OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

21291

PROJECT COVER

Country/Region:	TANZANIA
Project title:	Phasing out CFCs at MANSOOR DAYA CHEMICALS LIMITED.
Sector Covered:	AEROSOLS
ODS Consumption in this Sector:	In 1993 ODS consumption in the sector was 150 MT of CFC composed of 75 MT of CFC-11 and 75 MT of CFC-12.
Project impact:	Phase-out of 150 MT of CFC-11 and CFC-12 (50/50) used for production of 500,000 cans of aerosols per year.
Project duration:	18 months
Project economic lifetime:	10 years
Total proposed project cost:	US $745,800
Project investment cost:	US $660,000
Incremental Operating Cost: (6 months operational cost)	US $0.00
Implementing Agency's overheads:	US $85,800
Proposed MF financing:	US $745,800
Cost effectiveness:	See Annex C: Unit Abatement cost
Counterpart enterprise:	MANSOOR DAYA CHEMICALS LIMITED DAR-ES-SALAAM, TANZANIA.
Implementing Agency:	UNIDO
Coordinating Ministry:	Ministry of Industry and Trade

PROJECT SUMMARY

Through the implementation of the project 100% of the CFC used as aerosol propellants (75 MT of CFC-11 and 75 MT of CFC-12) in MANSOOR DAYA CHEMICALS LIMITED plant in Dar-es-Salaam, TANZANIA and in all the national territory will be phased out; i.e., 100% of CFCs used in aerosol production in Tanzania will be phased out as the enterprise is the only producer of aerosols in the country.

The chosen alternative propellant is hydrocarbon (butane/propane mixture). The project will include the conversion of the two CFC filling lines to hydrocarbon propellants; the installation of hydrocarbon gas storage and treatment, as well as the necessary system for quality control and the requirements for fire and explosion protection for the operation of the plant.

The consumption of CFCs in MANSOOR DAYA CHEMICALS LIMITED for the production of aerosols amounts to 150 MT per year. The mentioned figures correspond to an average production of aerosols amounting to 500,000 units of 350 ml volume each. If no conversion were to take place, the estimated consumption of CFCs in production of aerosols in Tanzania is estimated at 250 MT per year for the next five years.

BACKGROUND

SECTOR BACKGROUND.

The use of aerosols as one of industry's most modern packaging systems for easy delivery of diverse products needed in modern life, has introduced an important industrial development. Aerosols are used for application of different products such as insecticides, paints, air fresheners, hair sprays, deodorants, hair mousses, shaving lather, medicinal products and products used in the automotive industry and other industrial sectors. The major producer of aerosols in the world is the United States of America; in Europe the main producer is the United Kingdom, followed by Germany. Developing countries do not produce significant quantities of aerosols compared with the level of aerosol production in industrialized countries; nevertheless, they are able to cover the local needs for some needed products at competitive margins. Table No.1 shows the share of manufacture of aerosols during 1992 and 1993 in the main industrialized countries; as well as in some developing countries.

TABLE No.1: AEROSOL PRODUCTION 1992-1993 (MILLIONS UNITS)*

COUNTRY	1992	1993	+/_%
UK	800	935	6
Germany	698	729	4
Belgium	175	172	(2)
Denmark	26	26	1
Finland	14	16	16
Austria	36	37	3
Spain	196	181	(8)
Sweden	14	16	11
France	590	595	1
Greece	20	23	17
Italy	280	285	3
Netherlands	218	260	19
Portugal	26	27	6
Switzerland	35	37	5
Turkey	26	26	1
Europe Total	3,233	3,369	4.2
USA	2,989	2,940	(2)
Australia	142	152	7
Japan	622	635	2
World Total	6,986	7,096	1

* Manufacturing Chemist, January 1995.

