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PROJECT PROPOSAL: MAURITIUS

This document includes the following project proposal:

- National CFC-12 Recovery and Recycling Programme and Demonstration of Retrofit Technology in Commercial Refrigeration UNDP

PROJECT COVER SHEET

COUNTRY: MAURITIUS

PROJECT TITLE: National CFC-12 Recovery and Recycling Programme and Demonstration of Retrofit Technology in Commercial Refrigeration

SECTOR COVERED: Refrigeration and air-conditioning

ODS USE IN SECTOR: 23.8 Tons/year of CFC12 in 1994

PROJECT IMPACT: 7.875 Tons/Year of CFC12

PROJECT DURATION: 1 Year

ECONOMIC LIFE: 5 Years

TOTAL COST: US\$ 176,350

PROPOSED MLF GRANT: US\$ 176,350

COST-EFFECTIVENESS: Grant effectiveness - N/A
Unit Abatement Cost - US\$ 5.90/kg

COORDINATING NATIONAL BODY: Ministry of Environment and Quality Life

IMPLEMENTING AGENCY: UNDP

APPRAISAL DATE: May 1995

PROJECT SUMMARY

Under the project, a comprehensive National Programme for Recovery/Recycling of refrigerant in the refrigeration and air-conditioning sectors, including mobile air-conditioning (MAC), will be implemented, and a least-cost commercial refrigeration retrofit technology will be demonstrated. Project activities include a two-part training seminar on theoretical and hands-on teaching concerning the recovery of CFC refrigerants and good practices in the handling of refrigerants during servicing and installation. The project will provide recovery and recycling equipment and establish a National Recycling Network for the recovered refrigerant. The project will also retrofit a small public cold storage facility to demonstrate a least-cost retrofit technology for dissemination to interested industries in Mauritius and in the neighboring region.

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PROJECT FOR THE GOVERNMENT OF MAURITIUS
NATIONAL CFC-12 RECOVERY AND RECYCLING PROGRAMME
AND DEMONSTRATION OF
RETROFIT TECHNOLOGY IN COMMERCIAL REFRIGERATION

1. PROJECT OBJECTIVES

The objectives of the project are to establish a national network for the recovery and recycling of CFC refrigerant in the refrigeration, air-conditioning and MAC sectors, provide training on good maintenance and repair practices, and demonstrate a least-cost retrofit technology for application in the commercial refrigeration sector.

2. SECTOR BACKGROUND

The Country Program for the phaseout of Ozone Depleting Substances (ODS) in Mauritius was approved in July 1993 and shows that in 1991 44.98 metric tons (64 %) of ODS were used in the R+A/C sector. According to the latest information from the Ministry of Environment and Quality of Life, the total imports of ODS for the R&A/C and MAC sectors during 1994 included 24.3 tons of CFC12, of which it is estimated that 23.8 tons (97.9%) of CFC12 were used for the maintenance of existing R+A/C and MAC equipment.

There are 3 main importers of CFCs in Mauritius, 11 authorized car dealers, 1 central MAC workshop, 12 refrigeration equipment importers/service centers, and over 125 technicians in the informal sector performing various types of refrigeration maintenance and repair services. Due to its tropical climate and isolated location, Mauritius depends heavily on refrigeration for food storage and distribution; a large share of CFC consumption is related to operation of refrigeration systems in the food industry. The biggest CFC-user in Mauritius is the Agricultural Marketing Board (AMB), which has the overall responsibility for storage and distribution of agricultural products in Mauritius. AMB is a para-statal enterprise with four cold storage facilities, including one at the airport and one at the harbour to store goods and produce in transit. Two of AMB's facilities are currently using R-22.

This project is an important part of an overall strategy of the Government of Mauritius to phase out ODS by 1998. For the domestic refrigeration sub-sector, two projects are now under implementation to phase out the use of ODS in domestic refrigerator manufacturing. For the refrigeration and air-conditioning sub-sectors, priorities are to stop the discharge of ODS into the atmosphere due to leaks and servicing emissions in the refrigeration and air-conditioning servicing sectors, to ensure a supply of recovered/recycled refrigerant to service existing facilities, to gradually reduce

and/or ban import of CFCs once a recovery and recycling programme is fully operational, and to promote ODS-free retrofit technologies. This project proposal therefore constitutes a major step towards total ODS phaseout in Mauritius. To ensure the success of this project and the overall ODS phaseout programme, the Government of Mauritius is considering enforcement of some of the provisions of its Environment Act, e.g. control/ban of controlled substances. A proposal to control the emissions of ODS is also under consideration.

