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Higher Council for Environment and Natural Resources
Ministry of Industry

UNIDO

United Nations Industrial Development Organization

REFRIGERANT MANAGEMENT PLAN

Final Report

January 1999

EXECUTIVE SUMMARY

This Refrigerant Management Plan aims at developing a comprehensive and detailed programme to phase-out 200 tons of CFCs used for servicing refrigeration and air-conditioning equipment in Sudan. The current CFC consumption for servicing is 249 tons. The Plan follows the phase-out target set in the Country Programme from 1994.

Sudan ratified the Vienna Convention and the Montreal Protocol in 1993 and operates under the Article 5 of the protocol. The Country Programme was compiled in 1993-4 and approved by the Executive Committee 1994. The Institutional Strengthening Programme has been operational since June 1995. The funding of the Institutional Strengthening Programme will expiry at the end of 1998.

According to the 1994 Country Programme the total ODS consumption was approximately 606 ODP tons, of which approximately 303 tons in the refrigeration and air-conditioning sectors.

The phase-out of ODS has started in the industry. Some 281 and 6 tons of ODS in aerosol and foams industries, respectively, has been phased out. Almost all (7,3 tons of 10) initial charge in the refrigeration is phased out and the remaining phase-out of 2,7 tons is under implementation.

The CFC 12 volumes used for recharging have decreased from approximately 293 tons to approximately 252 tons by the end of 1997. A further phase-out of 2,7 tons will be reached through a small investment project by the end of 1998. Generally, the reduction in the recharge volumes has been reached, not so much by design, but through market (sharp price increases of CFC 12). The 1999 consumption freeze is already reached. Thus the remaining CFC refrigerant consumption, the target volume of this Refrigerant Management Plan, is approximately 249 tons

By compiling this Refrigerant Management Plan the Government wants to present a comprehensive programme to phase out 200 tons (80 %) of 250 tons of CFC refrigerants by the end of the year 2002 leaving out a diminishing amount needed to service the old equipment until it reaches the end of its technical and economical life. The old equipment will be increasingly serviced using recovered and recycled substances. The plan indicates measures and sub-programmes with costs. When approved and funded this plan will serve as a guideline and enable the government to concentrate in effective phase-out measures regarding other ODS like halons and methyl bromide.

The Refrigerant Management Plan has four components:

Training programme on good practices in refrigeration and air-conditioning maintenance

Recovery and recycling of refrigerants

Training of customs officers and development criteria for ODS and ODS consuming equipment import

Phasing-out CFCs at a carbon-dioxide production plant

The total incremental costs of the implementation of the refrigerant management plan are estimated at USD 1,227 million of which the Government of Sudan will finance approximately USD 20,000.

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1. COUNTRY SITUATION

1.1. Status of Sudan with Regard to the Montreal Protocol

Sudan ratified the Vienna Convention and the Montreal Protocol in 1993. Sudan is classified to operate under Article 5 of the Protocol.

1.2. Status of the Country Programme

The Country Programme to phase out Ozone Depleting Substances (ODS) was compiled in 1993-4 and approved by the Executive Committee in 1994. The Country Programme has served as a general guideline for the Government and environmental authorities in developing phase-out actions and measures supporting them.

The Country Programme targeted at accelerated phase-out; CFCs to be eliminated by the end of the year 2007, Annex A/Group 2 substances (halons, 3 ODP tons) by the end of 2007 and Annex B/Group 2 substances (carbon tetrachloride 2,2 ODP tons) by the end of 2005.

Out of the four technical-industrial phase-out projects included in the 1994 Country Programme three (aerosols, initial charge in refrigeration and foams) are implemented or under implementation. The refrigeration and air-condition related training (& recovery/recycling) has not been technically initiated. It may be noted that the 1994 Country Programme did not cover all industrial CFC consuming capacity in detail. Some capacity was not operational, but existing, in 1993-94. Therefore there may be a need to seek support for small industrial phase-out projects in foam and aerosol sectors.

The Action Plan section included in the 1994 approved Country Programme is in annex 1.

Sudan has a Higher Council for Environment and Natural Resources. This body is the highest authority to set policy targets for environmental issues, including the Montreal Protocol, and also oversees the implementation of international conventions. The Council established in 1993 a National Committee for the Implementation the Montreal Protocol as an advisory body, which Committee has representatives from all relevant governmental, academic and industrial/business sectors. The practical, operational unit for ODS issues is the Ozone Office, established in 1994, located at the Ministry of National Industries.

The above described administrative framework operates according the principles set in the approved Country Programme.

1.3. Status of the Institutional Strengthening Project

The Institutional Strengthening Project has been operational since June 1995. The project is implemented through the Ozone Office located in the Ministry of Industry. The Institutional Strengthening Project was originally programmed to run for a period of three years (up to May 1998) but has been extended (without any extra budget) up to the end of 1998. It is likely that some of the funds allocated for the project are still available in 1999, but it seems that the Ozone Office is not able to carry out all tasks related to the implementation of the Refrigerant Management Plan (to last approximately 3 years) unless some funds are allocated for the administration of the RMP. When preparing this document it was assumed that the Institutional Strengthening Project is not extended. Therefore the budget for this RMP includes funds for local consultancy to administer and manage the RMP throughout its duration.

One professional co-ordinator (half-time) and one industry professional (half-time) and two assistant operate the Ozone Office. Furthermore, the office is supplied with normal equipment and consumables. This set-up enables the office to run the normal administrative and co-ordination business, reporting etc. The Office has been successful in preparing, co-ordinating and implementing the industrial phase-out projects. The recent and ongoing activities of the Ozone Office are as follows:

- *maintaining the legal framework related to the Montreal Protocol regulatory and control measures
- *preparation on phase-out projects now under implementation
- *reporting to the Ozone Secretariat, Multilateral Fund and Implementing agencies
- *development of a ODS database
- *promoting awareness on ODS issue
- *preparation of a survey covering halons and methyl bromide
- *collecting background material for training, recovery & recycling programmes

Since 1995 the Ozone Office has prepared and facilitated the implementation of three industrial phase-out projects; Conversion of the local refrigeration manufacturing industry from CFC 12 to 134a (phase-out effect 7,3 ODP tons); Conversion the local flexible foam production from CFC 11 to non-ODS blowing agents (phase-out effect 6 ODP tons); Conversion of the local aerosol production from CFC 11/12/114 to hydrocarbon propellants (phase-out effect 281 ODP tons).

The changing business practices (ODS imports are difficult to track, maintenance business is split in smaller units, second hand equipment is entering into the market) and e.g. fluctuating import volumes are difficulties which the Institutional Strengthening Project and the Ozone Office are facing.

1.4. Current Situation

Refrigerants

According to the Country Programme the ODS consumption (annex A and B substances only) in 1991 was 606,2 ODP tons. The following table indicates the 1997 consumption figures.

Consumption in 1994 Country Programme Consumption figures from 1991			Reported consumption In 1997
Annex-Group	Substance	ODP tons	ODP tons
A-Group I	CFC-11	88,5	26,0
	CFC-12	507,0	280,0
	CFC 114	5,5	
A-Group II	Halon 1211	3,0	1,5
A-Group III	Carbon tetrachloride	2,2	4,3
Total Annex A & B		606,2	311,8
C*	HCFC-22*	*	**
E*	Methyl Bromide*	*	3,5
All ODS			315,3

*) Not inventoried in the Country Programme.

**) HCFC 22 is imported but due to inaccurate customs statistics/classification the figures are not separated from other industrial chemicals. However, the volumes are quite small (in ODP tons).

Out of the current total of 311,8 tons of ODS approximately 252 tons of CFC consumed in the refrigeration sector as follows:

User Sector/Use	Application	Consumption in the Country Programme ODP tons	Consumption in 1997 ODP tons	Remarks
Domestic refrigeration	Initial charge	10,0	(2,7)	*
Domestic and commercial refrigeration	Recharge	234,0	189,0	**
Cold stores and industrial refrigeration	Recharge	52,0	52,0	
Industrial chillers	Recharge	5,0	5,0	
Air-conditioning	Recharge	2,5	3,3	***
Total		303,5	(252,0) 249,3	

*) The phase-out from 10,0 to 2,7 tons is actually reached in 1998 when the conversion project will be finalised. The remaining 2,7 tons will be phased out by projects already initiated.