In the framework of the National Country Programme for the phase-out of ozone depleting substances in various sectors of the industrial production in Tanzania, special attention was given to the conversion of the existing aerosol industrial facility at MANSOOR DAYA CHEMICAL LIMITED, into a facility which does not use CFCs. The Tanzanian government plans to promote and motivate the industrial development of the country which is considered one of the most need, least Developed Countries in Africa. To achieve the mentioned goal, priorities have been given to promote the development and modernization of these indigenous industries which are in the hands of native population. The national policy is to achieve and sustain the industrialization of the country and to assure the protection and conservation of available

natural resources by introducing modern clean technologies and modernizing those already existing.

The Ministry of Tourism, Natural Resources and Environment of Tanzania has undertaken efforts to eliminate the ozone depleting substances from the current industrial practice and to revise those new technological processes which could be promoted for industrial utilization, and has supported MANSOOR DAYA CHEMICAL Ltd. in its efforts to eliminate CFCs from the aerosol manufacturing process.

The Ministry of Industry and Trade has expressed interest in having the phase-out implemented as an important step towards the industrial development of the country.

The population of Tanzania reached 26,542,000 inhabitants in 1993 and is expected to reach 32,292,000 by the year 2000 and 42,732,000 by the year 2010. The government's policy is to stimulate the role of the private sector in the social and economic development of the country.

To achieve the industrialization goals, the country requires a healthy and educated population. National programmes for improvement of health and education systems are presently under implementation. Malaria is considered the most affecting environmentally-related disease in the country, which is transmitted by the Anopheline mosquitoes. Control of the mosquito population is of major importance. Insufficient sanitation conditions contribute to the rapid propagation of the malaria vector. Liquidation of the Anopheline mosquito has to be the first step for elimination of the disease in the country. Production and distribution of environmentally friendly insecticides were started several years ago by MANSOOR DAYA in Tanzania. The company is the only producer of the easy and safe to use insecticides for distribution in both rural and urban regions in the country. The government is interested in increasing the level of production of insecticides, and supports MANSOOR DAYA's development programme. The company's production covers 60% of the national market. The rest of the national demand is satisfied by cheap imported products of questionable environmentally safe origin.

Tanzania does not produce any CFCs; all utilized CFCs for industrial production are imported.

MANSOOR DAYA'S BACKGROUND

The company is the only producer of insecticides in Tanzania and started their manufacture in the form of aerosols in 1963 working with two small capacity semi-automatic machines. In 1973 a new semi-automatic machine with an output of 3 million cans per year at full capacity operation was purchased and the company started the production of several aerosol products to satisfy the needs of population; among them it is important to mention some

natural insecticides, air fresheners, hair sprays, deodorants etc. A list of the major formulations produced during the past years is shown in Table No. 2.

TABLE No. 2. MAIN PRODUCTS MANUFACTURED BY MANSOOR DAYA

TRADE MARK	TYPE OF PRODUCT
X-PEL	super insecticide spray
X-PEL	super cockroach killer
TROPIC	air freshener
NO-BITE	insect repellent

At the present time the company is producing 500,000 cans/year of different aerosol formulations, mainly insecticides and air fresheners. Today, due to liberalization in the market, most of the cosmetics aerosols are imported and the company has aimed all its efforts at the satisfaction of the requirements of the national demand for insecticides and air fresheners. The mentioned products are manufactured using the mixture CFC-11/12, at the rate of 50% of each product. For the performance of the production programme at the present time CFCs have to be imported - mainly from Europe. After the conversion all ingredients for the production process, such as odorless kerosene, natural pyrethrum and propane-butane, will be purchased from local manufacturers.

MANSOOR DAYA operates mainly with one aerosol line which was supplied by PAMASOL, Switzerland, several years ago and, in addition, two older machines which are put into operation only for the manufacture of small quantities of special products are available for eventual production needs. The above-mentioned machines were supplied by AERATOM company from Switzerland about 30 years ago. AERATOM company no longer exists, and today it is extremely difficult for MANSOOR DAYA to obtain the necessary spare parts on the international market.