It is well-known from experience in the refrigeration sector that a significant reduction in CFC consumption can be achieved through improved maintenance practices and the effective use of recycling and recovery methods. Since the Government of Mauritius has already passed its Environment Act and is currently considering strict enforcement, it is essential that the necessary mechanisms be first in place to minimize any adverse impact on the country as a whole. The intent of this project is to provide funding to allow for the fulfillment of this requirement through provision of recovery and recycling equipment needed, training programme on improved maintenance practices, and transfer of know-how on least-cost retrofit technologies.

3. THE PROJECT

This project has three main components: a training programme, establishment of a National CFC Recovery and Recycling Network, and a demonstration unit for commercial refrigeration retrofit technology.

3.1 TRAINING PROGRAMME

The training programme will consist of:

1. A one-day Training-of-the-Trainers Seminar; and
2. 3 one-day training seminars by the trainers.

The objective of these Seminars will be to familiarize all those involved regarding the proposed national CFC recovery and recycling programme and teach the different methods for recovery of refrigerants.

3.1.1 Training-of-the Trainers Seminar

This Seminar will be for one day during which an international refrigeration consultant will teach 6-8 teachers, from the Refrigeration Departments of the Industrial and Vocational Training Board (IVTB) and the University of Mauritius, the technologies and equipment available for recovery and recycling and the different methods of recovering refrigerant, with and without the equipment supplied under the project. The teachers will be shown how to

demonstrate the usage of the recovery units. The consultant will also give the teachers a review of good refrigeration servicing practices.

3.1.2 Training Seminars

It is envisaged that three one-day Training Seminars will be conducted by the 6-8 trainers. It is intended that all technicians in both the organized and the informal sectors will be covered by these Seminars and benefit from them. The first seminar will be attended by the original trainer (international consultant) to ensure that any deficiencies are detected and corrected before the remaining seminars are carried out.

Each Seminar will train approximately 40 technicians thereby preparing at least one person from each of the estimated 125 Refrigeration Centers in Mauritius. The training will include hands-on experience as well as theoretical teaching, a presentation of the National R/R Programme, an explanation of the need for recovery and recycling and an introduction to recovery and recycling technologies and methodologies in different systems as well as good practice during refrigeration servicing and maintenance.

The Training Seminars will be conducted within the facilities of the Industrial and Vocational Training Board (IVTB) and special attention will be paid to assure that the teaching staff of the IVTB's Refrigeration Department are fully prepared to continue teaching Recovery of refrigerants and the other Servicing Good Practices taught during these Seminars.

The Seminars will utilize (among other materials) some of the existing training documentation and material prepared for other ongoing projects, as well as other materials prepared by UNEP.

The related cost for the training programme is as follows:

US\$

1 International consultant/lecturer (airfare, DSA, 7 days' fees)	10,000
Logistical arrangements for workshop	3,000
Duplication of technical literature	500
2 recovery machine and ancillary equipment (see notes)	3,000
Contingencies (10% of above)	1,600
TOTAL	18,100

NOTES: (see Notes in 4.2)

The recovery machine will incorporate an OFP device and include a DOT recovery cylinder. The ancillary equipment for each recovery machine will include; 2 ERC cylinders incorporating an OFP switch and 1 Recovery Equipment Kit.

3.2 CFC RECOVERY AND RECYCLING PROGRAMME - CREATION OF A NATIONAL RECOVERY AND RECYCLING NETWORK

Based on the present needs of Mauritius, under the project, a National Recovery and Recycling Network will be established. The Network will include the following participants:

- . 27 refrigeration and air-conditioning maintenance centers, each will receive the necessary equipment for the recovery of CFC12;
- . The Electrical Services Division of the Ministry of Energy, for the servicing of R&A/C in Government buildings, Hospitals, etc., will be provided with 2 sets of recovery equipment;
- . The Agricultural Marketing Board. Based on its needs, 3 sets of recovery/recycling equipment will be supplied, together with 2 x 1,000 Kg. and 6 x 500 lbs refrigerant storage cylinders, for the servicing of its cold stores;
- . The National Recycling Center to be nominated by the Ministry of Environment. The Center will receive 2 standard recovery/recycling machines and the necessary ancillary equipment to treat the recovered refrigerant. In addition, 2 sets of recovery equipment will also be supplied to be held at the Center in case needed by maintenance centers not included in the Network or as replacement during repairs of recovery machines; and
- . The MAC Recycling Center. One MAC recovery/recycling machine and equipment will be provided.

