by the Government of India) to submit plans of action associated with the fund balances of the accelerated CFC production phase-out project and the phase-out in consumption and production of CTC.

37. With regard to the CFC production plan, the Secretariat reviewed the request of the Government of India in light of the Agreement between India and the Executive Committee of the Multilateral Fund for the accelerated CFC production phase-out approved at the 56th meeting (decision 56/63), which supplemented the Consensus Agreement for the Indian production sector approved at the 29th meeting (decision 29/69). It was noted that the Agreement for the accelerated phase-out, states *inter alia* that "the Funding components of this Agreement will not be modified on the basis of any future Executive Committee decision that may affect the Funding of any other production sector projects or any other related activities in the Country." In the Consensus Agreement the Executive Committee provided India with maximum flexibility in using the agreed funds to meet the reduction requirements agreed, and that it was "of the understanding that with the exception of US $2 million which must be used by the Government of India solely to monitor and effectuate full compliance with this agreement and the ODS phase-out generally, as long as expenditures are otherwise consistent with this agreement, the remaining funds provided to India pursuant to this agreement may be used in any manner that India believes will achieve the smoothest possible CFC production phase-out possible." Based on the funding related clauses of the Agreement, the Secretariat considered appropriate that UNDP implement the remaining activities accelerated CFC production phase-out plan with the funding balance from the last tranche approved for the World Bank.

38. With regard to the CTC consumption and production project, the Secretariat reviewed the request of the Government of India in light of decision 70/7 (not to incur any new commitments and to return, by the end of 2013, the fund balances for the CTC phase-out plan in India implemented by the World Bank), and the Agreement between the Government of India and the Executive Committee approved at the 41st meeting (decision 41/95) and subsequently amended at the 45th meeting (decision 45/48). It was noted that the Agreement states *inter alia* "that the Country will have full flexibility in the use of Multilateral Fund assistance to achieve the overall objectives of this Agreement and to meet its obligations to the Montreal Protocol. Therefore, specific funds that were thought to be needed for specific items originally proposed in the Plan for the Phase out of Consumption and Production of CTC, except the US $2 million which must be used by the Country solely to implement, monitor and effectuate full compliance with this Agreement, can be reallocated to other activities as long as expenditures are consistent with this Agreement and eligible within the context of the Montreal Protocol." Moreover, "the Funding components of this Agreement will not be modified on the basis of any future Executive Committee decision that may affect the Funding of any other consumption/production sector projects or any other related activities in the Country". Based on the funding related clauses of the Agreement, the Secretariat considered appropriate that the Government of Japan and UNDP implement the remaining activities of the CTC sector plan.

39. The Secretariat also noted the firm commitment by the Government of India to complete remaining activities of the accelerated CFC production phase-out project and the phase-out in

consumption and production of CTC by the end of 2016, and any remaining funds would be returned to the Multilateral Fund at the first meeting of the Executive Committee in 2017.

Secretariat's recommendations

40. The Executive Committee might wish:

(a) With regard to the accelerated CFC production phase-out project in India:

(i) To note the return by the World Bank of US $1,057,000, plus agency support costs of US $79,275, associated with the funding balance of the accelerated CFC production phase-out project to the 75th meeting;

(ii) To approve the action plan for the remaining activities associated with the accelerated CFC production phase-out project in the amount of US $1,057,000, plus agency supports of US $79,275 for UNDP with a revised completion date of end of 2016, noting that any remaining funds would be returned to the Multilateral Fund at the first meeting of the Executive Committee in 2017;

(iii) To approve the revised Agreement between the Government of India and the Executive Committee for the accelerated CFC production phase-out to include UNDP as an additional implementing agency, contained in Annex I to the present document;

(iv) To request the World Bank and UNDP to submit the project completion report of the accelerated CFC production phase-out project to the last meeting of the Executive Committee in 2017;

(b) With regard to the phase-out in consumption and production of CTC in India:

(i) To note the return by the World Bank of US $750,093 plus agency support costs of US $56,257 associated with the funding balance of the phase-out in consumption and production of CTC to the 75th meeting;

(ii) To approve the action plan for the remaining activities associated with the phase-out in consumption and production of CTC in the amount of US $750,093, plus agency support costs of US $56,257 for UNDP, and to extend the completion date to the end of 2016, on the understanding that any remaining funds from the Government of Japan and UNDP would be returned to the Multilateral Fund at the first meeting of the Executive Committee in 2017;

(iii) To approve the revised Agreement between the Government India and the Executive Committee Fund for the phase-out in consumption and production of CTC phase-out to include UNDP as an additional cooperating implementing agency, contained in Annex II to the present document; and

(iv) To request the World Bank, together with the Governments of France, Germany and Japan, and UNEP and UNIDO as cooperating implementing agencies to submit the project completion report of the phase-out in consumption and production of CTC to the last meeting of the Executive Committee in 2017.

PART III: TEMPORARY USE OF A HIGH-GWP TECHNOLOGY BY ENTERPRISES THAT HAD BEEN CONVERTED TO A LOW-GWP TECHNOLOGY

Background

41. The Government of the Dominican Republic[3] and El Salvador[4] submitted requests for the approval of funding tranches of their respective HPMPs at the 74th meeting. In both cases, they reported that although the foam enterprises had converted to a low-global warming potential (GWP) technology, they were currently using a high-GWP technology as the low-GWP technology was not locally available. In approving the tranches for both countries the Executive Committee, *inter alia*, requested UNDP to continue assisting both Governments in securing the supply of the alternative technology, and to report to the Executive Committee on the status of the use of the interim technology at each meeting until the original technology selected or another technology with a low-GWP was fully introduced.[5]

42. UNDP submitted to the 75th meeting a report on the status of the use of the interim technology by the foam enterprises in the Dominican Republic and El Salvador.

43. With regard to the Dominican Republic, UNDP reported that they had facilitated contact between the enterprises and systems houses locate in the United States, which could supply such alternatives on a commercial scale. As the supply of these systems would depend on the demand in the country, UNDP could not guarantee a stable supply of such alternatives. However, the foam enterprises are still using high-GWP blowing agents in their operations.

44. UNDP reported that at present, methyl formate pre-blended polyols have been supplied to El Salvador by a systems house based in Mexico. Trials have been conducted using these systems and were successful. Based on this, all foam companies in El Salvador are now assured of a supply of low-GWP alternatives.

Secretariat's comments

45. In discussions with UNDP, the Secretariat was informed that there are some challenges remaining with regard to ensuring a supply of low-GWP alternatives to the Dominican Republic, and that it will continue to report to the Executive Committee on the status of the conversions, as requested.

46. With regard to El Salvador, UNDP considered that as there is now a supply from the systems house in Mexico, there is no remaining impediment for the enterprise to complete the conversion to the low-GWP technology as approved.

Secretariat's recommendation

47. The Executive Committee may wish:

(a) To note with appreciation the report provided by UNDP, and the efforts made to facilitate the availability of low-global warming potential (GWP) pre-blended polyol systems domestically in the Dominican Republic, and El Salvador;

[3] UNEP/OzL.Pro/ExCom/74/27.
[4] UNEP/OzL.Pro/ExCom/74/29.
[5] Decision 74/41(b) and (c) for the Dominican Republic; and decision 74/42(b) and (c) for El Salvador.

(b) To note that the supply of low-GWP pre-blended polyols for foam enterprises in El Salvador has been secured and that the Government of El Salvador would be able to complete the conversion in the foam sector with low-GWP alternatives as planned; and

(c) To request UNDP to continue assisting the Government of the Dominican Republic in securing the supply of low-GWP alternative technology and to provide a report on the status of the conversion of the enterprise in the foam sector in line with decision 74/41(c).

PART IV: GLOBAL: LOW-COST OPTIONS FOR THE USE OF HYDROCARBONS IN THE MANUFACTURE OF POLYURETHANE (PU) FOAMS. AN ASSESSMENT FOR THE APPLICATION IN MULTILATERAL FUND PROJECTS IN EGYPT

Background

48. At its 58th meeting, the Executive Committee approved a project to demonstrate low-cost options for the use of hydrocarbons (HC) as a foaming agent in the manufacture of PU foams in Egypt, to be implemented by UNDP (decision 58/31). Progress reports on the implementation of the demonstration project were submitted to the 66th[6], 73rd[7], and 74th[8] meetings.