The main filling line under operation at MANSOOR DAYA includes the following unitary operations and facilities: can loading table with conveyer system, with product filler and manual placing of the valve, crimper and two gas fillers. The operations indicated below are manually performed: water bath testing, drying, cap placing and case packing.

In addition to the existing filling lines some test equipment is available; such as pressure test gauges, crimp dimension gauges and balances.

The industrial facility operates in one shift of 8 hours during 300 days per year.

The difference between the actual production and the installed capacity is a result of the following:

- Difficulties in obtaining financing for purchase of raw materials, specifically CFCs.

- Since 1991 the purchase of CFC propellants has been difficult.

PROJECT OBJECTIVE

The objective of the project is to completely phase out the use of 150 MT of CFC per year (75 MT of CFC-11 and 75 MT of CFC-12) as aerosol propellants in Tanzania, by converting the production facility at MANSOOR DAYA CHEMICAL LTD., from a CFC utilizing installation to a hydrocarbon based production process in the field of aerosols.

The phasing out of CFCs could reach 250 MT per year in the next 5 years. The total project impact, therefore, will be the phasing out of a minimum of 1500 MT of ODS in the next 7 to 10 years.

PROJECT DESCRIPTION

MANSOOR DAYA CHEMICAL LIMITED is prepared to phase out the use of ODS in the aerosol sector as soon as they obtain the requested technical and financial assistance, the necessary machinery and equipment are installed and the plant staff is trained.

Based on the technical characteristics of the installation, the products manufactured by the company, and the local availability of raw materials, it is suggested to replace CFCs with hydrocarbon aerosol propellants. The mentioned substances are used as the main replacement products for CFCs in the production of aerosols. Among the advantages of hydrocarbon aerosol propellants, the following could be mentioned:

- They have similar spray patterns as CFCs.
- They are very stable in the formulations and in time.
- They do not affect the ozone layer.

One of the main disadvantages of the hydrocarbons is their extreme flammability; this implies the need for special care in handling and storage practices.

At present, the filling of aerosols cans at MANSOOR DAYA is mainly performed on the PAMASOL rotomat equipment. Occasionally some special products are still filled on the AEROTON machines. The production lines in MANSOOR DAYA are not automated. After

the cans are filled, they are tested in a very primitive, manually operated water bath; further all the operations are manual (drying, capping and packing).

For the conversion of the production to LPG, MANSOOR DAYA can use the same machines for product filling, valve insertion and crimping, and then the cans will be sent outside for gas filling with LPG. The gassed cans will come back for water bath testing, capping and packing.

The existing filling room at MANSOOR DAYA could be utilized for the production process after conversion, the presently available machines do not need to be relocated to another area, only their position in the room layout will be modified. See the annexed sketch.

The company has purchased some land and the gas filling process will take place outside the product filling room. For this a special platform will be built as well as the access for the LPG cars and loading process. A protective fence will also be built. All the above-mentioned activities will be carried out by MANSOOR DAYA with the company's resources.

The assistance required through the project is sought for:

A. Procurement of additional gas filling system with external gas house and safety control system.

B. Procurement of gas transfer and LPG purification system.

C. Services for installation and commissioning of the modified facility and training of the personnel.

The major components of the project are the conversion of the filling line and the supply of LPG from the bulk storage tank.

A detailed description of project requirements is as follows:

A. New filling system

A.1 A special hydrocarbon gas filling room complete with ventilation, gas detector system and mounted gas piping system. Special control system is required for the filling line which also acts as a control for the complete gas house. This control system has to be located in a safe area of the factory and close to the production line and to the access door from the factory to the gas house. Included in the control system is also the gas detection read out. The gas detection system is fully interlocked and operates and controls the ventilation and the LPG shut-off valves. See annex A.