Though the AMB have cold stores located in four different parts of the island, only the Main Stores at Moka (31 Cold Rooms) and the transit unit at the airport (5 Cold Rooms) use CFC12, the other two locations use HCFC22. The reason for supplying 3 R/R equipments is that the total refrigerant content of the two installations with CFC12 is 4,850 Kg. and individual store unit charges are as high as 1,600 Kg. The recycling of these large amounts of refrigerant could take over a week and during this time the equipment would not be available. Owing to the type of produce being stored which requires a 24-hour operation, and the need for a constant and controlled temperature, delays in maintenance would not be acceptable. The refrigerating units at the AMB Headquarters (MOKA) consist of units built in 1963/5, 1975/6 and 1985/6. The oldest

batch will be replaced with non-ODS systems. The AMB Management is currently considering options to either replace or retrofit the 1975 batch, while the 1985 batch (also the cold store at the airport) will be retrofitted. The government of Mauritius is therefore anxious to receive technical assistance for transfer of technology and alternatives.

The Recycling Centers will be located in Port Louis and their services will also be made available for the treatment of CFC12 recovered by Mauritius based companies or maintenance centers, not directly included in the Recovery Network.

The equipment needed for the Recovery and Recycling Network includes the following items:

CFC 12 EQUIPMENT TO BE USED BY 70 MAINTENANCE CENTERS

	US\$
- 31 Recovery machines (see notes)	31,000
- 67 x 30 Lb. ERC Refrigerant recovery cylinders with two ports and OFP switch	6,700
- 31 Recovery equipment kits (see notes)	11,000
- 30 Recovery bags	720

CFC 12 EQUIPMENT TO BE USED AT RECYCLING CENTERS

- 5 Recycling Machines	15,000
- 1 MAC Recycling Machine with scale	6,600
- 6 Refrigerant identification kits (see notes)	3,300
- 15 x 100 Lb Cylinders with OFP switch	5,500
- 10 x 500 Lb cylinders with dual ports	10,000
- 4 Recovery equipment Kits	1,430
- 2 x 1,000 Kg. storage cylinders	10,000

MAINTENANCE AND SPARES	5,000
FREIGHT COSTS	5,000
CONTINGENCIES (10%)	11,000
TOTAL:	122,250

NOTES:

Each recovery machine will include a DOT recovery cylinder to act as a buffer tank. This buffer tank is necessary to increase the recovery rate of medium weight and therefore acceptably portable equipment.

Of the 67 recovery cylinders, 62 (2 each) will be distributed among the 31 Recovery Centers. All the remaining cylinders will be used by the Recycling Center or held in reserve for use when large Refrigeration or A/C systems are serviced or retrofitted.

The Recovery Equipment Kits are necessary for a correct and safe usage of the recovery machines. Each kit will include a gauge manifold with hoses, a leak detector, 2 service couplings, a set of service hoses, a thermometer, a weighing scale, piercing pliers, goggles and gloves.

The 30 Refrigerant Recovery Bags are to be used for recovery of CFC from domestic refrigeration.

The MAC recycling machine will be supplied with 2 recovery cylinders

The Refrigeration Identification Kit is of utmost importance to define the degree of contamination in the recovered refrigerant and to avoid the attempted recycling of mixed refrigerants.

Samples will be taken of the recycled refrigerant and the samples will be analyzed for cleanliness under the supervision of the Coordinating Unit, which is the Ministry of the Environment and Quality of Life (MOEQL). The Ministry will also be responsible for monitoring the amount of CFC recycled.

The recycled CFC will be returned, as such, to the Recycling Network at a price that shall be not more than that which will reasonably cover the running costs of the Recycling Center. This price will be monitored by MOEQL. The Recycling Centers will be situated within the installations of one of the principle refrigerant suppliers and the MAC Recovery/Recycling Center will be situated within the installations of one of the principle MAC Service Centers the companies owning the installations will be responsible for the running of the centers. The refrigerant suppliers will be invited to submit their proposals and qualifications to MOEQL which will be responsible for the site selection for the two Centers.

