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EXECUTIVE COMMITTEE OF
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**EVALUATION REPORT ON MAC PROJECTS IN INDIA: FOLLOW-UP TO
DECISION 37/5 (c)**

I. Background

1. The Executive Committee discussed at its 37th meeting the report on the information collected concerning the status of implementation of MAC projects as follow up to decision 36/3 (Doc. UNEP/OzL.Pro/ExCom/37/7). The analysis of information received from nine countries with MAC projects revealed that only in India significant numbers of CFC based MAC systems and components are still produced. Therefore, the Committee decided to limit the field evaluation to India. (Decision 37/5).

2. The evaluation mission took place on 2 and 3 September 2002 and comprised the Senior Monitoring and Evaluation Officer, an expert in MAC production as independent consultant, and as resource person, the staff member of the Secretariat responsible for the review of MAC projects. The Ozone Cell of the Ministry of Environment and Forests of the Government of India was very helpful in briefing the mission and in organizing the visits to the companies. Comments on the draft evaluation report were received by the Ozone Cell and by the World Bank and were taken into account for finalizing the report.

3. MAC Producers in India are obliged by a national regulation published in July 2000 to complete phase-out of CFC-12 MAC systems and components by 1 January 2003, date from which no more CFC-MAC systems are allowed to be installed and sold. This ruling applies to new vehicle production; sales of components for servicing and repair of existing CFC-12 based MAC units are still allowed until 1 January 2010.

4. Three major companies, all of which received grants from the MLF to convert their CFC-12 based MAC system production to HFC-134a compatible technology, account for the majority of manufacturing and supply of MAC systems to the Indian market. These companies are:

- (a) Subros Ltd
- (b) Sanden Vikas (SVIL)
- (c) Pranav Vikas (PVIL)

5. A fourth company ACD/Visteon, produced from its start some years ago only HFC-134a based MAC systems.

6. Subros Ltd. is 74% locally owned with the remaining 26% split evenly between Denso and Suzuki of Japan. Sanden Vikas ownership is split 50% local and 50% foreign (Sanden International of Japan). Pranav Vikas is 100% owned by the local partner of Sanden Vikas.

7. Sanden Vikas and Pranav Vikas completed fully the conversion of the production from CFC-12 based MAC systems to HFC-134a compatible technology. Subros completed Phase I conversion of their production for cars exported by their main client, Maruti, and a few directly exported components and MAC systems. However, it continues to manufacture CFC-12 based MAC systems to satisfy local market demand. 70% of the production still consists of CFC-12 based MAC systems.

8. Cost of HFC-134a in India continues to be significantly higher than of CFC-12. Subros cited the cost of one kilogram of HFC-134a at US \$ 11 to US \$ 12 compared to about US \$ 5 per kilogram for CFC-12. It seems that the import duty on HFC-134a is one of the reasons contributing to its high cost while CFC-12 is produced locally. The higher cost of HFC-134a and of HFC-134a MAC systems are the main reasons for Maruti, the main client of Subros, to continue so far installation of CFC-12 MAC systems.

II. Assessment of Projects

II.1 State of Implementation of the Conversion

9. SVIL and PVIL successfully introduced from 1998 to 2000 HFC-134a compatible technology into their MAC production. All CFC- MAC system production has been ceased in both companies by end of March 2001. The likelihood of renewed production of CFC-12 based MAC is nil as all dedicated equipment for the production of CFC-MAC systems, including for servicing purposes, has been either permanently modified for HFC-134a MAC production or destroyed.

10. Based on customer requirements, replacement components for CFC-12 based MAC system have been produced in advance and are in storage. This bank of spare parts will be used to satisfy future customer needs. It enables SVIL & PVIL:

- (a) To have the needed components at hand to satisfy their service commitments to customers.
- (b) To eliminate the need to continue CFC-12 based MAC system production.
- (c) To allow for disposal of all dedicated production equipment for CFC-12 based MAC systems.