Final report

49. In response to decision 74/13, UNDP has submitted a final complementary report on the additional activities undertaken, which included optimization of the three-way mixing head by SAIP, the equipment manufacturer, and trials of the pre-blended cyclopentane versus directly injected systems conducted by Dow Chemical. The final report of the assessment is contained in Annex III to the present document. The key conclusions of the demonstration project are presented below:

(a) Pre-blended cyclopentane systems are sufficiently stable and can be commercially used;

(b) Pre-blended normal-pentane (n-pentane) systems are unstable and not recommended for commercial use, except when they are used through a direct injected system;

(c) Direct injection with cyclopentane can achieve the same effectiveness as pre-blended systems in view of density and thermal insulation when using optimized equipment;

(d) Any performance differences between polyols blended *in situ* and those blended in systems house is most likely related to blending and handling operations with the systems houses being more precise;

(e) Indicative differences in foam density between the different ways to apply HCs-based polyols could not be substantiated; and

(f) Simplified safety requirements (less exhaust, less sensors and less piping) from pre-blended HC and direct injection compared to *in situ* blended system could represent savings between US $50,000 and US $100,000.

50. The report also informed about three equipment suppliers that offer direct injection of blowing agents (i.e., Cannon, used in pilots' projects in Brazil, OMS focusing in retrofit and SAIP used in the pilot project for HCs in Egypt).

[6] UNEP/OzL.Pro/ExCom/66/17.
[7] UNEP/OzL.Pro/ExCom/73/17/Add1.
[8] UNEP/OzL.Pro/ExCom/74/12.

51. On pre-blended systems, the report mentions that Bayer (systems house) has supplied commercially pre-blended systems in Eastern Europe, and Pumex/Mexico, a systems house that developed cyclopentane pre-blended systems with assistance from the Multilateral Fund, has the capacity of supplying these systems to all customers that are willing to comply with its safety requirements.

Secretariat's comments

52. The Secretariat and UNDP discussed the main differences between the use of pre-blended cyclopentane and directly injected cyclopentane with the optimized dispenser. UNDP indicated that although the two approaches avoid the pre-blender and all related safety requirements, direct injection reduces more storage requirements than the pre-blended option.

53. With regard to capital and operational costs required for the end-user, UNDP explained that in general, retrofits are lower in costs when taking the direct injection approach. However, when the entire dispenser has to be replaced, pre-blending is lower in cost. UNDP also clarified that for end-users with low-pressure dispensers, retrofit would be feasible but would probably not provide the intense blending required for both pre-blends and direct injection. This subject may require further analysis as it was not part of the demonstration project.

54. With regard to the advantages for an end-user of selecting the HC-pre-blended option against HC-direct injection, depending on the condition of the dispenser, in most cases, the pre-blended option may have a lower cost, provided that the HC-based pre-blended polyol is available in the particular market. This is the case in Mexico where the use of pre-blended systems is heading up even in smaller enterprises.

55. UNDP explained that the minimum size for an end-user to benefit from these options was initially estimated at 25 metric tonnes of HCFCs, but current experience in Mexico suggests that this threshold could be lowered. As experience is gained through the implementation of stage I of the HPMP for Egypt, additional information would become available.

56. UNDP considers that the main barriers to adopt any of these two options are long-standing perceptions on safety and limited know-how in a given market.

Secretariat's recommendation

57. The Executive Committee may wish:

(a) To note with appreciation the final complementary report on the "Low-cost options for the use of hydrocarbons in the manufacture of polyurethane foams. An assessment for the application in Multilateral Fund projects" contained in document UNEP/OzL.Pro/ExCom/75/20, submitted by UNDP; and

(b) To request bilateral and implementing agencies to share the UNDP assessment report on "Low-cost options for the use of hydrocarbons in the manufacture of polyurethane foams. An assessment for the application in Multilateral Fund projects" together with information on other alternatives, when assisting Article 5 countries in preparing projects for the phase-out of HCFC-141b in polyurethane foam applications.

PART V: COMPLIANCE ASSISTANCE PROGRAMME ON THE UN OFFICE OF INTERNAL OVERSIGHT SERVICES (OIOS) AUDIT

58. Pursuant to decisions 73/53(b)[9] and 74/10[10], UNEP submitted the report on the actions taken to implement the recommendations 1, 3, 4 and 7 of May 2014 of the United Nations Office of Internal Oversight Services on UNEP OzonAction Branch, as attached to the present document.

Secretariat's recommendation

59. The Executive Committee may wish to note the report on the actions taken to implement the recommendations 1, 3, 4 and 7 of May 2014 of the United Nations Office of Internal Oversight Services on UNEP OzonAction Branch, submitted by UNEP pursuant to decisions 73/53(b) and 74/10.

[9] Decision 73/53(b) requested UNEP to report to the 74th meeting actions taken to implement the recommendations 1, 3, 4 and 7 taken from the May 2014 report of the United Nations Office of Internal Oversight Services (OIOS) on the audit of the UNEP OzonAction Branch.

[10] Decision 74/10 requested UNEP to submit its written report on the audit of the UNEP OzonAction Branch to the 75th meeting so that the Committee could keep those issues under consideration in the context of the approved Compliance Assistance Programme budget.

Annex I

REVISED AGREEMENT BETWEEN INDIA AND THE EXECUTIVE COMMITTEE OF THE MULTILATERAL FUND FOR THE ACCELERATED CFC PRODUCTION PHASE-OUT

1. This Agreement supplements the Consensus Agreement for the Indian production sector for which the Executive Committee and India entered into at the 29th Meeting ("the Existing Agreement"). This Agreement represents the understanding of India ("the Country") and the Executive Committee with respect to the Accelerated Phase-out of the CFC Production by 1 August 2008.

2. The Country agrees to revise its CFC production phase-out schedule with the understanding that:

(a) India would produce no more than 690 MT of CFCs, primarily for the manufacturing of metered-dose inhalers (MDIs) up until 1 August 2008;

(b) India's CFC producers would sell no more than 825 MT of CFCs for MDI production in the years 2008 and 2009, comprising 690 MT of new production and 135 MT reprocessed from existing stock;

(c) India would export 1,228 MT of CFCs no later than 31st December, 2009;

(d) India would not import any new virgin CFCs;

(e) Any by-product non-pharmaceutical grade CFCs generated from the production under (a) are counted against the limit in row 2 of Table 1 in Appendix 1 and could be released to the market;

(f) This Agreement does not cover any CFC production that may be agreed by the Parties to meet essential uses for India; and

(g) Other conditions in the Existing Agreement, in addition to the above, are applied to this Agreement.

3. The Country accepts that, by its acceptance of this Agreement and performance by the Executive Committee of its funding obligations described in Table 2 of Appendix 1, it is precluded from applying for or receiving further funding from the Multilateral Fund in respect to the phase-out of the production of CFCs.

4. Subject to compliance by the Country with its obligations set out in this Agreement, the Executive Committee agrees in principle to provide the funding set out in row 3 of Table 2 in Appendix 1 (the "Funding") to the Country. The Executive Committee will provide the funding tranches associated to the new accelerated phase-out at the 57th and 60th Executive Committee Meetings. For the subsequent tranche in 2009 under the Existing Agreement, the release of this tranche will follow the terms and conditions stipulated in the Existing Agreement.

5. The Country will meet the production limits as indicated in row 2 of Table 1 in Appendix 1. The Country also agrees to allow for independent technical audits administered by the **implementing agencies (World Bank, and UNDP for the final technical audit)** and by the in order to confirm the production, reprocessing limit, sales (both export and domestic) and stock of CFCs in accordance with the agreement.

6. The Country agrees to assume overall responsibility for the management and implementation of this Agreement and of all activities undertaken by it or on its behalf to fulfil the obligations under this Agreement. The Country also agrees to establish policies or enforcement mechanisms to ensure coordination of CFC phase-out efforts in both the production and consumption sectors by implementing policy and regulatory measures set out in Appendix 2.

7. Should the Country, for any reason, not meet the Targets for the elimination of the Substances or otherwise does not comply with this Agreement, then the Country agrees that it will not be entitled to the Funding. In the discretion of the Executive Committee, funding will be reinstated according to a revised Funding Disbursement Schedule determined by the Executive Committee after the Country has demonstrated that it has satisfied all of its obligations that were due to be met prior to receipt of the next instalment of Funding under the Funding Disbursement Schedule. In addition, India understands that the Executive Committee may reduce the funding of the subsequent tranches on the basis of US $1,000 per ODP tonnes of reductions not achieved for the commitments mentioned in paragraphs 2 and 5 of this Agreement.

8. The Funding components of this Agreement will not be modified on the basis of any future Executive Committee decision that may affect the Funding of any other production sector projects or any other related activities in the Country.

9. The Country, the Executive Committee, the World Bank **and UNDP** may mutually agree to take steps to facilitate implementation of this Agreement. In particular, it will provide access by the World Bank **and UNDP** to information necessary to verify compliance with this Agreement.

10. All of the agreements set out in this Agreement are undertaken solely within the context of the Montreal Protocol and as specified in this Agreement. All terms used in this Agreement have the meaning ascribed to them in the Protocol unless otherwise defined herein.

11. This revised Agreement supersedes the Agreement reached between the Government of India and the Executive Committee at the 56th meeting of the Executive Committee.