***)The 1994 Country Programme lumped together the recharge volumes of domestic and commercial units, which are technically very similar to each other and maintained by the small workshops.

***) Includes CFC 11 0,3 - 0,5 ODP tons

The decrease of recharge volumes in domestic and commercial refrigeration is partially because e.g. Pepsi Cola dealers and dealers of one large dairy company have been forced (by the principals) to abandon CFC run units. Partially the decrease might be of temporary nature reflecting business fluctuations. CFC 12 price increase of approximately 50 % may have forced the maintenance companies to economise the refill. The new non-ODS equipment entering in the market is also slightly contributing to the decrease.

Equipment

Regarding the number of refrigeration and air-conditioning units a reference is made to the Country Programme.

Regarding equipment related development since 1994 the following can be noted:

CFC-free, mainly HFC 134a run domestic and small commercial equipment is entering in the market, and start affect marginally on the CFC volumes needed for servicing. However, the servicing requirements of the new equipment are hardly known.

The number of air-conditioning devices is increasing. Old type of small air-conditioning units run on CFC 11 are disappearing. New window type and split units are run on HCFC 22. Old centralised systems are hardly operated any more.

A remarkable part of refrigeration equipment used in cold stores and industry as well as industrial chillers are technically. The equipment leaks and maintenance is difficult. Retrofitting of the larger equipment has been discussed when preparing this document. Regarding almost all the equipment the retrofitting of the refrigeration part of the units should be complemented by retrofitting or totally renewing the non-refrigeration components of the systems. For most businesses this is not technically and economically feasible in the current conditions.

Most of the new vehicles, if delivered with air-conditioning units, are CFC-free.

The retail price of virgin CFC-12 is approximately 4-5 USD/kg, remarkably up since 1994. The sources of supply seem to vary much more than earlier. The price of HFC-134a is not stabilised, but it seems that it is 6-7 times higher than CFC-12 price. The price range is extremely wide depending on volume procured, supply channel etc. The number of importers is not stable.

It can be estimated that some 60 % of CFC consuming equipment is concentrated in the capital area, Khartoum, Khartoum-North and Omdurman. The other geographical concentrations are in Atbara, Qadaref, Obeyed-Kosti, Port Sudan and Wadi Madani areas.

Maintenance

The current maintenance standards of domestic and commercial refrigeration equipment are generally poor. When refilling the equipment actual refrigerant volume used is 2-3 times more than the final charge volume. Maintenance workshops have no leak detectors, the cleaning and flushing of the system is made by the coolant itself.

Larger industrial installations are usually serviced regularly, but commercial difficulties often result in lowering the standards by using non-professional operators.

There is no recovery and recycling activity. All used refrigerants are vented into the atmosphere.

A remarkable part of the equipment is delivered to the maintenance, not because the refrigerant has leaked or run out, but because compressor and electric motor failure, caused by fluctuating electricity supply. Thus the

refrigerant charge is generally recoverable. However, the current substandard maintenance practices result in venting these easily recoverable charges into the atmosphere. This makes the recovery and recycling an attractive business. It should be noted that the refrigerant (to be) covered due to motor burn outs is highly acidic and requires a good standard recycling equipment for processing.

A survey carried out by the Ministry of Industry in 1998 indicates that the Greater Khartoum area (Khartoum, Khartoum-North and Omdurman) has approximately 660 refrigeration and air-conditioning workshops, who employ some 2100 people. Of these employees (including workshop managers), 400 (19 %) have a basic refrigeration and air-conditioning related training. The rest has gained skills on-the-job or in short courses arranged by vocational training centres. It should be noted that the training centres are hardly able to give adequate training because of e.g. almost complete lack of demonstration equipment.

It can be estimated that Sudan has currently approximately 1000 commercially licensed refrigeration service workshops. The total number of technicians working on refrigeration maintenance may be as high as 4000, of whom a remarkable part work as part-timers.

A brief survey made when preparing this document indicated that the workshops rely on rudimentary equipment. Most of the shops miss e.g. vacuum pumps and all tooling is inadequate.

The fact that compressors designed for HFC-134a can (at least temporarily) run on CFC-12 is confusing. There is also a temptation to use HFC-134a (which may in some cases be purchased at a low price) in compressors designed for CFC-12, which will quite immediately lead to a functional failure.

However, most of the workshop managers have idea about the Ozone issues, new non-ODS refrigerants and that their characteristics differ from the old ones. In general there are no preparedness to use new refrigerants.

Training

The Mechanical Engineering Faculty of Sudan University for Science and Technology has a Refrigeration and Air-conditioning Department, training some 30 people annually. The department has training facilities, but the equipment is not modern or functional. The current training covers the non-ODS refrigeration only at a theoretical level. The people who graduate from the faculty hardly work in the practical maintenance business, which is dominated by small, technically rather low standard workshops. A remarkable part of the graduates emigrate (especially in the Gulf area) after graduation.

The Vocational Training Centres located in all major towns have teaching and instruction capacity, but don't generally have demonstration equipment, as mentioned above. The Training Centres in Khartoum, Port Sudan and Wadi Madani are equipped with some basic demonstration equipment. Thus the people participating in refrigeration related courses have to learn the actual skills on-the-job. In the Khartoum Vocational Training Centre some 30 people graduate annually.

In addition to the above mentioned Vocational Training Centres (run under the Ministry of Labour and Social Welfare) there are other refrigeration related training centres (run under different youth welfare schemes) which provide refrigeration related short-term training.

It seems that the refrigeration and air-conditioning related training is attractive and the institutions carrying out the training have no problems to recruit trainees. The envisioned employment opportunities in the sector courage young people to seek formal training.

2. JUSTIFICATION FOR RMP

Sudan has been able to follow the phase-out schedule set in the Country Programme. Sudan has already phased out all CFC use in aerosol sector. Phasing out CFCs in foam production and refrigeration manufacturing will be reached in near future. In general the Refrigerant Management Plan is needed to keep this very positive development going on.

The Government has been avoiding direct intervention. Changing and fluctuating trading patterns and subsequent problems in monitoring and collecting reliable statistics makes the continuation of this policy difficult. It may be said that what can be reached with the non-intervention policy is now reached. The finalisation of the phase-out needs more focusing, both regulatory measures and incentives.

The 1994 Country enumerates e.g. the following actions to be adopted and implemented to reach the phase-out schedule:

*The Government is prepared to consider increased import duties or taxes on the controlled substances in case the planned (reduced) consumption figures are not reached.

*The Government is prepared to introduce bans on foreign manufactured refrigeration and air-conditioning equipment, if the products are obsolete or banned in their home markets due to ODS.

*The Government will be liberal and supportive regarding licences and permits required by manufacturing and service businesses which intend to establish facilities for phasing out ODSs.

*The Government will introduce a licensing system for refrigeration and air conditioning servicing operators in order to enhance better working practices.

*The Government will actively support training and publicity campaigns using the public media, and will encourage the different branches of public administration to co-operate.

*The Government will encourage the participation of voluntary organisations and citizen groups to support the training and awareness campaigns.

The Government is now starting to implement, i.e. to turn the policies into practical measures with the help of this RMP. It is expected that a well-defined management plan and supportive government policy will serve as an indicator for private businesses and large users to refrain from any adverse operations in regard of the phase-out. The representatives of industry and maintenance business contacted think that the phase-out of ODS is a necessity and Sudan cannot lag behind the development in the region.

The envisioned training and recovery & recycling programme is very extensive and provides equipment for one thousand workshops. It is also envisioned that the recovered refrigerant presents a financial incentive for businesses. To make this envisioned system operational an appropriate management and control system is needed. The implementation of the import and consumption related rules, mentioned above, is a necessity.