11. Subros also introduced successfully HFC-134a compatible technology into MAC production. Subros supported exports of its main client Maruti with HFC-134a MAC systems (in limited quantities) as early as 1994 and with expanded production from October 1996 onwards. While HFC-134a technology was implemented as approved, CFC-12 based MAC system production doubled in parallel to keep up with the increase of demand for the domestic market. HFC-134a MAC system production accounts now for approximately 30% of total production. CFC-12 MAC system production equipment is still fully used and it was evident that several upgrades and capacity increases were added during recent years. It is planned that, by early December 2002 CFC-12 based MAC system production will be limited to the service and repair of existing CFC systems. During the visit to the company, Subros' management informed that all production equipment for CFC-based MAC systems will then be placed in a separate building.

II.2 Development of Production Capacity and Production of MAC at Subros

12. Installed and licensed capacity for the production of CFC-12 based MAC systems was until March 1995, 50,000 units per year, as confirmed in Subros Annual Report 1994-1995. The following Annual Report covering the period from April 1995 to March 1996 indicates an increase of capacity to 150,000 units per year, resulting from an expansion programme funded by Subros. It is not fully clear whether all of the added capacity was in place before 25 July 1995, as a result of an expansion in 1992-1994, as Subros claims. The 1994/95 Annual Report said that "capital equipment orders have been placed and major machinery received"; the following year's report confirms completion of the capacity expansion to 200,000 MAC Systems per year. While the production of CFC-12 MAC systems increased in 1995/96 to 100,006 units (compared to 65,319 units the year before), the 35,000 units in addition to the previous year's production could have been produced also if the commissioning of the new capacities would have taken place after July 1995, and not in March 1995 as now claimed by Subros. The larger part of the additions to plant and machinery, including investments for doubling the capacity of motor fan production, have been reported for the years 1995/96 and 1996/97 (see table 1) and, as mentioned above, the capacity increase for CFC-12 MAC systems was reported only in the 1995/96 annual report (see table 2).

Table (1) Additions to Plant and Machinery at Subros

Year	Value in Million Rupees	Rate (1 INR) = US \$	Value in Millions US \$
4/94-3/95	31.2	0.0318	1.0
4/95-3/96	113.8	0.0284	3.2
4/96-3/97	174.8	0.0278	4.9
Totals	319.8		9.1

Source: Subros Annual Reports

Table (2) Capacity and Production of MAC at Subros

Year	Installed Capacity		Actual Production	
	CFC-MAC	HFC-MAC	CFC-MAC	HFC-MAC
4/93-3/94	50,000 ¹	0	43,300	0
4/94-3/95			65,319	3,620
4/95-3/96	150,000 ²		100,006	13,544
4/96-3/97			109,263	19,352
4/97-3/98			124,280	25,560
4/98-3/99		50,000 ³	131,555	13,508
4/99-3/00			165,906	15,340
4/00-3/01		100,000 ⁴	136,334	48,865
4/01-3/02			126,313	61,122

¹ Capacity in place since the middle of the 1980ies

² Capacity expansion funded by Subros, reported in Annual Report 1995-1996

³ Conversion project funded by MLF, implementation started in 1995, completed in November 1998

⁴ Capacity expansion funded by Subros during 1999 to 2001

Source: Subros Annual Reports and PCR.

13. The conversion project to HFC-134a based MAC units was approved in November 1993, the grant agreement was signed in June 1995 when also the contracts were awarded. Completion according to the PCR occurred in November 1998, three years after the originally planned completion date. The project established a new line for HFC-134a based MAC systems running in parallel to the old line producing CFC-12 based MAC units. In this sense, no conversion took place but the company was enabled to satisfy Maruti's demand for HFC-134a based MAC systems for exported cars. In parallel, the production of CFC-12 based MAC systems doubled between 1994/1995 and 1997/1998 and continued on that level in the following years with a peak in 1999/2000. (See Table 2).

14. There are no clear figures in the project document and in the PCR concerning the production capacity planned and created. It was expected that Maruti would require in 1994/1995, 12,000 HFC-134a based MAC systems for exported cars, and Nippondenso indicated an annual demand for 11,000 HFC-134a based compressors to be exported to their various subsidiaries. The indirect phase-out was calculated as 84 ODP tonnes, assuming an original charge of 1 kg CFC-12 per MAC unit installed, plus an additional 350 grammes per year for servicing of a total of 50,000 MAC units. In the PCR, only 23 ODP tonnes are claimed as actual phase-out, relating back to the 23,000 HFC units planned for exports but without calculating service charges nor considering actual production of HFC-134a based MAC units which in 1998/1999, the year of project completion, was 13,508 units.