Appendix 1
TARGETS AND FUNDING

Table 1. Production targets

Description	Year		
	2008	2009	2010
1. Targets under the existing Agreement (ODP tonnes)	2,259	1,130	0
2. Production under this Agreement (ODP tonnes)	690	0	0

Table 2. Funding

Description	Year		
	2008*	2009*	2010**
1. Funding under the existing Agreement (US $'000s)	6,000	6,000	0
2. Support cost under the existing Agreement (US $'000s)	450	450	0
3. Total adjusted funding for this Agreement (US $' 000s)	0	2,113	1,057
4. Support cost for the adjusted funding for this Agreement(US $'000s)	0	0	238
5. Total funding to be released to the country and agencies	6,450	8,563	1,295

(*) Funding approved for the World Bank.
(**) Funding returned to the Multilateral Fund by the World Bank and approved for UNDP at the 75th meeting

Appendix 2
POLICY AND REGULATORY MEASURES

12. As per the Plan of Action submitted by the Country at the 54th Meeting of the Executive Committee, the Country agrees to undertake the following measures:

(a) Ban the production of CFCs, excluding any production for essential uses that may be agreed by the Parties for India, by 1 August 2008;

(b) Ensure consistency of the consumption schedule of the Ozone Rules and the consumption limits in row 3 of Appendix 2 – A of the Agreement between India and the Executive Committee for the national phase-out of CFC consumption in India focusing on the refrigeration service sector;

(c) India will not import any more new/virgin CFCs; and

(d) Strengthening of the system for monitoring movement of CFC stocks and imports, if any.

Annex II

REVISED AGREEMENT BETWEEN INDIA AND THE EXECUTIVE COMMITTEE FOR THE PHASE-OUT IN CONSUMPTION AND PRODUCTION OF CTC

1. This Agreement represents the understanding of India (the "Country") and the Executive Committee with respect to the complete phase-out of consumption and production of the Montreal Protocol controlled substance set out in Appendix 1-A (the "Substance") prior to 1 January 2010, in compliance with Protocol schedules.

2. The Country agrees to phase out consumption and production of the Substance, as defined by the Montreal Protocol, in accordance with the annual phase-out targets set out in rows 1 and 2 of Appendix 2-A (the "Targets") for this Agreement, which at a minimum, correspond to the reduction schedules mandated by the Montreal Protocol. The Country accepts that, by its acceptance of this Agreement and performance by the Executive Committee of its funding obligations described in paragraph 4, it is precluded from applying for or receiving further funding from the Multilateral Fund in respect to the Substance.

3. The Country considers that the use of the Substance in the production of DV acid chloride (DVAC) to be a feedstock use. If either the Country or the Parties ever reclassify that use or any other feedstock use to a controlled status, the Country agrees that it would phase out that use with no compensation from the Multilateral Fund.

4. Subject to compliance by the Country with its obligations set out in this Agreement, the Executive Committee agrees in principle to provide the funding set out in row 13 of Appendix 2-A (the "Funding") to the Country. The Executive Committee will, in principle, provide this funding at the Executive Committee meetings specified in Appendix 3-A (the "Funding Approval Schedule").

5. The Country will meet the consumption and production limits for the Substance as indicated in rows 1 and 2 in Appendix 2-A. It will also accept independent verification by the relevant Implementing Agency of achievement of these consumption and production limits as described in paragraph 9 of this Agreement.

6. The Executive Committee will not provide the Funding in accordance with the Funding Disbursement Schedule unless the Country satisfies the following conditions at least 30 days prior to the applicable Executive Committee meeting set out in the Funding Disbursement Schedule:

(a) that the Country has met the Targets for the applicable year;

(b) that the meeting of these Targets has been independently verified as described in paragraph 9; and

(c) that the Country has submitted and received endorsement from the Executive Committee for an annual implementation programme in the form of Appendix 4 A (the "Annual Implementation Programs") in respect of the year for which funding is being requested.

7. The Country will ensure that it conducts accurate monitoring of its activities under this Agreement. The institutions set out in Appendix 5-A (the "Monitoring") will monitor and report on that monitoring in accordance with the roles and responsibilities set out in Appendix 5-A. This monitoring will also be subject to independent verification as described in paragraph 9.

8. While the Funding was determined on the basis of estimates of the needs of the Country to carry out its obligations under this Agreement, the Executive Committee agrees that the Country will have full flexibility in the use of Multilateral Fund assistance to achieve the overall objectives of this Agreement and to meet its obligations to the Montreal Protocol. Therefore, specific funds that were thought to be needed for specific items originally proposed in the Plan for the Phase out of Consumption and Production of CTC, except the US $2 million which must be used by the Country solely to implement, monitor and effectuate full compliance with this Agreement, can be reallocated to other activities as long as expenditures are consistent with this Agreement and eligible within the context of the Montreal Protocol. Any remaining funds provided to the Country pursuant to this Agreement may be used in any manner that the Country believes will achieve the smoothest and most efficient CTC phase out.

9. The Country agrees to assume overall responsibility for the management and implementation of this Agreement and of all activities undertaken by it or on its behalf to fulfill the obligations under this Agreement. The World Bank (the "Lead IA") has agreed to be the lead implementing agency and France, Germany, Japan, **UNDP** and UNIDO (the "Cooperating IAs") have agreed to be cooperating implementing agencies under the lead of the Lead IA in respect of the Country's activities under this Agreement. The Lead IA will be responsible for carrying out the activities listed in Appendix 6-A, including performance and financial verification in relation to all activities, within the purview of the World Bank, in accordance with this Agreement and with specific World Bank procedures and requirements. The Country also agrees to periodic evaluations, which will be carried out under the monitoring and evaluation work programmes of the Multilateral Fund. The Cooperating IAs will be responsible for carrying out activities listed in Appendix 6-B, including performance and financial verification in relation to activities implemented under their supervision.

10. The Lead IA will assist the Country to implement activities required for achieving the Targets specified in this Agreement and also to assist the Country to carry out activities related to policy and regulatory development to support sustainable phase-out of the Substance in both the consumption and production sectors. The Cooperating IAs will, in collaboration with the Lead IA, provide support for activities related to investment activities to support the phase-out of the Substance in the metal cleaning and process agent applications and in the textile industry as described in the sector plan (IND/PHA/40/INV/363). The funding for activities implemented by the bilateral Cooperating IAs will be counted against their bilateral contributions to the Multilateral Fund in annually specified tranches. In case the Lead IA or any of the Cooperating IAs would like to sub-contract part of their activities to other implementing agencies, concurrence of the Country must be sought and the description of such an arrangement should be reported in the annual implementation programmes.

11. The Executive Committee agrees, in principle, to provide the Lead IA and the Cooperating IAs with the respective fees set out in rows 4, 6, 8, 10 12 and **14** of Appendix 2-A.

12. Should the Country, for any reason, not meet the Targets for the elimination of the Substance or otherwise does not comply with this Agreement, then the Country agrees that it will not be entitled to the Funding in accordance with the Funding Disbursement Schedule. At the discretion of the Executive Committee, Funding will be reinstated according to a revised Funding Disbursement Schedule determined by the Executive Committee after the Country has demonstrated that it has satisfied all of its obligations that were due to be met prior to receipt of the next instalment of Funding under the Funding Disbursement Schedule. The Country acknowledges that the Executive Committee may reduce the amount of the Funding by the amount set out in Appendix 7-A in respect of each ODP tonne of reductions in consumption and production not achieved in any one year.

13. The Funding components of this Agreement will not be modified on the basis of any future Executive Committee decision that may affect the Funding of any other consumption/production sector projects or any other related activities in the Country.

14. The Country will comply with any reasonable request of the Executive Committee, the Lead IA, and the Cooperating IAs, to facilitate implementation of this Agreement. In particular, it will provide the Executive Committee, the Lead IA and the Cooperating IAs, with access to information necessary to verify compliance with this Agreement.

15. All of the agreements set out in this Agreement are undertaken solely within the context of the Montreal Protocol and do not extend to obligations beyond this Protocol and as specified in this Agreement. All terms used in this Agreement have the meaning ascribed to them in the Protocol unless otherwise defined herein.

16. This revised Agreement supersedes the Agreement reached between the Government of India and the Executive Committee at the 45th meeting of the Executive Committee.