The measures proposed will enable the Government and refrigeration businesses to continue the phase-out according to the Country Programme avoiding future set-backs and high economic and social costs.

3. ASSISTANCE RECEIVED

The compilation of this Refrigerant Management Plan has been supported by UNIDO, which sent a consultant to work for a short period in Sudan to compile the background information, assess the situation and develop contact with authorities and businesses already involved or to be involved in phase-out actions. The Ozone Office, high executives of the Ministry of Industry, Higher Council for the Environment and Natural Resources as well as private businesses have actively supported the compilation of this Refrigerant Management Plan. The Customs Department has been consulted regarding the control and licensing opportunities. The training department of the Ministry of Labour and Social Security and the Faculty of Mechanical Engineering of the Sudan University for Science and Technology have been instrumental in compiling the training and recovery-recycling project proposals. Some maintenance workshop

owners and CFC dealers have provided valuable practical details. The Sudanese Industries Association has contributed to a seminar arranged for all key players having interest in this Refrigerant Management Plan.

5. COMPONENTS OF THE PHASE OUT STRATEGY

The Multilateral Fund and the Government have supported the phase-out actions in the other sectors than refrigeration. The industrial investment projects have resulted in almost complete phase-out except in the refrigeration maintenance.

The Country Programme defines the phase-out strategy as follows:

The Government of Sudan will focus on achieving an accelerated phase-out with an objective of phasing out ODS consumption in refrigeration and air-conditioning by the end of 2002 leaving out minor amounts of CFC 12 to be used for the maintenance old domestic and commercial equipment, which is reaching the end of its economic and technical life span beyond that date. The recovered and recycled substances will be increasingly used for maintenance.

The regulatory actions to phase-out refrigerants have been and are still almost non-existing, since the government policy is not to interfere in the trade. It seems that the phase-out in the refrigeration maintenance needs some regulatory support, which is developed in the connection of this RMP.

5. ACTION PLAN

Based on the experience gained since the preparation of the Country Programme and on further negotiations and discussions with the Government and businesses, it is proposed that the Refrigerant Management Plan will consist of the following components:

- Training programme for good practices refrigeration
- Recovery and recycling programme
- Training programme for customs officers and development of criteria for ODS and ODS consuming equipment imports.
- Conversion of Carbon Dioxide Co.'s refrigeration system from ODS to non-ODS

Training Programme for Good Practices in Refrigeration

This project aims at training approximately 20-25 local trainers, who will be recruited from the staff of the Sudan University for Science and Technology, Vocational Training Centres and major businesses. The people to be trained as trainers already have a basic training (mainly from the University) in mechanical and electrical engineering and refrigeration thus being able to adopt both the theoretical and practical aspects related to the equipment running both on ODS and ODS-free refrigerants. The training of the trainers will be arranged in Khartoum area, the venue being the Sudan University for Science and Technology. The training of trainers will be arranged in two batches, one for people from the Khartoum area, one from outside. The estimated duration of the trainers training is one week for each group.

The University of Sudan will be provided with up-to-date demonstration and training equipment, which will remain at the University to be used later on for the standard curricula-related training.

The trained trainers will be appointed by the Ozone Office to run the training of approximately one thousand (1000) shop-floor technicians during the two years following the trainers' training. The shop-floor technicians to be trained are recruited from the practical maintenance businesses. The training courses will be arranged in seven (7) locations in Sudan. These training locations will be provided with up-to date equipment and tools enabling the continuation of training after the aforementioned 1000 trainees have passed their courses. The aim is that every regularly working maintenance business will have at least one trained technician/operator after this training exercise is over. The participation in the training will be a mandatory requirement for the extension/renewal of the commercial licence of the maintenance workshops.

The estimated long-term phase-out impact is 150 tons of CFC 12 representing the avoidance of wastage of virgin refrigerant when maintaining and refilling the equipment.

The costs of the training are estimated at USD 259,325. The project proposal is attached as annex 2.

Recovery and Recycling Programme

This project aims at establishing seven (7) recycling centres in the major towns in Sudan and providing 1000 service companies with basic recovery equipment (vacuum pump, recovery cylinders, leak detectors). The estimated phase-out impact is 50 tons of CFC recovered and re-used to service the CFC consuming equipment. The costs of recovery and

recycling are estimated at USD 877,005. The project proposal is attached as annex 3.

Training of Customs Officers

This project aims at training a core team of customs officers in proper recording and detecting of ODS. Refrigerant detecting equipment will be provided. The imports of ODS and ODS containing equipment will be regulated but the measures will be implemented gradually. The development of regulatory system must be in line with the neighbouring countries and implemented in a way causing a minimum social cost. The phase-out impact is mainly indirect, but without doubt, the awareness, that strict regulatory measures exist, will discourage some traders from harmful trading patterns. The cost of this activity are estimated at USD 69,000. The project proposal is attached as annex 3.

Conversion of Carbon Dioxide Co.'s refrigeration system

Carbon Dioxide Co. Ltd. is the main modern CO₂ gas producer in Sudan. The CO₂ production process has two components run on ODS: CO₂ liquefaction system run on R502 (68 % CFC-12) and refrigerated static tank run on CFC- 12. The annual consumption of CFC-12 is approximately 2.0 tons because of systems leaks. The company has produced a technical plan to convert both ODS run components into a system to be run on non-ODS. The total cost of the conversion are estimated at USD 84,000, of which 42,000 USD incremental.

Note

The Institutional Strengthening Project (supported through UNEP IE) will formally expire at the end of 1998. The budgets of the proposed projects in this RMP include project specific preparation and technical assistance. The general preparation, monitoring and reporting input required from the Ministry of Industry and the Ozone Office in not included in the project budgets. It is therefore expected that the Institutional Strengthening Project will be extended and the funds replenished allowing the proper administrative running of the RMP.

Budget

The following table summarises the costs of actions:

Action	Objectives	Total costs USD	Funding		
			MF	Govt of Sudan	Other
1. Training for good practices in refrigeration	Training of 25-30 trainers and 1000 shop-floor technicians	259,325	239,325	20,000	
2. Recovery and recycling of refrigerants	Procurement of recovery and recycling equipment	877,005	877,005		
3. Training of the customs officers	Monitoring of imports and exports, support to regulatory actions	69,000	69,000		
4. Conversion of Carbon Dioxide Co.'s refrigeration system	Phase-out of ODS recharge	84,000	42,000		42,000
	TOTAL	1,289,330	1,227,330	20,000	42,000

Financial support of USD 1,227,330 is sought from the Multilateral Fund. Technical assistance is needed for the initiation and implementation of first three projects. A very short term technical assistance input is envisioned for the industrial conversion project. It may be noted that part of the technical assistance needs can be covered by the local expertise.

The time schedule of the activities, together with the phase-out impact is indicated in chapter 7.

The Government of Sudan will commit herself to the proposed financing schedule. The Carbon Dioxide Co. is committed to finance the non-incremental part of the conversion costs.

6. INSTITUTIONAL FRAMEWORK

The Ozone Office at the Ministry National Industries will implement the Refrigerant Management Plan and its components supported by the National Team for the Implementation of the Montreal Protocol.

The Sudan University for Science and Technology and the Ministry of Labour and Social Welfare will be involved in the training. It is further envisioned that the training can be implemented with initial external technical assistance only.

The monitoring will be carried out by the Ozone Office, supported by the University and Ministry of Labour regarding first two projects and by the Customs Department regarding the third project.

The monitoring and (possible evaluation) of the industrial conversion project will be run according the MF and UNIDO procedure set for these type of projects.

The Higher Council for Environment and Natural Resources will supervise the whole Refrigerant Management Plan implementation activity.

The Multilateral Fund and UNIDO will receive regular reports on the progress and results.

7. IMPACT

As discussed earlier it is expected that the CFC 12 consumption for maintenance purposes will no more increase from the current 247 tons p.a.