The sites chosen for each Recycling Center will necessarily include protected but properly ventilated areas for the siting of the recycling equipment and for the storage of the recovered and recycled refrigerant. The chosen operators will be supplied with refrigerant containers for the storage of the recycled CFC but, will be expected to possess adequate equipment for transferring the recycled refrigerant to portable cylinders as well as cylinders to secure storage for the CFC unacceptable for recycling. The technicians responsible for the operation of the Recovery Centers must have recognized experience in handling refrigerant. Operational details will be established by MOEQL and this activity will be included in the project implementation workplan.

The quantity of CFC that will not have to be imported anymore, as a result of the recovery and recycling efforts under this project, is estimated as follows:

- 1) 31 recovery machines and 4 recovery/recycling machines will recover an average of 1 Kg of refrigerant per day per machine.
- 2) There are 250 working days per year.
- 3) 90% of the recovered material can be recycled.

Annual recycled CFC would amount to 7.875 Tons.

It should be noted that this figure does not include the amounts of CFC that might be recovered during retrofits to non CFC refrigerants or during scrapping of equipment or that recovered, with or without equipment by technicians not directly included in the project and which will be accepted for recycling by the Center created by the project. Nor does it include the amounts of CFC that would be expected to be saved by the better servicing practices emphasized during the Training Seminars (repairing of leaks, etc.).

3.3 DEMONSTRATION OF RETROFIT TECHNOLOGY

This part is a demonstration activity, meant to provide technical know-how for retrofitting CFC-based refrigeration equipment to non-CFC refrigerants. The selected site for this technology demonstration is the AMB cold store at the airport which has very efficient, compact individual cold rooms for various types of produce, each room being served by two compressors. The latest technology and retrofitting know-how will be provided based on recommendations from the existing compressor manufacturer (Prescold/Copeland) and the refrigerant manufacturers. Although only a small amount of CFC12 (360 kg) will be replaced, the proposed retrofitting offers the ultimate solution to the ODS emission reduction challenge and bring about an accelerated CFC phaseout of CFC. Based on the experience gained and the success of this demonstration unit, AMB will finance the retrofit of the rest of its cold store facilities. This unit will also serve as a technology demonstration model for the rest of the industry in Mauritius as well as for the entire region to follow.

The project will provide the retrofit know-how, necessary materials, equipment and training of key local personnel to retrofit a commercial refrigeration system serving five cold storage rooms. A breakdown of costs is provided below:

New refrigerants	US\$ 15,000
(less use of recovered CFC stock)	(5,000)
New lubricants	4,200
New thermal expansion valves	2,800
Training, installation & flush system, start-up and demonstration tests	3,000
International consultant (2 wks, airfare & DSA)	12,000
Contingencies	4,000
Total:	US\$ 36,000

4. PROJECT COSTS

4.1 Capital Cost

The total project cost is broken down as follows:

Training Consultant	US\$10,000
Training seminars	3,500
Equipment	114,250
Retrofit Technology Transfer & Training (14 days, airfare & DSA)	12,000
Retrofit costs	20,000
Contingency	16,600
TOTAL:	US\$176,350

4.2 Operational Costs

There will be operational savings which will result from the fact that recycled CFCs will replace CFCs which would otherwise have to be purchased. On the other hand, there will be operational costs related to the

- additional labour needed to recover the gases;
- longer time needed to service one vehicle, often resulting in loss of revenues as less cars per day can now be serviced;
- handling and transportation of recovered refrigerant.

It is estimated tha savings will be equal to costs, so that no operational costs/savings are included in the project.

4.3 Unit Abatement Cost

The unit abatement cost is calculated as follows:

a) Incremental capital cost	US\$ 176,350
b) Project economic life	5 Years
c) incremental recurrent cost	-
d) CFC consumption	7,875 kgs
e) Capital recovery factor (5 years)	0,2638
Unit abatement cost (a x e + c) / d = 5.90 US\$/Kg	

5. PROJECT IMPLEMENTATION

5.1 MANAGEMENT

UNDP, in close collaboration with MOEQL, will oversee the successful implementation of this project and will provide technical assistance during project execution.