Appendices

Appendix 1-A: The Substance

Annex B:	Group II	CTC

Appendix 2-A: The Targets, and Funding

	Baseline[1]	2003	2004	2005	2006	2007	2008	2009	2010
Montreal Protocol Consumption Reduction Schedules (ODP tonnes)[2]	11,505	N/A	N/A	1,726	1,726	1,726	1,726	1,726	0
1. Max allowable total consumption (ODP tonnes)	11,505	N/A	N/A	1,726	1,147	708	268	48	0
Montreal Protocol Production Reduction Schedules (ODP tonnes)[3]	11,553	N/A	N/A	1,733	1,733	1,733	1,733	1,733	-
Production allowance for basic domestic needs of Article 5 countries (ODP tonnes)[4]		-	-	1,155	1,155	1,155	1,155	1,155	1,733
Total production allowed by the Montreal Protocol (ODP tonnes)		N/A	N/A	2,888	2,888	2,888	2,888	2,888	1,733
2. Max allowable total production (ODP tonnes) for this Agreement	11,553	N/A	N/A	1,726	1,147	708	268	48	-
3. WB agreed funding		8,520,843	9,180,112	399,045	9,556,267	4,020,938	3,211,875	3,211,874	-
4. WB support costs		639,063	688,508	29,928	716,720	301,570	240,891	240,891	-
5. France agreed funding		-	1,000,000	1,000,000	500,000	500,000	-	-	
6. France support costs		-	85,000	85,000	85,000	85,000	-	-	
7. Germany agreed funding		-	700,000	700,000	300,000	300,000	-	-	
8. Germany support costs		-	57,500	57,500	57,500	57,500	-	-	
9. Japan agreed funding		-	2,500,000	2,500,000	-	-	-	-	
10. Japan support costs		-	280,000	280,000	-	-	-	-	
11. UNIDO agreed funding				3,500,000	399,046				
12. UNIDO agreed support cost				262,500	29,928				
13. UNDP agreed funding								**Footnote 5**	
14. UNDP agreed support cost								**Footnote 5**	
15. Total agreed funding (US $)		8,520,843	13,380,112	8,099,045	10,755,313	4,820,938	3,211,875	3,211,874	
16. Total support costs (US $)		639,063	1,111,008	714,928	889,148	444,070	240,891	240,891	
17. Total agreed costs (US $)		9,159,906	14,491,120	8,813,973	11,644,461	5,265,008	3,452,766	3,452,765	

1/ Baseline consumption and production levels are defined as the average levels of consumption and production during the period from 1998 – 2000.
2/ Maximum allowable consumption levels stipulated in the Montreal Protocol (85 per cent reduction in 2005 and 100 per cent reduction by 2010).
3/ Maximum allowable production levels stipulated in the Montreal Protocol (85 per cent reduction in 2005 and 100 per cent reduction by 2010).
4/ Allowable production levels for meeting basic domestic needs of Article 5 countries as per the Beijing Amendment (10 per cent of base level from 2005 and 15 per cent of base level from 2010).
5/ At the 75th meeting, the Executive Committee noted the return of US $750,093 plus agency support costs of US $56,257 from the World Bank and approved US $750,093 plus agency support costs of US $56,257 for UNDP.

Appendix 3-A: Funding Approval Schedule

17. The annual funding allocations, except those for 2004 and 2005, as shown in Appendix 2-A will be considered for approval at the second meeting of the year of the annual plans. The funding allocations for 2004 and 2005 will be submitted for approval at the first meeting of the respective annual plans.

Appendix 4-A: Format of Annual Implementation Programme

1. Data

Country _____
Year of plan _____
# of years completed _____
# of years remaining under the plan _____
Target ODS consumption of the preceding year _____
Target ODS consumption of the year of plan _____
Level of funding requested _____
Lead implementing agency _____
Co-operating agency(ies) _____

2. Targets

Indicators		**Preceding year**	**Year of plan**	**Reductions**
Supply of CTC	Import			
	Production*			
	Total (1)			
Demand of CTC	Process Agents			
	Solvent			
	Total (2)			

*For ODS-producing countries

3. Industry Action

Sector	Actual consumption preceding year (1)	Consumption year of plan (2)	Reduction within year of plan (1)-(2)	Number of projects completed	Number of servicing related activities	ODS phase-out (in ODP tonnes)
Manufacturing						
Process Agents						
Solvents						
Other						
Total						
Servicing						
Total						
Grand total						

4. Technical Assistance

Proposed Activity: _____

Objective: _____
Target Group: _____
Impact: _____

5. Government Action

Policy/activity planned	**Schedule of implementation**
Type of policy control on ODS import:	
Public awareness	
Others	

6. Annual Budget

Activity	**Planned Expenditures (US $)**
TOTAL	

7. Administrative Fees

Appendix 5-A: Monitoring Institutions and Roles

1. The Country will be responsible for implementing the CTC phase-out plan. To strengthen capacity of the Country to undertake a series of activities required to achieve permanent phase-out of CTC in accordance with the agreed Targets, a small management unit with a high degree of decentralization to ensure maximum coverage of all residual CTC users, will be established.

2. The management unit will be established within the Ministry of Environment and Forests. The role of the management unit entails development of detailed implementation plan and overall monitoring and supervision of the CTC phase-out plan. The responsibility of the management unit includes:

(a) preparation and implementation of the annual implementation programme with assistance from the Lead IA and Cooperating IAs;

(b) identification and assistance in the design of sub-projects under the plan;

(c) monitoring and supervision of project implementation at the national level including coordination of independent verification of the ODS phase-out by the beneficiary enterprises;

(d) information exchange support to the Ozone Cell, regional centers and beneficiary enterprises;

(e) reporting to the Director of the Ozone Cell on CTC phase-out related activities and providing recommendations on Government's interventions to be undertaken by the Ozone Cell, if required;

(f) periodic assessment of the alternatives supply situation;

(g) support implementation of information exchange and training activities; and

(h) maintenance of database and relevant records related to the CTC phase-out plan.

Appendix 6-A: Role of the Lead IA

3. The Lead IA will be responsible for a range of activities specified in the project document and in this Agreement along the lines of the following:

(a) ensuring performance and financial verification in relation to all activities in accordance with this Agreement and with its specific internal procedures and requirements as set out in the Country's CTC Phase-out Plan;

(b) providing verification to the Executive Committee that the Targets have been met, and the achievement/progress of associated annual activities as indicated in the annual implementation programme;

(c) assisting the Country in preparation of the annual implementation programmes;

(d) ensuring that achievements in previous annual programmes are reflected in future annual implementation programmes;

(e) carrying out required supervision missions;

(f) ensuring the presence of an operating mechanism to allow effective, transparent implementation of the programme, and accurate data reporting;

(g) ensuring that disbursements to activities undertaken under the Lead IA supervision are made to the Country based on the Targets in the annual programmes and provisions in this Agreement;

(h) providing assistance with policy, management and technical support when required;

(i) developing, in consultation with the Country and the Cooperating IAs, the annual phase-out targets for each IA; and

(j) developing a standard for verifying performance in achieving the Targets.

Appendix 6-B: Role of Cooperating IAs

1. The Cooperating IAs will be responsible for a range of activities specified in the project document, in the respective Annual Implementation Plan and in this Agreement along the lines of the following:

(a) conducting performance and financial verification in relation to activities implemented under their supervision;

(b) providing reports to the Executive Committee, through the Lead IA, on these activities and their impact in terms of ODP phase-out, for inclusion in the consolidated reports and annual programmes to be prepared by the Country with the assistance of the Lead IA;

(c) assisting the Country in preparation of annual implementation programmes for relevant activities under their supervision;

(d) ensuring that achievements of their activities are reflected in future annual implementation programmes;

(e) carrying out required supervision missions;

(f) providing the presence of an operating mechanism to allow effective, transparent implementation of their activities, and accurate data reporting pertaining to ODP impact of their corresponding activities;

(g) provide, in collaboration with the Lead IA, policy development assistance, management and technical support when required; and

(h) coordinating its activities with the Lead IA and among all Cooperating IAs.

Appendix 7-A: Reductions in Funding for Failure to Comply

1. In accordance with paragraph 12 of the Agreement, the amount of funding provided may be reduced by US $4,510 per ODP tonne of reductions in consumption and production not achieved in the year.

LOW COST OPTIONS FOR THE USE OF HYDROCARBONS IN THE MANUFACTURE OF POLYURETHANE FOAMS

AN ASSESSMENT FOR APPLICATION IN MLF PROJECTS

- FINAL COMPLEMENTARY REPORT -

SEPTEMBER 2015

Table of Contents

EXECUTIVE SUMMARY

The MLF/UNDP demonstration project on low-cost hydrocarbons (HC) technology was approved at the 58th meeting of the Executive Committee in July 2009, with the main technology report submitted to and approved by the 66th meeting of the Executive Committee in April 2012.

That main report on the potential use of preblended or direct injected hydrocarbons in the manufacture of (rigid) polyurethane foams, identified potential follow-up issues as follows:

- To optimize the three-way injection mixing head;
- To investigate whether system house (SH)-preblended and directly injected approaches lead to lower free rise densities;
- To extend the direct Injection approach to a cost-effective retrofit model;
- To develop a costing concept, and
- To prepare tailored safety concepts for each of the two mentioned approaches.