The timing and estimated impact of the implementation of the Refrigerant Management Plan and its components are indicated in the following table

Action	Year					
	1998	1999	2000	2001	2002	2003
1. Training for good practices		■	■	■	■	
Estimated phase-out impact Tons of ODP p.a.		12	40	100	150	
2. Recovery and Recycling			■	■	■	
Estimated phase-out impact tons of ODP			10	30	50	
3. Training of customs officers and development of criteria for ODS and ODS consuming equipment imports		■	■	■	■	
Estimated phase-out impact tons of ODP			n/a	N/a	n/a	
4. Conversion of Carbon Dioxide Co.'s refrigeration system		■	■			
Estimated phase-out impact tons of ODP		2				
Total impact, tons of ODP		14	50	130	200	
Remaining CFC refrigerant consumption for service purposes	249	235	199	119	49	

■ Project implementation ■■■■ Monitoring, follow-up, reporting

When implemented the four proposed activities will result in phase-out of 204 ODP tons leaving out a volume of 45 tons, which is needed for service purposes in 2002 and beyond. It is expected that this service tail will be phased out by the end of 2007 by implementing regulatory measures and through scrapping old CFC consuming domestic, commercial and industrial equipment.

The impact of the Training of Customs Officers and development of criteria for ODS and ODS consuming equipment imports (and implementation of the subsequent regulations) is indirect.

The combined cost effectiveness of the four projects will be USD 6,44 per one kg of CFC phased-out.

Annexes

- 1. Country Programme (1994) Action Plan**
- 2. Training for Good Practices in Refrigeration**
- 3. Recovery and Recycling Programme**
- 4. Training of the Customs Officers and Development of Criteria for ODS and ODS Consuming Equipment Imports**
- 5. Conversion of Carbon Dioxide Co.' s Refrigeration System**

Annex 1

Country Programme (1994) Action Plan

3.2. Action Plan

3.2.1. Government Actions

The preparation of this Country Programme, and the forthcoming National Seminar, and the involvement of the main users of ODSs in Sudan, has paved the way for the government's involvement in enhancing the phase-out. Also bearing in mind that Sudan is completely dependent on the imports of ODSs and largely dependent on technologies from industrialised countries, it is believed that supply constraints may achieve the planned reduction in consumption. Therefore the government actions are regarded as complementary. It can be seen that the government's role is vital in implementing the quick phase-out through supporting the projects mentioned later in chapter 3.2.2. The government's actions are also needed to counterbalance some adverse issues that may arise.

*The Government is prepared to ban the use of some new controlled substances (i.e. substances that are not presently consumed in Sudan) which might emerge on the market.

*The Government is prepared to consider increased import duties or taxes on the controlled substances in case the planned (reduced) consumption figures are not reached.

*The Government is prepared to introduce bans on foreign manufactured refrigeration and air-conditioning equipment, if the products are obsolete or banned in their home markets due to ODS.

*The Government will be liberal and supportive regarding licences and permits required by manufacturing and service businesses which intend to establish facilities for phasing out ODSs.

*The Government will introduce a licensing system for refrigeration and air conditioning servicing operators in order to enhance better working practices.

*The Government will actively support training and publicity campaigns using the public media, and will encourage the different branches of public administration to co-operate.

*The Government will encourage the participation of voluntary organisations and citizen groups to support the training and awareness campaigns.

*The Government will draw the attention of international organisations and NGOs to give financial and technical support for the phase-out measures.

*Taking into consideration the limited number of operators in the ODS consuming sector the Government is promoting voluntary agreements, consultations, and actions in all issues that may be in need of redress.

*The Government will carry out a detailed survey on halons with the Civil Defence Administration, and on carbon tetrachloride with some laboratories and research institutes with the aim of finding alternatives.

3.2.2. Projects

Based on survey results, discussions with representatives from industrial associations, and participants of the National Team, the following five projects are proposed to be implemented using the support of the Fund and the concerned implementing agency.

Institutional Strengthening

The government of Sudan has clearly expressed its commitment to the phase-out targets of the Montreal Protocol, aiming to reach reduction and total phase-out of the ODSs earlier than those set in the Protocol for countries operating under the article 5. It is proposed that a specific Ozone Office will be established within the Higher Council of Environment and Natural Resources to enhance the government capacity to follow-up, monitor, prepare possible administrative bans and quotas, taxes, training and awareness campaigns and other measures as expressed in chapter 3.2.1.

*The Ozone Office will cover all industry sectors and all uses of ODSs

*The office will be an operational unit with two professionals and support staff to carry out all the necessary functions needed to enhance the implementation of the Country Programme. The office will be provided with necessary equipment such as computers, copy machines, telephone and telecommunication facilities

*Start date: August 1994

*No specific technical input other than the equipment mentioned above, would be required.

*The benefits of the institutional strengthening project will be difficult to estimate, because the effects will be indirect. However, in terms of improved implementation and by introducing administrative measures and awareness it may be estimated that the institutional strengthening will cut 5 % from the unrestrained forecast consumption of ODSs.

*the incremental costs of the project will be USD 170,000 for the initial period of three years 1994-1996.

*The different ministries, government agencies, Sudanese Industries Association and major private industries as members of the National Team of ODS have been consulted regarding the institutional strengthening.

The government of Sudan will prepare a separate, more detailed document on this issue for the Fund's approval through the UNEP IE/PAC.

Training Programme on Refrigeration and Air-Conditioning

As described earlier, the substandard maintenance practices of cold storage and industrial refrigeration equipment, and especially bad practices of smaller domestic refrigeration and air-conditioning units in small workshops, are a major source of leaks and waste of money regarding ODSs in Sudan. Most of maintenance workshops are members of the Sudanese Industries Association or other wise related to it on commercial grounds. The maintenance operators are aware of the forthcoming constraints with the CFC use and thus motivated to improve practices and the business results. Therefore the following training and certification scheme is proposed:

*Industry Sector: Refrigeration; Sudanese Industries Association, P.O.Box 2565 Khartoum and Ministry of Labour and Social Security/Vocational Training Department.

*An organisation of regional training workshops to train instructors in good maintenance practices. Providing the vocational training centres with appropriate equipment (pressure testing and recovery) to reduce leaks and assess the feasibility of recovery and recycling of ODSs. Introducing a (voluntary) certification system for maintenance workshops and operators.

*Planned starting date: September 1994

*An expert familiar with the maintenance practices similar to those in Sudan (for approx. 2 man-weeks) is required to design the programme and organise equipment procurement in conjunction with the responsible organisation and

governmental agency. As with the technical input the equipment needed will be procured from abroad.

*It can be assumed that on an annual level a reduction of 25 tons of ODP (1995) and a cut of 150 tons (1998) can be reached, representing roughly 8 % and 40 %, respectively, of the total consumption in recharging.

*The total incremental cost of the project in 1994-1996 will be approximately USD 200,000. The breakdown of the costs is assumed as follows:

-preparation of the project	USD 10000
-equipment	USD 120000
-instructors, fees, expenses	USD 30000
-support to the participants	USD 10000
-teaching materials, publicity expenses	USD 30000

The possible savings in the coolants' consumption (approx. USD 50000 p.a. in the year 1995) are not reflected in the costs.

*The Sudanese Industries Association as well as the Ministry of Labour and Social Security/Vocational Training Department has been consulted during the work of the National Team regarding the rationale and practical implementation of the project.

The government will prepare a separate, more detailed project document on this issue through UNEP IE/PAC. Outside expertise may be needed for the preparation of the project document.

Substitution of Butane (LPG) and Finger/Trigger Pumps for CFCs as Propellants in Aerosols Production

Sudan has long had aerosol production facilities both for cosmetic and insecticide aerosols. These production facilities are run on long term technical and commercial co-operation with foreign companies. The existing production facilities represent an essential component in Sudan's industrial infrastructure, and are connected to the local market and consumers through a well-established distribution network. The continuous production capacity is justified.

*Industry Sector: Aerosols; Sudanese Cosmetics & Household Products Ltd, P.O.Box 2304 Khartoum

*Partial replacement of CFCs as aerosol propellant by purified butane and/or by mechanical dispensers.