15. Subros claims that the conversion project only funded a production capacity for 15,000 HCF-based MAC units and that the company had to add substantial funds to bring the capacity to 50,000 units per year. However, in the PCR dated January 2001, no counterpart funds nor an additional expansion under Phase I were mentioned. Instead, it is stated that "infrastructure in the facilities has been created as planned under Phase II. Government regulations have delayed implementation. Phase II is not a MLF project". (PCR p. 4). This seems to indicate that Subros indeed invested additional funding in preparing the expansion of capacities for the production of HFC-134a based MAC systems for the domestic market (phase II) but it does not say the same for exports (phase I).

16. The PCR indicated that trial runs were held from 6/95 to 10/97. In table 1 above actual production volumes of 19,352 units were achieved from 4/96 to 3/97 that means prior to completing trial runs. Installed production line capacity at that time must have been greater than 15,000, otherwise production of 19,352 units would not have been achievable at a time when the line was still being tested and debugged.

II.3 Implementation Delays

17. All three projects were significantly delayed, in particular Subros which took more than 5 years to complete (see Annex I).

18. Delays in implementation were generally due to :

- (a) Identification of local suppliers for equipment and material that meets specification.

- (b) Suppliers who could not meet delivery schedules and/or specifications.
- (c) Some procedural and administrative issues, considered as minor though by Subros.
- (d) Maruti took a long time to prepare the specifications for HFC-134 based MAC systems, due to extensive communication and coordination with Suzuki and Denso.

II.4 Choice of Equipment

19. PVIL, SVIL, and Subros selected and implemented HFC-134a compatible technology that is suitable and consistent with the approved projects.
20. Most Equipment was imported from Japan with assistance from the enterprise partner in Japan. PVIL sourced the Nocloc furnace from Europe and several components for the nitrogen plant locally.
21. In all cases, the new equipment needed extra space for a safe and good working environment. Additional upgrades/ capacities were incorporated; however, this was done at the expense of the enterprises.

II.5 Sustainability

22. PVIL, SVIL, and Subros demonstrated confidence in their capabilities to sustain continuous HFC-134a MAC system production. Resident engineers from their partners in Japan are part of management and technical staff. The production facilities of all visited companies were clean, with good lay out, and good working conditions. All companies seem to have achieved a good level of efficiency, productivity and quality in their manufacturing process. This was evident by:
- (a) Little or non existence of rejects, and the
 - (b) Absence of non-conforming materials.
23. An example of the level of competence achieved is that PVIL designed and built additional MAC HFC-134a production equipment by themselves.

II.6 Fate of old Equipment

24. For PVIL & SVIL it was clear that all dedicated production equipment for CFC-12 based MAC systems is no longer in service. It was scrapped or permanently modified.

25. For Subros it was understood that some of the equipment was scrapped for the production of CFC-12 based MAC. A detailed list of CFC-12 MAC system equipment that was rendered unusable in October 1996 (July 1997 in another table) was provided in the PCR, certified by an independent engineer. This could not be clearly confirmed as the production line for CFC-12 MAC systems has been kept fully operational, production volumes have more than doubled during project implementation and new equipment to produce CFC-12 based MAC systems was added in response to market demand in particular by Maruti, to which Subros is linked through participation of Suzuki in both companies.

III. Conclusions

26. The vehicle manufacturers control the timing of conversion for the MAC producers, which have to follow the demand of the former. Maruti stated that higher cost was the primary reason for delaying conversion of some of their lower-end car models. Subros switched a portion of its production to HFC-134a MAC systems to support Maruti's export commitments, and continued the production of CFC-12 MAC systems for the local market as long as Maruti continued to install them in cars destined for the Indian market.

27. Earlier legislation would have been the only way to accelerate the phase out of CFC-12 based MAC systems. Cost for CFC-12 was and is still considerably less than for HFC-134a, and the same goes for the MAC systems for CFC-12 compared to HFC-134a, although the car manufacturers do not pay a higher price any more for HFC-134a MAC systems but force the MAC producers to bear the additional costs.

28. Discussions between the industry and the Government of India on legislation to enforce the conversion took a long time. They started in 1996, a draft was prepared in April 1998, followed by a final draft in January 2000 and publication in July 2000, calling for complete phase out by January 2003.