After a review of previous conclusions, this report summarizes, comments, and draws conclusions on findings from this follow-up work. Based on the initial report, UNDP decided to optimize the mixing head (with the machine supplier - SAIP) and conduct further study on the density effect of system house-blended as well as directly injects CP systems. (with the assistance of Dow Formulated Systems).

IMPROVEMENT OF THE MIXING HEAD

SAIP developed a new mixing head to improve impingement and therefore blending of the injected three components. After some further improvements, this head was installed and trials to address the effectiveness of the system house (SH) -preblended and directly injected systems commenced.

Dow reported that insulation values improved indeed and are now virtually identical to the ones with preblended cyclo-pentane (c-pentane or CP). It can therefore be concluded that

CP DIRECT INJECTION IS AS EFFECTIVE IN THERMAL INSULATION AS PREBLENDED SYSTEMS

They reported on density verification trials as follows:

Test	**Runs : 1,2,3 (avg) CP : Preblend**	**Runs : 4,5,6 (avg) CP : 3rd Stream**	**Notes**
Reactivity	Same reactivity profile: CT : 4-5 , GT : 55-58 . TFT : 88-90		
Free rise density 0.5 hr	24.40	24.24	Normal difference & deviation
Free rise density 24 hr	25.07	25.20	Normal difference & deviation
Crocodile	25.07	25.20	Normal difference & deviation
Flow Index 0,5 & 24 hr ,	1.315 / 1.275	1.324 / 1.295	
At 10 % OP			
Compression Set	145	140	
10^0C mean temp	20.00	20.46	0.46 - 0.5 advantage for preblend
23^0C mean temp	21.45	22.03	0.46 - 0.5 advantage for preblend
At 15 % OP			
Compression Set	155	156	
10^0C mean temp	20.45	20.49	In range
23^0C mean temp	21.38	21.88	0.46 - 0.5 advantage for preblend

From Dow's report it is concluded that.

A DIRECT STREAM APPROACH PROVIDES NO DENSITY ADVANTAGE OVER PREBLENDED SYSTEMS

UNDP designed a simplified safety system for both approaches—SH-preblending and direct injection. While the basic requirements remain the same as for enduser blending, the simplification requires less exhaust, less sensors and less piping as a result of eliminating the need of a preblender. As preblending is an operation that most foam manufacturers are not used to, there are benefits from simplified operations as well. Overall cost savings are estimated to be US$ 50,000 - 100,000 per project.

The overall conclusions of this pilot project are that:

- Preblended cyclopentane systems are sufficiently stable and can be commercially used;
- Preblended normal-pentane (n-pentane) systems are unstable and not recommended for commercial use. However, in direct injected systems, normal-pentane as well as cyclo-pentane (c-pentane) can be used;
- Direct injection with c-pentane (CP) can achieve the same effectiveness as preblended systems in view of density and thermal insulation when using optimized equipment;
- Any performance differences between end-user blended and SH blended systems is most likely related to blending and handling operations with the SHs being more precise;
- Indicative differences in density between the different ways to apply HCs could not be substantiated;
- Cost savings from SH-blended and direct injection compared to enduser-blended systems are in the range of 50,000 - 100,000 US$, and
- Simplified safety requirements apply

There are now three equipment suppliers that UNDP is aware of that offer direct injection of blowing agents:

- Cannon/Italy used in UNDP pilot projects for MF and ML in Brazil;
- OMS/Italy focusing on retrofit;
- SAIP used in the UNDP pilot project for HCs in Egypt.

As to preblended systems, apart from Bayer, who has supplied commercially preblended systems in Eastern Europe, Pumex/Mexico has developed CP preblended systems as part of an MLF/UNDP project. Pumex is offering these systems to all its customers that are willing to comply with safety requirements developed by the system house. It has produced videos showing safe operational practices and fire behavior of resulting products.

Recently Pumex has conducted extensive trials in the sprayfoam sector with good results. It expects to have replaced 70% of its HCFC-141b consumption by the end of the year, mostly by cyclo-pentane and is participating in a UNDP demonstration project sponsored by the US State Department in which it will address CP/HFO blends.

1. INTRODUCTION

In the main technology assessment report on potential use of preblended or direct injected hydrocarbons in the manufacture of (rigid) polyurethane foams, submitted by UNDP in March 2012 for the consideration at the 66th meeting of the Executive Committee, potential follow-up issues were identified as requiring further investigation:

- To optimize the three-way injection mixing head;
- To investigate whether the tentative fact that preblended and directly injected approaches in the use of pentane and cyclopentane lead to lower free rise densities can be substantiated;
- To extend the Direct Injection approach to a cost-effective retrofit model;
- To develop a costing concept based on this report as well as the follow-up outcome; and
- To prepare a tailored safety concept for each of the two mentioned approaches.

SAIP, UNDP's partner in the development of a direct injection dispenser and Dow, UNDP's partner in the development of preblended hydrocarbon (HC) systems, were contacted and two tasks were developed:

- With SAIP, the optimization of the mixing head of the dispenser provided under this project;
- With Dow, to conduct a follow-up study on the possible (beneficial) density effect of preblended or directly injected cyclo-pentane.

After receiving the outcome of these tasks, UNDP would then decide, how to address the other mentioned issues, which are:

- Preparation of tailored safety concepts for direct HC injection and preblended HC systems;
- Possible extension of the Direct Injection approach to a cost-effective retrofit model; and
- A costing concept based on this original as well as the follow-up findings.

This report summarizes and comments on the findings from Dow, SAIP and the follow-up work by UNDP and can be considered a final complementary report on the issue. It has been delayed because of:

(i) management changes at Dow Italy who had directed the original study—making it necessary to move the entire task to Dow-Egypt;
(ii) political unrest in Egypt which caused delay in conducting the necessary trials; and
(iii) initially inconclusive results on density benefits, necessitating a change in the trial set-up.

There has been considerable time passed between the initial report—March, 2012 which was considered final at that time—and this "final" complementary report—September 2015 that addresses issues highlighted in the initial report that the ExCom deemed worth pursuing. It would be of interest to review in how far preblending and/or direct injection have progressed in the market and what the effect(s) have been on technology and chemical systems. UNDP has added a brief review to that matter to this report.

This report starts with a review of previous conclusions as mentioned in the initial and the first follow-up complementary report. It proceeds then with a description of equipment and chemical development work that has been performed based on suggestions from the initial report. The report continues to address issues of safety and costing and then draws conclusions from the follow-up work as well as conclusions from the consolidated work and closes with a review of current market activities on preblended/direct injection of hydrocarbons.

UNDP acknowledges the work by Dow as well as SAIP in chemical and equipment development. It is also grateful to Pumex/Mexico for sharing information on their work in bringing preblended cyclo-pentane into the market.

2. SUMMARY OF THE INITIAL REPORT

The initial main technology report offered conclusions that can be summarized as follows:

PREBLENDED HYDROCARBONS (HCs)

- Pre-blended cyclo-pentane (CP) systems are sufficiently stable and can be commercially used;
- No preblender and related (tanks, piping) equipment needed, leading to savings of around US$ 100,000;
- There were indicative costs savings expected from lower densities. However, more research was needed to confirm this. If confirmed, the overall difference in operating costs was estimated between 6 and 8%;
- Against this, the possibility of higher transportation costs needed to be considered;
- K-values are 5-8% higher than for HCFC-141b foams but equal to conventional c-pentane (CP) foams.

USE OF NORMAL PENTANE (NP)

- Preblended NP systems are stable for less than a month and therefore not recommended for use;
- In case of direct injection, normal-pentane as well as cyclo-pentane can be used;
- The k-values achieved with direct-injected n-pentane are inferior leading to the conclusion that this substance should not be used in critical thermal insulation applications.

DIRECT INJECTION

- Equipment developed for direct HC injection shows good reproducibility and consistency as well as homogenous mixtures, despite higher polyol viscosities;
- The three way mixer head showed insufficient impingement and needed redesign;
- Free blown densities from direct injection are even lower than for preblended cyclo-pentane;
- No preblender along with auxiliary equipment (tanks, piping, etc) is needed but the need for a third dosing line might absorb most, if not all of these savings;
- Based on lower comparable densities, incremental operational costs savings of up to 10% can be expected when using direct injection. This statement still needed confirmative through further trials.

PROPOSED FURTHER WORK

Dow, who performed the experimental work of this project reported that “Third stream addition of pentane, in the specific of System B has a positive effect in lowering the free rise density (better blowing efficiency)….In principle this seem to indicate that third stream could allow to go for slightly lower applied densities.”

Dow also recommended as future work optimization of pentane impingement pressure and reactivity to close the delta in gel time and thermal conductivity that were observed vs pre-blended process.

Based on Dow’s findings and recommendations, UNDP decided to optimize the mixing head (with the machine supplier SAIP) and conduct further study on the density effect of system house-blended as well as directly injects CP systems.