*Procurement of molecular sieves to purify the butane to be used. Procurement of purified butane from abroad to ensure the odour-free propellant. Procurement of containers/cylinders to transport butane from abroad. Testing the new chemical formulations possibly required by the new

propellant. Training the staff to use the new propellant. Support the company to construct new/modified production facilities taking into consideration the flammability and other properties of butane.

*Planned starting date: 3rd quarter of 1994

*Outside support is needed in the design of the whole transition project, in the design of the new production facilities. The molecular sieves and mechanical dispensers will be required from abroad. Also outside support in training will be needed.

*On the annual level, when the programme has been implemented (1997), the reduction of approx. ODP will be approximately 340 tons.

*Incremental cost USD 600,000, out of which approx. 50 % is needed for relocation of the existing production lines, explosion proof ventilation equipment etc. The costs of redesign and training represent approx. 15 % and the procurement of finger/trigger pumps, cans (or bottles) LPG storage tanks and purification equipment (sieves etc.) the rest. The possible lower price of the CFC replacement (LPG) is not reflected in the incremental cost estimate.

*The company management has been consulted during several negotiations and plant visits, and the proposal has the support of the management.

The government of Sudan will prepare, in association with the company, a more detailed project proposal.

Introduction of New Domestic Refrigerator and Water Cooler Compressors, Suitable for non-CFC Coolants

Sudan has a long history of producing domestic refrigerators, water coolers, and cold storage and air-conditioning equipment in close co-operation with the leading foreign manufacturers. It is important that the know-how and skills gained, as well as the operation and maintenance will be supported by continuous, sustainable domestic production.

*Industry Sector: Refrigeration and Air-Conditioning; (represented by Coldair Engineering Company Ltd, P.O.Box 804 Khartoum)

*Prepare the company to procure and use equipment (compressors and other devices) needed to meet the requirements of non-CFC coolants. Also the retrofitting of the existing larger commercial and industrial units to use alternative coolant will be assessed.

*Planned starting date: 3rd quarter of 1994

*Outside support is needed to procure the new domestic refrigerator and water cooler compressors for experimental purposes from the current suppliers of this equipment, who should also provide the company with the necessary technical expertise. The same also concerns larger condensing units used in cold storage room installations.

*The reduction of ODS reached within a transition period of 4 years will be approx. 4 tons per year for manufactured products. The reduction of ODS used in recharging will actually go beyond the year 2000, depending partially on the rate at which the current equipment will be replaced.

*Incremental costs will consist of the price difference between the old type and the new type of compressors and the current CFC (R12) and the forthcoming non-CFC (R124a) coolant, over a transition period of 5 years, as well as of staff training expenses. The incremental cost will be approx. USD 150,000.

The company has been thoroughly consulted about the project and more detailed data prepared by the company itself is included in the working papers of this Country Programme.

The government of Sudan will prepare, in association with the company, a more detailed project proposal.

Replacing CFC as a Blowing Agent and/or Introducing Alternative Technologies in Flexible Foam Production

Sudan has one major producer of flexible foams which has been operational since the 1960s. It has relatively modern production facilities, buildings, and machinery as well as trained staff. The market for soft foam products is stable. Taking into consideration the relatively low price of the product and high transportation cost it is reasonable to support the local production.

*Industry Sector: Foams; Patra Foam Company, Khartoum/El Bagir

*Supporting the company in replacing CFC as a blowing agent through retrofitting the equipment, testing new blowing agents (not yet defined) etc. to reach acceptable quality level of the products

*Start date: 1st quarter of 1995

*Outside expert support is needed to evaluate the characteristics of the existing equipment and its suitability in using non-CFC-blowing agents. Also some retrofitting equipment and process design expertise is needed. Financial support to compensate for the price differences of CFC and non-CFC blowing agents, and support to compensate for the loss due to (most probably) substandard production in the testing period will be required.

*The benefits will be a gradual phase-out of ODSs of 6 tons in 1995 up to the total phase-out of approx. 28 tons in 1998.

*The incremental cost of the project will be USD 200,000 for the initial period of 1995-1997. An essential part of the costs consist of expert services and lost (non-saleable) production.

*The company management has been consulted on the technical and financial issues, and plant visits have been made.

The government of Sudan, in association with the company, will produce a more detailed project document. Short-term technical expertise support is needed for the project design.

The following are very rough estimates regarding the reduction of the use of the ODS when implementing the projects. The reduction is calculated from the unconstrained consumption estimate.

Project	1995	1996	1997	1998	Substances
Institutional Strengthening	35	37	40	42	All
Training on Refrigeration and Air-Conditioning	25	50	100	150	CFC 12
Aerosols, New Blowing Agents	20	330	340	360	CFC 11, 12, 114
Refrigeration, New Compressors	3	6	8	10	CFC 12
Foam Blowing , New Agents, Technology	6	12	20	25	CFC 11
Total	89	435	508	507	

PROJECT COVER SHEET

COUNTRY:	Sudan
SECTOR COVERED:	Refrigeration Maintenance
PROJECT TITLE:	Training for Good Practices in Refrigeration
PROJECT DURATION:	32 months + 2 months for follow-up
PROJECT IMPACT:	150 ODP tons of CFC
PROPOSED BUDGET:	USD 259,325
INCREMENTAL COST:	USD 259,325
IMPLEMENTING AGENCY:	United Nations Industrial Development Organization
NATIONAL COORDINATING AGENCY:	Ozone Office/Ministry of Industry

PROJECT DESCRIPTION

1. Background

This project will provide technical information and training to service, maintenance and repair personnel in the refrigeration sector in order to reduce ODS consumption during the servicing of refrigeration and air-conditioning units. In order to reach the objectives as identified in the Country Programme Action Plan and Refrigerant Management Plan, professional training for hands-on service, maintenance and repair personnel is essential. The servicing of refrigeration equipment accounts for approximately 250 ODP tons of CFC 12. Therefore, this training project for refrigeration service technicians is critical to the effective ODS phase-out in Sudan since the refrigeration maintenance sub-sector counts practically for all (98 %) Annex A and B consumption in the country after the projects already implemented or being now under implementation are finalised.

The other components to phase out CFCs in refrigeration and air-conditioning are:

*The recovery and recycling project which is designed to start after this training is initiated.

*The training of customs officers and development of criteria to monitor and control (quotas, bans) imports of ODS consuming equipment (new or second-hand)

*The conversion of an industrial refrigeration system from CFCs to non-ODS refrigerants

2. Project Objectives

This project is being proposed to train refrigeration technicians in the country in the proper methods of performing repairs, maintenance and installation of refrigeration and air conditioning equipment to avoid leaks and unnecessary emissions of CFCs. The aim of the project is to improve service and maintenance practices in order to prevent intentional and/or unintentional releases of ODS into the atmosphere, making it possible for refrigeration equipment to operate to the end of its useful life.

The training programme will, in the first stage, train approximately 25-30 trainers, who will then be responsible to act as instructors/trainers to train approximately one thousand (1000) shop floor operators

The training the trainers programme component will include theoretical and hands-on sessions and will cover the following items: Elements of ozone depletion, its effects, and the relation with Montreal Protocol controlled refrigerants; methods for appropriate servicing and maintenance practices for ODS-containing refrigeration equipment, as well as for equipment working with new replacement refrigerants, leak detection; general concepts of refrigerant recovery and recycling; correct handling of refrigerants; government regulations which will affect the refrigeration sector.

It will ensure permanent use of good refrigeration service and maintenance practices for systems using ozone-friendly substances, and the correct handling of new replacement refrigerants. This project will be co-ordinated with the Recovery and Recycling project being proposed along with the Government's Refrigerant Management Plan.

A long-range objective is to enhance the refrigeration related courses at the Sudan University of Science and Technology and at seven (7) Vocational Training Centres.

3. Expected Results and Criteria for Success

It is expected that the following results will be obtained by this project:

*Reduction of ODS consumption due to leaks and poor practices.