29. The long discussion process and preparation for the legislation left sufficient time for Maruti and Subros, the only enterprises which still have to convert, to prepare themselves for the deadline of 1 January 2003. Subros has already from 1999 to 2001 expanded its capacity for the production of HFC-134a based MAC systems to 100,000 units per year.

30. A concern, however, exists with regard to the fact that the majority of the existing vehicles in India are without A/C and might partly be re-equipped with CFC-12 based MAC systems during the next years for the following reasons:

- (a) Some vehicle owners now have the means to add A/C to their vehicles, but not to purchase a new vehicle with A/C.
- (b) CFC-12 and CFC-12 based MAC systems will continue to be available on the market for servicing. Subros plans to continue the production of CFC-12 based MAC systems to meet service market requirements, and SVIL and PVIL will serve this demand from spare part banks.

- (c) No regulations are in place to prevent installation of new CFC-12 based MAC systems in older vehicles.
- (d) Consumers will select the lower cost option.

31. Considering the quantity of vehicles without A/C in India, this risk should be taken seriously. If pro-active and proper steps are not taken, CFC-12 MAC system installation in older vehicles may increase and CFC-12 MAC production will continue to meet market demands.

IV. Recommendations

32. The Executive Committee might consider to decide:

- (a) To take note of the findings and conclusions of the present evaluation report.
- (b) To limit funding for a second conversion project at Subros to those capacities clearly installed and commissioned before 25 July 1995.
- (c) To encourage the Government of India to consider the introduction of:
 - (i) Economic incentives to retrofit old cars with HFC-134a based MAC systems only.
 - (ii) Regulation to prevent the installation of CFC-12 based MAC systems in older vehicles that do not already have an A/C system.
 - (iii) Measures to reduce the price of HFC-134a, for example by decreasing the import duty.

INDIA
OVERVIEW OF MAC AND MAC COMPRESSOR PROJECTS

UNEP/OzL.Pro/ExCom/38/6
Annex I

Code	Project Title	Project Description	ODS Replacement	ODP to be Phased Out	ODP Phased Out*	Approved Indirect Phaseout	Total Funds Approved including Adjustments	Funds Disbursed*	Date Approved	Approved Date of Completion	Date Completed as Reported	Date Completed as per Evaluation	Project Duration (Months)	Delays (Months)
IND/REF/11/INV/12	Modification of CFC-12 MAC manufacturing for HFC-134a at Subros Ltd.	Changes in compressor assembly line, tube liquid, hoses, task receiver, condenser, compressor parts machinery, technology transfer and training.		0	0	84	1,710,000	1,648,419	Nov-93	Nov-95 Mar-97 (as revised)	Nov-98	Not fully completed**	61	20
IND/REF/22/INV/116	Conversion to non-CFC technology in the production of MAC systems at Pranav Vikas India Ltd.	Replacement of the fin machine and associated equipment, (tube decoiling, straightening and cutting machinery and tube cleaning facilities), an automatic temperature controlled brazing furnace, technology transfer fees, training, installation and commissioning. \$200,000 will be paid by the enterprise for equipment that would be used for the production of evaporators. The company is planning to re-locate to a new plant which involves expenses on land and building, procurement of cleaning equipment, air compressor, and electrical distribution and control systems.		0	0	16.07	944,914	854,245	May-97	Jun-99	Aug-00	Mar-01	47	21
IND/REF/22/INV/121	Conversion to non-CFC technology in the production of MAC systems at Sanden Vikas India Ltd.	Modification and replacement of equipment and related components including crimping machine and swaging machine, in-house assembly of the production line after locally sourcing other equipment (benches, conveyor system, tooling for checks), modification of power lines, compressed air supply and circulation of solvents, technology transfer fees, training, and installation and commissioning. This approach will minimize investment costs in the compressor manufacturing facility. The enterprise will finance additional costs associated with equipment for manufacturing the compressor cylinder block, front housing, receiver drier and oil dehydrator, and technology transfer fees, estimated at \$1,249,548.	CFC-113 to Aqueous Cleaning	8.4	8.4	13.51	490,820	360,655	May-97	Jun-99	Aug-00	Mar-01	47	21

* According to the 2001 Progress Reports

**Not yet fully completed in the sense of decision 28/2 of the Executive Committee