3. FOLLOW-UP WORK

A first follow-up complementary report dated September 2014 reported inconclusive results based on problems with a new three-way mixing head. This kept Dow-Egypt from making sufficient trials and final conclusions.

It appeared that the favorable density effect compared to conventionally prepared c-pentane (CP) blends still exists but because of the mentioned technical problems with the mixing head, this finding was not conclusive. Further mixing head revisions were implemented followed by more trials. As reported, the political situation in Egypt caused some delays in the program as well.

IMPROVEMENT OF THE MIXING HEAD

SAIP provided a new mixing head to improve impingement and blending of the injected three components. After some further improvements, this head was installed with trials implemented in 2015.

Subsequently, Dow-Egypt reported that insulation values improved and are now virtually identical to the ones with preblended and conventionally blended (in situ with a locally installed preblender) cyclopentane. It can therefore be concluded that

CP DIRECT INJECTION IS AS EFFECTIVE IN THERMAL INSULATION AS PREBLENDED SYSTEMS

DENSITY VERIFICATION TRIALS

Six machine evaluations were conducted using a refrigeration system (Voracor CR 1070):

- Three with preblended CP (in the polyol);
- Three with CP as third stream directly in the mixing head

The outcome of these trials can be summarized as follows:

Test	**Runs : 1,2,3 (avg) CP : Preblend**	**Runs : 4,5,6 (avg) CP : 3rd Stream**	**Notes**
Reactivity	Same reactivity profile: CT : 4-5 , GT : 55-58 . TFT : 88-90		
Free rise density 0.5 hr	24.40	24.24	Normal difference & deviation
Free rise density 24 hr	25.07	25.20	Normal difference & deviation
Crocodile	25.07	25.20	Normal difference & deviation
Flow Index 0,5 & 24 hr ,	1.315 / 1.275	1.324 / 1.295	
At 10 % OP			
Compression Set	145	140	
10^0C mean temp	20.00	20.46	0.46 - 0.5 advantage for preblend
23^0C mean temp	21.45	22.03	0.46 - 0.5 advantage for preblend
At 15 % OP			
Compression Set	155	156	
10^0C mean temp	20.45	20.49	In range
23^0C mean temp	21.38	21.88	0.46 - 0.5 advantage for preblend

No further comparison between densities from system house (SH) and recipient (end-user) Preblending has been conducted. As the operation is basically the same—just executed at different locations—it is believed that any difference is related to better procedures at system houses, resulting in less loss of blowing agent.

Current tests on MF, ML and HC blends with HFOs in Mexico (a USA sponsored project) show that ABA losses can be considerable and that proper procedures against evaporation from blends are important.

Attachment-1 contains Dow's detailed test reports and describes the test methods used. From the report it is concluded that.

A DIRECT STREAM APPROACH PROVIDES NO DENSITY ADVANTAGE OVER PREBLENDED SYSTEMS

SAFETY

By not requiring a preblender with auxiliaries, both systems—(SH) Preblending and Direct Injection—allow for a simplified safety system. While the basic requirements remain the same, the simplification requires:

- Less exhaust
- Less sensors
- Less piping

Also, an operation that most foam manufacturers are not used to—system blending—is not anymore required. **Attachment-2** shows the simplified safety requirements for a refrigerator system.

COSTS

The removal of a preblender with auxiliaries from the cost of a conversion from HCFC-141b to cyclo-pentane should save around US$ 80,000-100,000 per project. In case of direct injection, this cost reduction is partly reduced by the cost increase of the dispenser (estimated on US$ 30,000). Currently, Cannon, OMS and SAIP offer such dispensers. However, direct injection allows for more economic retrofit of existing dispensers as a study by Impianti OMS states (**Attachment-3**).

4. CONCLUSIONS

CONCLUSIONS FROM THE FOLLOW-UP REPORT

Conclusions from the additional work carried out on behalf of UNDP and summarized before, is that

- Direct injection with CP can achieve the same effectiveness as preblended systems in view of density and thermal insulation **when using optimized equipment;**
- Any performance differences between end-user blended and SH blended systems is **most likely related to blending** and handling with the SHs being more precise;
- Indicative differences in density between the different ways to apply HCs could not be substantiated;
- Cost savings from SH-blended and direct injection compared to end-user blended systems are in the range of US$ 50,000 - 100,000, and
- Simplified safety requirements apply.

This, combined with the conclusions from the initial report lead to the following.

CONCLUSIONS FROM ALL REPORTS

- Pre-blended cyclopentane systems are sufficiently stable and can be commercially used;
- Cost savings from SH-preblended and direct injection compared to end-user blended systems are in the range of US$ 50,000 - 100,000:

- Preblended normal-pentane systems are unstable and not recommended for commercial use. At the same time, for direct injected systems, normal-pentane as well as cyclo-pentane (c-pentane) can be used;
- Direct injection with c-pentane can achieve the same effectiveness as preblended systems in view of density and thermal insulation when using optimized equipment;
- Any performance differences between end-user blended and SH blended systems is most likely related to blending and handling operations with the SHs being more precise;
- Indicative differences in density between the different ways to apply HCs could not be substantiated;
- Cost savings from SH-blended and direct injection compared to end-user blended systems are in the range of US$ 50,000 - 100,000, and
- Simplified safety requirements apply

EXPERIENCE FROM THE MARKET

There are now three equipment suppliers that UNDP is aware of that offer direct injection of blowing agents:

- Cannon/Italy used in UNDP pilot projects for MF and ML in Brazil
- OMS/Italy focusing on retrofit
- SAIP used in the UNDP pilot project for HCs in Egypt

As to preblended systems, apart from Bayer, who has supplied commercially preblended systems in Eastern Europe, Pumex/Mexico has developed CP preblended systems as part of an MLF project assisted by UNDP. Pumex is offering these systems to all its customers that are willing to comply with safety requirements developed by the system house. It has produced operational videos showing safe practices and fire behavior of resulting products.

Recently Pumex has conducted extensive trials in the sprayfoam sector with good results. It expects to have replaced HCFC-141b by the end of the year, mostly by cyclopentane and is participating in a UNDP demonstration project sponsored by the US State department in which it will address CP/HFO blend**s.**

ACKNOWLEDGEMENTS

UNDP thanks Dow Formulated Systems, Middle East and Africa—in particular Mr. Adel Momen and Mr. Mohamed El Fikky—for their help in carrying out the necessary trials to conduct the follow-up study.

5. ATTACHMENTS

Attachment-1 Detailed Report from Dow Formulated Systems
Attachment-2 Simplified Safety requirement for the use of Hydrocarbons utilizing SH-preblended or direct-injected systems
Attachment-3 E. Greco, G. Podrecca, “Direct Injection of Blowing Agent into the Mixing Head as a Third Stream” PU Magazine, 05/20150

PROCESS SAFETY GUIDELINES

IN THE MANUFACTURE OF PU INSULATION FOAMS WHEN USING FLAMMABLE SUBSTANCES AS BLOWING AGENT USING PREBLENDED RSYSTEMS OR DIRECT INJECTION

The following safety concept is based on internationally recognized and applied standards. In addition, it is possible that local standards or company policies exist that have to be adhered to. The stricter standard will prevail in a given situation:

- **Classify all identified hazard areas following IEC 79-10, second edition, 1986:**

  Zone 0: Where a constant amount of highly flammable/ explosive liquids or gases may be expected. Material must be explosion- proof and grounded.

  Zone 1: Where, from time to time, highly flammable liquids or gases may be expected. Material must be Ex-e, -d or -i and grounded.

  Zone 2: Where only by accident or scheduled maintenance highly flammable/explosive gases may be expected. Material required is Ex-n or with IP54 sealing and grounded.

- **Reclassify or restrict as many areas as possible by the application of engineered solutions such as ventilation, exhaust, ionized air blowers, other static dissipaters, separation walls, etc.;**

- **Safeguard areas that cannot be reclassified, through explosion proofing;**

- **Provide additional safeguarding through the use of a combustible gas monitoring system with sensors at designated potential emission points and a portable gas detector to be used as part of a formal monitoring plan for areas that do not have continuous monitoring;**

- **Provide adequate emergency response gear such as firefighting equipment;**

- **Train personnel in safe operating procedures, preventive maintenance, and emergency response. Use formalized procedures through a safety manual and an emergency response plan;**

- **Use an external expert, a qualified equipment supplier or a technology transfer agreement to supervise all designs, the implementation and the start-up. The initial production start-up after conversion should be attended by experienced operating personnel.**

With the help of this safety concept, it is possible to design actual modifications that have to be made to implement the transfer from HCFCs to hydrocarbons. Actual implementation can differ, depending on equipment, plant layout, housekeeping and surroundings.