*Reduction of ODS consumption by enhancing the introduction of alternative substances and non-ODS equipment

*Training of approximately 25-30 trainers, who will be responsible to train some 1000 refrigeration technicians/operators on good practices, and inclusion of such training as a permanent part of the curriculum of the vocational training centres

*Reduction in the number of repairs of refrigeration equipment and consequently a reduction in CFC releases into the atmosphere.

*Improved maintenance and servicing practices in the refrigeration sector;

*Improved regulatory framework and licensing for the refrigeration maintenance sector which will enforce good maintenance and servicing practices, as well as the recovery of refrigerants.

It is expected that the trained technicians will save approximately 150 tons of the estimated 180 tons of CFC, which is currently vented into the atmosphere.

To be successful a deep commitment from the participating companies is needed. The impact of the training will be supported by a certification system. The Institutional strengthening programme will develop a scheme according to which the issuance of new, and extension/renewal of old workshops' commercial licences will be refused unless there is at least one trained technician among the staff.

4. Target Audience

Sudan has currently approximately 4000 refrigeration and air-conditioning technicians who work in approximately 900 different service companies and workshops. In addition to service companies 5-6 larger industrial users have a refrigeration maintenance staff of their own.

The project aims at training approximately 30 technical teachers (working now at the vocational training centres, at the university, with equipment producers and larger industrial companies) to work as trainers. These trainers already have basic theoretical and technical training related to refrigeration and air-conditioning and also they have some experience from the practical maintenance business. The people to be trained as trainers will be recruited from the Khartoum area (approximately 18-20) and from the major regional towns (Atbara, El Obeyed-Kosti, Port Sudan, Wadi Madani, Qadaref)

After the trainers' training is over the Ozone Office will identify (with the help of businesses and the National Committee) approximately 1000 shop-floor technicians working now in the workshop and train them with the help of the trained trainers.

The technicians left out of the training represent people who are just temporarily in the business, service a very small number of units and thus account for a negligible volume of CFC consumption. It is expected that envisioned certification will force part of the non-participants out of the business.

5. Approach

The project will be in four phases:

Phase Ia: Procurement of demonstration equipment for the Sudan University for Science and Technology to execute the trainers' training.

The proposed demonstration equipment (see the Budget section) is specified in consultations with the representative of the universities to serve both the trainers' training as well as the long term purpose, i.e. inclusion a more comprehensive and up-to-date refrigeration element in the curricula of the University.

The training aids produced e.g. by the UNEP's Ozone Action Programme will be utilised.

Phase Ib: Training of trainers

This phase will be implemented and co-ordinated by the Ozone Office with the local consultants, and the University. This part of the training will include 12-13 training sessions lasting two (2) days each.

During this phase an international consultant/trainer will be appointed to facilitate the inclusion of appropriate technical development, alternative substances, retrofitting etc., in the training curricula.

The training of trainers will be organised in two batches, each lasting one week, number of participants in each course approximately 15. The international consultant/trainer will carry out the practical training in co-operation with the University's staff.

Phase IIa: Procurement of demonstration equipment for seven (7) Vocational Training Centres. The training equipment will be basically the same as that one to be procured for the University (see phase Ia). The equipment will be left at the Centres' use after the technicians' training is over.

Phase IIb: Training of shop-floor technicians

This phase will be implemented in approximately two years time after the trainers' training is finalised and demonstration equipment procured.

The technicians' training will consist of approximately one hundred (100) training courses lasting two days each. The number of participants in each course is approximately 10. Some 60 courses will be arranged in Khartoum area, 40 in the regional towns mentioned above.

The content of the technicians' training should fit to the practical skills and experience of the participants. The training will cover the ODS background, phase-out requirements, existing and envisioned international and national regulations, technical trends, alternative substances and methods. The envisioned national recovery and recycling scheme will be explained. The main part of the training should cover practical aspects of the maintenance like the vacuuming of equipment and recovery of refrigerants (paying specific attention to prevent venting into atmosphere), recharging, detection of leaks etc.

Phase III: Enforcement of certification system

It is expected that the Ozone Office and the National Committee for Implementation of the Montreal Protocol will develop a certification scheme concept (as mentioned above) before the technicians' training starts. This scheme will be explained to the trainees. The Ozone office will enhance some public awareness activities explaining to the general public the benefits of using the services of workshops having trained technicians. Only service businesses whose technicians (at least one person) are trained would be eligible to receive the proposed recovery and recycling equipment.

This phase will require the Ozone Office to produce a progress report on the results of the programme and suggested corrective measures, if applicable.

6. Time Frame

It is expected that the first part of demonstration equipment (for the University) will be procured in August-September 1999 and the training of trainers can take place before the end of 1999. The second part of the demonstration equipment (for seven training centres) will be procured before the end of 1999.

The two day training courses to train approximately 1000 shop-floor operators will start in January 2000 and the activity will last approximately two (2) years being finished at the beginning of 2002.

The inclusion of refrigeration training components in the curricula of the University and Vocational Training Centres will be developed starting from the year 2000.

7. Co-operation Partners

The Training will be arranged using the training facilities available at the Sudan University for Science and Technology and at the Vocational Training Centres. The trainers to be trained and further appointed to train technicians are coming from the University, Vocational Training Centres, from equipment manufacturers and (some of them) from the maintenance businesses.

The active, practical monitoring of the activity will be carried out by the National Committee. The Sudan Industries Association and the local (rather loosely organised) craftsmen union will be informed about the development of the training, its results and certificates issued to draw practical conclusions concerning the business. The Industrial Research and Consulting Centre (IRCC), which operates under the Ministry of Industry, will be involved in the long-term development of the training activity.

The criteria (and regulatory measures) for ODS and ODS containing equipment imports are being developed at the same time as the training activity is carried on. Therefore, the Customs department should be aware of the development regarding training to assess the proper and relevant regulations and their timely implementation.

8. Supporting and Follow-up Actions

The licensing/certification procedure for service companies will be developed jointly by the Ozone Office and the National Committee for the Implementation of the Montreal Protocol within 6 months from the initiation of the training. The content of this licensing is shortly, that a service company must have trained technicians on pay-roll to have a license. To participate in the recovery and recycling programme and to receive the necessary equipment service company's participation in the training is obligatory.

After the training is over the Ozone Office, a national consultant and the representatives of the University and Vocational Training Centres will carry out evaluation and enhance the continuation of the training as a normal activity.

The implementation of the activity, results achieved and conclusions will be reported to UNIDO and MF according to the issued guidelines.

9. Budget

COST ITEM	TOTAL USD
Local arrangements, logistics, recruitment of trainees for 30 months*)	45,000
International consultant (for training trainers) 20 days	7,000
Compensation for local trainers, 200 training days	20,000
Compensation for local trainers, 200 training days	20,000
International consultant, travel, DSA	4,000
Training material for trainers (30+5)	1750
Training material for shop-floor trainees (1000) including translations into Arabic	20,000
Office supplies, photocopying of material	5,000
Compensations for the 7 Vocational Training centres, space rents, facilities for 200 training days **)	20,000
DSA and travel for non-local (recruited from outside of the training centres' locations) 100 people x 2days days USD 50 day	20,000
Demonstration equipment for the university and 7 training centres***)	70,000
Local consultant, monitoring and evaluation of the project, two months*	3,000
Sub-total	235,750
Contingencies 10% of the above	23,575
Total	259,325

*) The monthly rates applied are approximately the same as in the Institutional Strengthening project

***) Contribution from the Government

***) The composition of the demonstration equipment will be as follows:

Vacuum pump, charging machine, recovery machine, recycling machine, 2 leak detectors (electronic and gas driven), 4 recovery cylinders service tools, accessories, spare parts). It is assumed that the equipment presents the basic standard equipment available in the market.