5.2 SCHEDULE

TASK	TIME FOR COMPLETION			
	Q1	Q2	Q3	Q4
PROCUREMENT				
Liaison with Manufacturers	XXX			
Procurement activities	X	XXX		
Delivery & Customs Clearance			XX	
TRAINING SEMINARS			XX XXX	
RETROFIT & START-UP				
DISTRIBUTION EQUIPMENT			XXX	XXX
RECYCLING ACTIVITIES				XXX
MONITORING SYSTEM				XXX

6. PROJECT IMPACT

The project will result in reduction of about 8 tons/year of CFC-12 and ensure a supply of recycled refrigerant to the domestic market. Better maintenance and repair practices will also lead to a reduction in ODS emission. In addition, the retrofit demonstration will lead to other retrofiting activities within AMB and other commercial refrigeration facilities.

7. ANNEXES

Annex 1: Technical Review

TECHNICAL REVIEW

I have reviewed the Mauritius Project, "Evaluation of Project on National Recovery /Recycling Programme and Demonstration of Commercial Refrigeration Retrofit Technology ", from the Recovery and Recycling sector, based on discussions with UNDP - MPU, the preparers, as well as review of the document.

- 1 Country of Origin Mauritius
- 2 Project Title **Evaluation of Project on National Recovery /Recycling Programme and Demonstration of Commercial Refrigeration Retrofit Technology**
- 3 Sector Recovery and Recycling (with a second component in the Refrigeration Sector as well)
- 4 Relationship to C.P. The project describes the original sectoral consumption and provides updated information which shows that the project is focused on the precise source(s) of the majority of the sectoral ODS use..
- 5 Technology

5a) Technical Soundness

The project addresses the technologies needed for a programme that achieves a good standards in maintenance, recovery, and recycle from both a quality and safety standpoint. It allows for significant extension of the life of existing installations by providing CFC12 for them after the supply becomes limited, while the retrofit technology essentially eliminates the need to consume some of the limited supply as well as extending the life of equipment. It also reduces emissions of CFC12 and provides the infrastructure for further reductions in the quantity of CFC emissions in the future. The recycling/recovery technology is standard and should readily be absorbed, and the retrofit technology is being used with ready acceptance in systems which are used for cold storage.

The added component of maintenance training is needed. It should significantly and safely reduce venting practices as well as the in-between routine leakage from the systems during operation, and should thereby offset accordingly the need for new production of equivalent quantities of CFCs.

5b) Safety

Recovery/Recycling systems can be operated safely. The probable use of pressure/vacuum systems requires adherence to procedures. The procedures should be spelled out clearly and be part of the initial and the ongoing training components. People should be trained before they are permitted to become operators of this

equipment. Periodic retraining is also recommended. Chronic personnel exposure needs to be controlled via equipment design for appropriate exhaust and low emissions.

6 Environmental Impact

The use of appropriate maintenance procedures, combined with the recycling as described in the project, as well as the retrofit to eliminate the actual consumption of CFC, will have a combined positive effect of reducing the operating emissions, as well as the maintenance emissions. The designer of the recycling project used a pareto target to determine the number of systems. It is believed that, with legislation in place, the estimated ODS savings (based upon the locations' historical losses) will most likely be exceeded as the citizens and trained maintenance personnel work together to adjust the locations they use, and thus capture additional material.

7 Project Costs

The cost components identified in the project cover the equipment required, and the training component, which includes "train the trainers" as a key feature to allow cost effective expansion of the training, and eliminate the need for costly international sourced training. The idea of using data from a survey to statistically place about 12 units of the 31 in the field, at key "pay off" points, points to the cost awareness in the project design. Reducing the number of training meetings, or seminars, from the original project design has further improved the cost effectiveness. The safety equipment and gauges in the equipment kits are needed. The use of the recovery bags may not materialize as expected, since the amount generally recovered from domestic systems is small, and transport to the recovery/recyclers may be too difficult for some of the bag owners. However, since the cost is so little, and the legislation may actually cause the use to be achieved nearly as expected, the attempt can be made at a cost of only \$720.

The retrofit portion includes the requisite training so that the installed equipment is modified and purged without damage. The use of the suppliers for a large portion of the training is anticipated in the project expense estimates, and if not employed as expected, the cost of this component could be higher when the project is actually implemented.

8 Implementation Timeframe

The proposed implementation timeframe of 24 months, with the recycle/recovery portion at 12 months, is feasible.

9 Recommendation

The project is sound, needed, and for a demonstration project, has a reasonable level of cost effectiveness. **Approval as proposed is recommended.**

CLINTON NORRIS

10 June 1995