A "standard" conversion for a discontinuous process would be along the following lines:

CENTRAL SAFETY AND CONTROL SYSTEMS

Gas Sensing and Alarm System

- The plant shall have installed gas sensors on locations where the possibility of emissions or leakage of CP exist. The sensors are to be connected to a centralized control panel in a safe area, clear from potential emission sources.
- The system shall be capable to trigger two consecutive visual/acoustical alarm levels, related to the percentage LEL reached. Recommended is a first level alarm on 15% LEL and a second alarm level at 30% LEL.
- The acoustical alarm shall be a minimum of 85 Db, or at least 15 Db over plant noise level.
- The visual alarm shall be in the pouring area.
- The first alarm shall be for warning purposes only.
- The second alarm shall shut down the pouring operation and the pentane supply, while increasing the process exhaust.
- The system shall have an independent power back-up.
- An auxiliary portable gas sensor with calibration unit shall be kept on site.

Exhaust System

- The plant shall have installed a centralized or sufficient localized emission extraction systems of sufficient capacity serving locations where the possibility of emissions or leakage of pentane exist.
- The system(s) shall have a two stage capacity and back-up power.
- The system(s) shall be interlocked with the sensor and alarm system.
- The system(s) shall have an independent power back-up.

Grounding

- All equipment in areas where CP emissions or leakage can occur shall be connected to a central electrical grounding system.
- The grounding shall conform with internationally accepted specifications e.g. NFPA 77.

Procedures

- The enterprise shall provide the necessary operational safety and emergency response instruction and training to staff and personnel involved in the operations using cyclopentane.
- A Safety Manager shall be appointed in the factory. The manager will receive appropriate training and education and be properly certified.
- Hazardous areas shall be clearly marked by signs indicating the Area Zoning.
- Piping shall be color coded.
- No smoking shall be allowed in the factory and its immediate surroundings. The no smoking policy shall be properly marked by signs.
- Periodic safety audits shall be effected. The audits shall include measuring of CP concentrations in areas not covered by permanent sensors through the use of the portable sensor by a qualified person.
- A Safety Manual shall be developed and maintained. The manual should as a minimum address:
    - Safety Organization and Responsibilities
    - Standard Procedures for Work in Hazardous Areas
    - Response to Emergency Alarms
    - Start-up procedures after Emergency Shutdown

CYCLOPENTANE STORAGE (IF APPLICABLE)

- Location and installation of storage systems for hydrocarbons are subject to local regulations.
- Design of tank, piping, valves shall comply with internationally recognized standards, e.g. ISPEL, NFPA 30 and NFPA 58. Recommended design pressure for a HC container is 250 psi.
- Tanks shall have an electrically/pneumatically operated shutoff control valve on the outlet pipe of the tank that can be activated from within the plant. In addition, it shall be possible to shutoff the electrical power supply to the tank from within the plant as well as at the tank.
- Nitrogen blanketing shall be provided.
- All components shall be properly grounded.
- Protection against lightning may be required depending on location.
- All installations within 4 m radius of the tank shall meet Zone 1 requirements.
- Minimal one gas detector, connected to the central gas sensing and alarm system, shall be installed.
- At a minimum two portable fire Extinguishers shall be installed.
- The tank shall be in a concrete (spill) containment of sufficient size in a fenced, locked area, preferable with a cover to protect against direct sunlight.
- The CP transfer pump, if included, shall be explosion proof with backflow protection.

FOAM DISPENSER

- Tanks shall be placed in/on individual spill containment of sufficient size.
- At a minimum, the polyol tank and pump shall be placed in an enclosure, attached to an adequately sized two stage ventilation system that allows 6/10 air replacements/ hour. Placement of the complete dispenser in an enclosure is recommended.
- Drip pans shall be placed under metering pumps.
- All installations in the enclosure shall meet Zone 1 requirements.
- At a minimum one gas detector shall be installed, attached to a central gas sensing and alarm system.
- Minimal two 6 kg ABC portable fire extinguishers shall be installed close to the foam dispenser.
- All equipment shall be properly grounded.

FIXTURES

- Cavities in fixtures shall be inerted by nitrogen prior to the foam pouring operation. IEC 79-10 provides instructions for the calculation of the amount of inertization gas.
- Emissions from fixtures shall be removed through an adequately sized two staged extraction system. Calculation of the lower stage ventilation capacity should be based on the emission of 5% of the CP injected.
- Generation of static electricity should be minimized through proper grounding. In addition, the installation of ionized air blowers and/or nitrogen flushing is recommended.

SAFETY INSPECTION CHECKLIST

1. CYCLOPENTANE STORAGE AND TRANSFER (IF APPLICABLE)

	REQUIREMENTS	OK	OBSERVATIONS
1.1	Meets local Specifications		
1.2	Certified by recognized Institution		
1.3	Suitable located		
1.4	Protected against traffic		
1.5	Placed on a pavement		
1.6	Fenced in with locked door		
1.7	Spill basin of adequate size		
1.8	Electrical installation meeting codes		
1.9	Gas sensor installed and operational		
1.10	Nitrogen blanketing		
1.11	Leak detection installed		
1.12	Two 9 kg ABC fire extinguishers		
1.13	Connection to the premixer meeting requirements		
1.14	Grounded, with extra cable to connect to drums or tank truck		
1.15	Interconnected with the central safety/alarm system		
1.16	Water hydrant in vicinity		
1.17	Easy access for delivery /operation		
1.18	Ex-proof transfer pump with backflow protection and lubrication		

2. FOAM DISPENSING AREA

	REQUIREMENTS	OK	COMMENTS /ACTIONS
2.1	Tanks placed in separate spill containments of 110% each		
2.2	Drip pans under pumps		
2.3	Polyol tank and pump placed in an enclosure attached to a two speed exhaust system		
2.4	Electrical installation meeting codes		
2.5	Two gas sensors		
2.6	Electrically grounded		
2.7	Two 6 kg ABC fire extinguishers		
2.8	Nitrogen blanketing polyol tank		
2.9	No cavities in the floor		
2.10	Interconnected with the central safety/alarm system (ventilation, automatic shut-off, gas sensor)		
2.11	Separated from other operations		

3. POURING AREA/FIXTURES

REQUIREMENTS		OK	COMMENTS /ACTIONS
3.1	Installed in a separate area		
3.2	No cavities in the floor		
3.3	Explosion proof electrical fixtures		
3.4	Connected to a two speed exhaust system		
3.5	Gas sensors at each pouring location		
3.6	Installation of a nitrogen flushing system on the mixing heads		
3.7	Installation of a nitrogen inertization system for the molds/fixtures		
3.8	Electrical installation meeting codes		
3.9	A 6 kg ABC fire extinguisher		
3.10	Fixtures electrically grounded		
3.11	Interconnected with the central safety/alarm system		

4. CENTRAL SAFETY/ALARM SYSTEM

REQUIREMENTS		OK	COMMENTS /ACTIONS
4.1	Placed in a safe, accessible area, separated from hazardous operations		
4.2	Interconnecting all gas sensors, exhaust systems, shut-off valves and other safety features into one central system		
4.3	Capable to trigger alarm on two consecutive LEL percentages		
4.4	Featuring acoustical as well as visual alarm and process shut down		
4.5	Independent power back-up		

5. SAFETY MANAGEMENT PROCEDURES

REQUIREMENTS		OK	COMMENTS /ACTIONS
5.1	Provision of operational safety and emergency response instruction		
5.2	Appointment of a Safety Manager		
5.3	Marking of all hazardous area's by signs indicating the area coding		
5.4	Installation of non-smoking signs		
5.5	Color coding of piping		
5.6	Pertinent standard operational procedures to assure proper safety		
5.7	Handheld sensor/calibrator		
5.8	Institution of regular safety audits		
5.9	Emergency response planning		

E. Greco, G. Podrecca

Direct injection of blowing agent into the mixing head as a third stream

Globally, manufacturers in the field of domestic and industrial refrigeration, sandwich panels and water heaters are under pressure to save the energy used by their products. Replacing banned or less-effective blowing agents with newer, more environmentally friendly blowing agents is one way to improve the energy efficiency of foam insulation. These newer blowing agents, however, can require expensive dedicated safety systems, equipment modifications or equipment replacements. Impianti OMS shows how to improve the thermal conductivity of polyurethane foam while minimizing costs of process changes by directly injecting a blowing agent, as a third stream, into a mixing head using high-pressure impingement mixing technology. In cooperation with a leading material and chemical systems supplier, OMS conducted experimental studies and subsequent trial sessions in its laboratory in Italy on industrial water heaters. The water heater manufacturer followed our technical suggestion to use a new generation blowing agent instead of water to meet new European energy usage requirements. The water heaters made with this technology exhibited a 26 % reduction in heat loss when compared to water heaters made with the original water-blown system. Our technical solution also showed good performance in terms of material flow, density distribution and fill weight. By directly injecting the blowing agent as a third stream at the mixing head, OMS demonstrated that a manufacturer can change blowing agents to achieve better energy efficiency while using existing equipment (with minor modifications) and minimizing the amount and cost of additional processing and safety systems.