PROJECT COVER SHEET

COUNTRY:	Sudan
SECTOR COVERED:	Refrigeration Maintenance
PROJECT TITLE:	Recovery and Recycling
PROJECT DURATION:	24 months + 6 months for follow-up
PROJECT IMPACT:	50 tons of CFC
PROPOSED BUDGET:	USD 877,005
INCREMENTAL COST:	USD 877,005
IMPLEMENTING AGENCY:	United Nations Industrial Development Organization
NATIONAL COORDINATING AGENCY:	Ozone Office/Ministry of Industry

PROJECT DESCRIPTION

1. Background

This project will provide approximately one thousand small workshops with the basic tools needed in recovering the used refrigerant. Currently all used refrigerants are vented into the atmosphere. The volume of used, recoverable refrigerants is rather high because most of the equipment is delivered to the service because of compressor and electric motor failure. This makes the recovery and recycling an attractive issue.

Sudan is using approximately 250 tons of CFC to service refrigeration and air-conditioning equipment. Out of this volume approximately more than 60 % is vented into the atmosphere due to bad service practices and lacking equipment. Since there is no operational recovery and recycling scheme for technicians the used refrigerant from the equipment is also vented into the atmosphere. The volume of the used refrigerant wasted is estimated at 100 tons. In case the service operators would have proper equipment for recovery and recycling some 50 % (50 tons) of this wasted old refrigerant could be

saved, treated and re-used. The use of recycled CFC will provide an alternative source from imported virgin CFC. It is expected that by securing this volume of refrigerant, the country's demand for imports of CFC will be reduced.

The other refrigerant phase-out components in Sudan are as follows:

- *Conversion of refrigeration production to use non-ODS refrigerants and thus phase-out all initial charge (almost finalised)
- *Training of refrigeration technicians for good practices
- *Training customs officers and development of criteria for ODS and ODS consuming equipment import licensing
- *The conversion of an industrial refrigeration system from CFCs to non-ODS refrigerants

The first action is under implementation.

Training of the technicians is scheduled to start during the first half of 1999. After the training is initiated and distribution of the recovery and recycling equipment to the maintenance companies to be run by trained technicians can be started.

2. Objectives

The project aims at supplying approximately 1000 service companies with basic recovery equipment (vacuum pumps) recovery cylinders and necessary tools. Further seven recovery centres will be established, three in the capital area Khartoum (including Khartoum North and Omdurman) and four in other major cities of the country. These centres will be authorised to collect used refrigerant, treat it and re-sell in the market.

3. Expected Results and Criteria for Success

The following are results expected from this programme:

- *the recovery of refrigerant before retrofitting or dismantling and scrapping operations
- *creation of the necessary infrastructure within the country for the collection, recycling and distribution of all CFC recovered by whatever means
- *encouragement to service workshops and companies to maintain their own systems and/or equipment, whether directly included in this programme or not, to recover CFC during servicing

The implementation of the training programme for good practices in refrigeration is a prerequisite for successful recovery and recycling. The Ozone Office needs to consult (supported by the National Team for Implementation of the Montreal Protocol) the businesses receiving the equipment. The recycling centres should apply reasonable and non-discriminatory policy when receiving and selling back the refrigerant to the workshops.

4. Approach

The quantity of CFC that will not have to be imported in the country (when the training is finalised and basic recovery equipment is on place) is estimated at 50 tons p.a., thanks to the recovery and recycling efforts of this programme, is of economical importance to the country.

Each of the 1000 workshops supplied with recovery machines (vacuum pumps) will recover an average of 55 kg of refrigerant per year, 90 % of the recovered material is recyclable; annual recycled volume is approximately 50 tons.

The location of recycling centres with machines and associated kits will be determined by evaluating the most effective locations with regards to their access to the largest and consistent volumes of CFC-12. Tentatively the location of the machines will be as follows: Three in the capital area (Khartoum) and four other major towns (most likely in Port Sudan, Wadi Madani, Qadaref and Obeyed-Kosti). These locations are the same where the training centres will run training of technicians.

5. Equipment

Recovery

Each one of 1000 workshops participating in the programme would receive a vacuum pump, leak detector, recovery cylinders and associated equipment. Leak detectors actually serve the charging (and reduction of leaks in charging), but it is reasonable to provide this with the other basic equipment and tools.

In order to reasonably recycle CFC recovered from the workshops having basic recovery equipment, seven recycling centres would be established.

Recycling

*recycling machines incorporating an OFP device and with capacity to fill automatically, in one single pass and continuous process a 120 lb. cylinder. Each machine will incorporate an oil separator, filters, (for acid, moisture and particles), automatic purging of non condensable gases, appropriate refrigerant gauge, hoses and a weighing scale;

*refrigerant identification kits to identify mixed refrigerants

* refrigerant cylinders with dual port and OFP device;

* 1000 lb. cylinders with dual port and relief valve;

* vacuum pumps to empty the cylinders;

*leak detectors; and

*maintenance and spare parts for the above.

The actual composition of the recycling equipment should be determined during the initial stage of the training in consultations with the external expert, local trainers and the Ozone Office.

6. Institutional Arrangement

The Ozone Office will co-ordinate the implementation of this programme. The operators of the seven recycling centres will be selected based on consultations. The small workshop owners have an association (loosely organised) which can be used as a practical vehicle to determine the locations of the recycling operators.

The operators of the centres will be obliged to keep records on refrigerants received, treated and re-used or re-traded. Since the centres will be in a monopoly position the Ozone Office will develop some criteria and conditions under which the refrigerants will be received and re-sold.

7. Budget

Units	Recovery and Recycling Equipment	Unit Costs USD	Total Cost USD
	Equipment for the workshops*		
1000	Vacuum pumps	250	250,000
1000	Refrigerant recovery cylinders with two ports	65	65,000
1000	Refrigerant recovery cylinders with two ports and OFP	100	100,000
1000	Recovery equipment kits including leak detectors	300	300,000
	Equipment for the recycling centres		
7	Recycling machines	7,000	49,000
7	Refrigerant identification kits	600	4,200
7	Vacuum pumps to empty the cylinders	250	1,750
7	100 lb. refrigeration cylinders with two ports and OFP	200	1,400
7	1000 lb. refrigerant cylinders with two ports	1,000	7,000
7	Refrigerant recovery cylinders with two ports	65	455
7	Refrigerant recovery cylinders with two ports and OFP	100	700
7	Recovery equipment kits including leak detectors	500	3,500
	Local consultant to develop the organisation and criteria for receiving and selling the CFC at centres		3,000
	Monitoring the activity for 24 months		12,000
	Sub-total		798,005
	Contingencies 10 % of the above		79,000
	Total		877005,00

*) The equipment will be procured in two batches. The first batch, covering some 300 workshops, will serve as a test ground for the distribution and introduction.

All operating costs including transportation of cylinders to and from the recycling centres, maintenance of the equipment that will be supplied under the present programme shall be included in the sale price of the recycled refrigerant.

The Ozone Office shall monitor the programme and ensure that the sale price of the recycled refrigerant is balanced in such a manner that no improper practices will occur.

PROJECT COVER SHEET

COUNTRY: Sudan

SECTORS COVERED: All

PROJECT TITLE: Training of Customs Officers and Development Criteria for ODS and ODS Consuming Equipment Imports

PROJECT DURATION: 18 months

PROJECT IMPACT: n/a

PROPOSED BUDGET: USD 69,000

INCREMENTAL COST: USD 69,000

IMPLEMENTING AGENCY: United Nations Industrial Development Organization

NATIONAL COORDINATING AGENCY: Ozone Office/Ministry of Industry

PROJECT DESCRIPTION

1. Background

The institutional structure within Sudan needs more organised and efficient systems to monitor and control the imports of CFC or CFC-containing equipment in the country. Customs statistics may not be as accurate as need be due to customs officers being untrained in recognising and identifying CFC, and the lack of specific customs codes for CFC and lack of regulations for their control. Sudan has approximately thirteen import/customs stations. Port Sudan accounts for more than 50 % imports volumes.

The Government is thus seeking to train its customs officers to implement more detailed import classification and in recognising ODS and ODS containing equipment to control and ensure that acceptable products are entering the country. The Customs Department and authorities responsible for compilation of statistics will be involved in this training activity to enhance the co-operation between these administrative units. The technical aspects of the training will be concentrated in the Customs laboratory in Port Sudan.

Traditionally, Sudan is not imposing any discriminatory measures on foreign trade. Currently the importation of ODSs is free. Imposing direct measures on ODS imports like punitive taxes, direct bans, permits, licences or quotas may result in unexpected trading patterns, parallel activities and punish the low-income earners through higher prices and non-availability of service. On the other hand, the importation and local production of non-ODS equipment needs incentives, which talks for the restrictions in imports.

To sort out the feasibility of restrictive measures on the imports of ODS and ODS containing equipment, it is proposed that an expert group will be established. This group should analyse the practical possibilities to impose any restrictive measures and their envisioned repercussions on the actual ODS and ODS containing equipment trade.

2. Objectives

This project aims at:

Training Customs officers (inspectors, controllers and customs policemen) to enable them to identify:

- *controlled substances under the Montreal Protocol

- *Imported refrigerators, freezers and other refrigeration equipment using CFC.

Providing CFC-detection equipment for major customs entry points in the country

In addition, this project will allow the Customs Department to create a database on imported ODS.

Developing and imposing clear rules (bans, quotas, licences) to actually restrict ODS and ODS containing equipment imports. The implementation of these activity will be made in a manner and publicly, that supports the training and recovery-recycling projects.

3. Expected results and criteria for success

The implementation of this training project will result in:

- *Development of reliable and valid statistics on national ODS consumption

- *Identification of ODS, ODS-using and ODS-containing equipment and discouraging parallel activities

- *Accurate implementation of restrictive import measures and resulting in decreasing importation volumes

- *Enhancement of the local non-ODS equipment production

- *Feed-back e.g. to the Ozone Office; needs to modify rules and regulations

The expected result is a more efficient control of ODS and ODS using equipment upon entrance to the country and enhancement of the entry of non-ODS in the market.

The successfulness of this activity can be observed indirectly only. The main issue is to create awareness in the trade and business and direct them to seek for new opportunities with non-ODS instead of continued ODS trade. The imported ODS volumes should continue to decrease steadily.

4. Target audience

The technical training will be directed to a core team of some 10 customs officers and foremen. They should come from the Customs Department and different customs entry points in the country and will be in charge of instructing the officers at customs stations.

5. Approach

The technical training will be arranged in one week's period, during which the core team will be familiarised with the following issues:

- *the management and practicalities of the revised Harmonised System

- *the technical recognising of virgin and recycled ODS, ODS mixtures

- *recognising ODS containing equipment

- *use of the equipment necessary for the detection and identification of CFC and CFC mixtures.

Recognising of generally known, irregular, trading patterns will also be discussed.

The UNEP developed "Regulations to control ODS - A Guidebook" and "Monitoring Imports of ODS - A Guidebook" will be used as training aids.

The project may also define and identify import channels, which need a special attention.

One international trainer/expert will be identified to support the core team in using the technical aids but also to elaborate the trade patterns, envisioned irregularities and corrective measures.

The Customs department needs to elaborate the repercussions of imports restrictions. When imposed, restrictive measures should be clear and one should envision the actual effects, among which the increasing of parallel activities should be taken into consideration. Unwise, economically and financially impossible conditions will lead to confusions only. It should be noted that the import duties levied currently mainly have a fiscal purpose.

The Customs department will establish an expert team to sort out suitable criteria. This team should be allowed to hire some outside expertise familiar with the ODS trade in the region. Also the department should actively collect information from the neighbouring countries and participate in the regional ODS and environment related workshops.

6. Time frame

The technical training should take place in August-September 1999. The development of criteria for imports is expected to last approximately one year. The Customs department should be technically ready to impose restrictions at the end of the year 2000.

7. Co-operating partners and their role

The customs department will be involved in the development of the content from the start of the project in order to get its input for specific issues in the training agenda. The involvement of business interests, represented e.g. through the Sudanese Industries Association, is essential. The participation of Government's finance authorities is expected. When developing criteria to restrict imports, the Customs department and the team should monitor the advancement of the training and recovery & recycling projects. That more further and successfully these projects have advanced that more realistic and effective is the imposition of the import restrictions.

8. Supporting and follow-up actions

The National team for the Implementation of the Montreal Protocol will monitor this activity. Since the imposition of restrictions most likely has some policy and fiscal aspects, the Higher Council for Environment and Natural Resources (a ministerial level body) should take a stand on this activity.

9. Project budget

Item	Budget, USD
Technical training	
International expert (travel, DSA, fee) for technical training , two weeks	6,000
Travel, DSA *)	3,000
Local organisation	2,000
CFC identification kits 8 x 600 USD;	4,800
Training material & aids, including translation	4,000
Compensation to trainees (travel, DSA)	5,000
Development of criteria for ODS imports	
International expert/advisor, fee	5,000
International expert, advisor, travel, DSA	3,000
Local travel of the expert team	2,000
International travel (in the region) of the selected members of the expert team to network & contact customs/ODS officers	10,000
Local consultants to support the expert team 12 months	18,000
Sub-total	62,800
Contingencies	6,200
Total	69,000

*) The training will be arranged in Port Sudan (The location of Customs Laboratory; Compensation for participants from the other areas of Sudan.

PROJECT COVER SHEET

COUNTRY: Sudan

SECTORS COVERED: Refrigeration

PROJECT TITLE: Conversion of Carbon Dioxide Co.'s Refrigeration System

PROJECT DURATION: 2 months + 1 month for monitoring and evaluation

PROJECT IMPACT: 2 tons of CFC

PROPOSED BUDGET: USD 84,000

INCREMENTAL COST: USD 42,000

IMPLEMENTING AGENCY: United Nations Industrial Development Organization

NATIONAL COORDINATING AGENCY: Ozone Office/Ministry of Industry

PROJECT DESCRIPTION

1. Background

Carbon Dioxide Co. Ltd is established in 1956. The company is producing carbon dioxide for several industrial purposes, also for making dry ice. The current production is approximately 6 tons of CO₂ per day. The current gas-oil burning facility is installed in 1983. The storage system is recently renovated.

The process has two essential refrigeration components:

- CO₂ liquefaction system using R-502
- Storage system using R-12

The refrigerant charge volume of the systems is quite modest, but due to the age of the system and the necessity to run the process continuously the annual recharge volumes are as high as 1.5 - 2.0 tons.

The company has preliminarily designed a new process to modernise both the CO2 liquefaction and storage system to use non-ODS refrigeration equipment

2. Objectives

This project aims at converting the existing refrigeration system from using ODS refrigerants to non-ODS refrigerants and thus completely eliminate all recharge need. Technically the conversion of the refrigeration systems must be combine with the renewal of the new liquefaction component.

A very essential side effect will be the complete CO2 recovery system to collect all revert gases, thus preventing the release of carbon dioxide into the atmosphere. The CO2 recovery system can be used when emptying, testing and recharging CO2 fire extinguishers, which is also a business of the company.

3. Equipment

The equipment needed consists of two components which both can be procured in packages including all components and installation:

*A new CO2 liquefaction system using non-ODS refrigerants

*A new refrigeration system for the static tank

4. Time frame

The beneficiary company is prepared to start the conversion activity within a few months. The technical conversion (installation and testing) can be carried out in 2 months.

5. Supporting and follow- up actions

As a support action, the Ozone Office should facilitate the procurement of the equipment package and advice the beneficiary regarding the formalities.

As a follow up action, the beneficiary and the Ozone Office will jointly produce a document describing the technical implementation of the project. This document should highlight the issues which are typical for small conversion projects. The document may serve as an example for other envisioned conversion projects. Standard reports will be delivered to UNIDO and Multilateral Fund.

6. Project budget

Item	Budget, USD
Consultancy, specifications for procurement	5,000
Equipment package including installation	78,000
Monitoring/experience report	1,000
Total	84,000