1 Introduction

Blowing agents used in polyurethane systems continue to be the focus of great interest and ongoing research because of the need to improve the physical-chemical properties of thermal insulation while preserving the environment (ODP-GWP). At this time, the use of flammable and potentially explosive blowing agents **(tab. 1)** in the production of low-density rigid foam requires dedicated equipment, technical solutions and pertinent safety systems. Because of this, insulation manufacturers find themselves facing significant investments in new equipment or conversion of existing foaming equipment.

Our alternative solution is injection of the blowing agent directly into the high pressure mixing head as a third component stream **(fig. 1)**. OMS in cooperation with Huntsman Italy and Domotec AG of Switzerland (water heaters manufacturer) conducted intensive research and several laboratory trials to prove the feasibility of this solution.

Today, manufacturers use rigid, low-density polyurethane foam as thermal insulation to control heat loss in hot water heaters. These manufacturers now must find different blowing agents to meet changing environmental regulations and energy efficiency standards. The test results of our laboratory, together with the results of analysis carried out at Huntsman laboratory in Ternate, Italy, confirmed that c-pentane can be used easily as a valid alternative solution in the production of domestic or industrial water heaters.

2 Experimental activities and trials

The experimentation activities involved the following steps:

a) Development and implementation of the dosing unit and mixing head for the blowing agent with particular attention to the injection of the third component directly into the mixing chamber of the high-pressure mixing head **(fig. 2)**.
b) Processing tests with a Lanzen-Brett mould **(fig. 3)** using c-pentane as the third independent stream, compared to an already blended system (polyol blended with c-pentane) and examination of the fi-

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Based on a poster presented at the Polyurethanes 2014 Technical Conference,

▼ **Tab. 1:** *Flammable blowing agents*

Blowing agent	HFC-365mfc	Methyl formate	Methylal	n-Pentane	i-Pentane	c-Pentane
Molecular weight / g/mol	148	60	76	72	72	70
Boiling point / °C	40.2	31.3	42	36.1	27.8	49.3
Gas conductivity at 25 °C / mW/(m·K)	10.6	10.7	14.5 (at 42 °C)	14.6	13.8	12
Flammability LEL-UEL / vol.%	3.6–13.3	5.0–23.0	2.2–19.9	1.5–7.8	1.4–7.6	1.1–8.7
Density / kg/m³	1,270 (20 °C)	982 (20 °C)	821 (20 °C)	631 (15 °C)	624 (15 °C)	748 (15 °C)
GWP	782	5	0	11	11	11
ODP	0	0	0	0	0	0

nal physical-mechanical properties of the two production methods (in cooperation with Huntsman) **(tab. 2).**

c) Foaming tests of several water heaters **(fig. 4)** using c-pentane as third independent stream in cooperation with Huntsman and Domotec as well as testing and analysis of the obtained results.

3 Results

The results of the mentioned experimentation activities prove as follows:

a) There was no particular processing difference between injecting a pre-blend of polyol/c-pentane and c-pentane injected as third stream directly into the mixing head.

b) The final physical-mechanical properties are very similar.

c) Compared to a water blown system, using c-pentane as a third stream achieved a weight reduction of 10–15 % and a 26 % improvement of the reverse heat leakage (RHL) **(tab. 3)**

4 Conclusions

The OMS third stream direct injection of flammable blowing agents into the mixing head achieved satisfactory results in terms of energy efficiency and for the final performances of the produced water heaters.

We believe that this solution can be easily used in other applications of thermal insulation, including the production of discontinuous panels, pipe insulation and industrial refrigeration.

It is essential to point out the lower financial investment of this solution that allows keeping the existing high-pressure foaming machine and just adding the blowing agent metering skid. ■

Component	Unit	Standard system	c-Pentane as third component
Polyol blend	pbw	100	100
c-Pentane	pbw	15	15
Isocyanate	pbw	156	156
Cream / gel time	s	4 / 38	4 / 40
Minimum filling on Brett mould	kg/m³	32	32.2
	pcf	1.997	2.01
Free rise density	kg/m³	22	22.3
	pcf	1.373	1.392
Lambda value at 10 °C	mW/(m·K)	20.4	20.2
Compression test (parallel / perpendicular)	kPa	162/128/102	150/135/121
	psi	23.5/18.6/14.8	21.8/19.6/17.5

◀ **Tab. 2:** *Tests using Lanzen-Brett mould*

Foaming trial	Water blown PU system		c-Pentane as third stream	
	Reference 1	Reference 2	Water heater No. 2	Water heater No. 4
Foam weight / kg	7.3	7.3	6.3	6.0
Heat flow / W	78.51	86.97	58.27	63.36
Average heat flow / W	82.74		60.81	
RHL / %			26.5	

◀ **Tab. 3:** *Foam weight and reverse heat leakage (RHL)*

Fig. 1: *Injection of the blowing agent directly into the high pressure mixing head as a third component* ▼

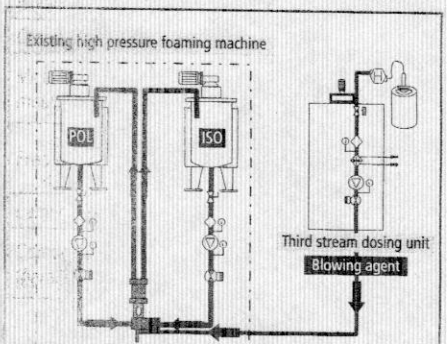


Fig. 2: *OMS Y2K mixing head for three components* ▼

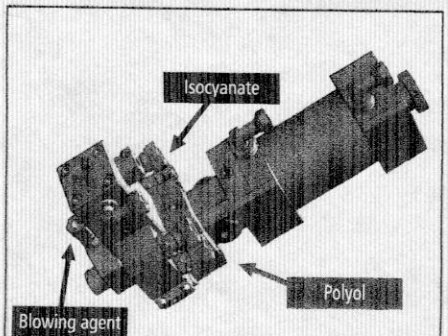


Fig. 3: *Lanzen-Brett mould in the OMS laboratory and R&D centre* ▼

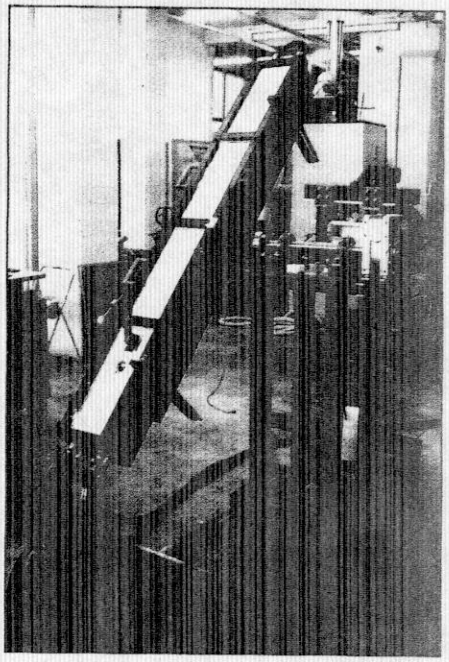
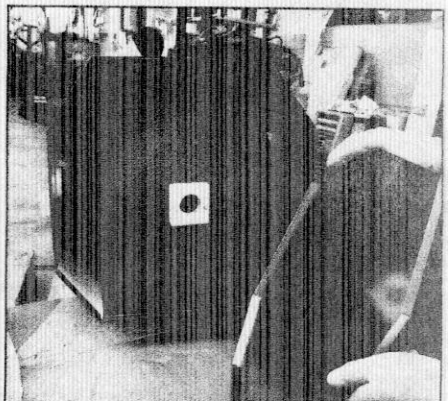


Fig. 4: *Water heater assembly before foaming operation* ▼



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INTEROFFICE MEMORANDUM MEMORANDUM INTERIEUR

OFFICE OF INTERNAL OVERSIGHT SERVICES · BUREAU DES SERVICES DE CONTRÔLE INTERNE

INTERNAL AUDIT DIVISION · DIVISION DE L'AUDIT INTERNE

TO: Mr. Christophe Bouvier, Director,
A: Office for Operations and Corporate Services,
United Nations Environment Programme

DATE: 28 May 2015

REFERENCE: IAD:GEN (004/2015)

FROM: Agness Chilinda, Chief, Nairobi Audit Section
DE: Internal Audit Division, OIOS

SUBJECT: **Status of oversight recommendations for the OzonAction Branch**
OBJET:

1. Reference is made to your request for a confirmation of the status of the oversight recommendations for the OzonAction Branch.

2. Please be informed that as at 28 May 2015, all recommendations for the OzonAction Branch were closed in the OIOS database.

3. Should you require any further clarification, please do not hesitate to contact us.

4. Thank you

cc: Mr. Gurpur Kumar, Deputy Director, Internal Audit Division, OIOS