A.2 A new separate rotary indexing gassing system is required for the filling line; the required system should include a gassing machine with two propellant filling heads, which should be guarded with primary enclosure for the ventilation system and also act as a mechanical protection. The machine will be installed in the gas house. Estimated capacity up to 50 cans/min, depending on the size of the can. A special system which consists of a primary and secondary ventilation, equipped with a two-speed explosion proof fans should be included.

A.3 New water test bath for the filling line with can drying system. The main characteristics of the system are indicated in Annex A.

A.4 A drying tunnel mounted in conveyor with blower and explosion proof motors.

A.5 A complete conveyor system from filling machine to the gassing room and from there back into the main filling area and the conveyer extension for packing line. Conveyor length is 25m.

A.6 Explosion proof lighting system.

A.7 Supply of some additional fire extinguishers suitable for extinction of LPG. A minimum amount required is 10 items.

B. LPG storage, purification and transfer system to the filling machine.

The refill of the storage tanks will be done by the gas suppliers by tank truck. The tank trucks do have their own pumping system and, therefore, the unloading transfer pump is not required as it will be provided by the gas suppliers to MANSOOR DAYA.

The transfer system required includes:

B.1 Supply of a pneumatic transfer pump which will be combined with the LPG purification system that works with molecular sieve. The length of columns will be two meters with a diameter of 4 inches. The throughput will be of maximum 10 liters per minute and the flow speed of the LPG will be on the tolerable limit of the molecular sieve.

B.2 Provision of the protection system for the protected areas: an LPG tank with 20,000 liters capacity, a pump area with molecular sieve filters and the tanker off loading zone.

The equipment supply for the above will include:

- one electrically driven main deluge pump, capacity 50 litres/sec.;
- one diesel driven stand by deluge pump of the same output;
- one jockey pump to maintain the water pressure in the system. Capacity and head to be decided base on the engineering designs;
- one main deluge valve;
- one compressor for air detection pressurization system;
- one flow providing system;
- one main feed pipe 50 m length; diameter 5 inches;
- pipe work over LPG tank and off loading zone as required based on the designs;
- one spare head plus 3 spares;
- one set of detecting nozzles;
- one set of control and isolating valves;
- one solenoid dump valve;
- two manual dump valves;
- one control panel for electric and diesel pump sets;
- one distribution board for pumphouse power users;
- one set of cables for pumphouse excluding main supplies to pump controllers and control panel.

C. Installation, commissioning and training

For the correct performance of the installation works, commissioning of the plant and on-the-job training of the personnel, the following services will be required:

C.1 One mechanical and one electrical engineer for a period of 20 working days to re-install the aerosol filling equipment, to do all the electrical cabling and connections and to give the necessary training to the local staff.

OTHER REQUIREMENTS

In addition to the above-mentioned equipment and services, the project requires other services, equipment and materials. MANSOOR DAYA agrees to cover the cost of the additional needs as listed below:

- suitable land for gas storage and gas house. Circa 200 square meters.
- concrete platform with roof for placement of the gas house and molecular sieve filters.
- water storage tank for the deluge system.
- pump house for the deluge system.
- electricity main supply to the pump house.

- local consulting engineers to manage the project in the different stages.
- modification of the laboratory to permit the safe work with flammable propellants.

JUSTIFICATION FOR SELECTION OF ALTERNATIVE TECHNOLOGIES

There are different possibilities to replace CFCs as propellants for industrial production of aerosols. Among the existing technological alternatives it is possible to mention:

- Utilization of compressed air or gas;
- Utilization of pressure capsules;
- Utilization of hydrocarbon propellants.

The first two alternatives are not commercially feasible, as these alternatives do not produce good spray systems, and the cost of phasing-out the CFC utilizing those alternatives is very high. In principle those alternatives are based on the introduction of constructive modifications and additions to the cans, valves and crimping systems.

Hydrocarbon aerosol propellants are used more than any other propellant as the main replacement for CFCs. They are readily available, give good spray patterns, and do not affect the ozone layer. MANSOOR DAYA has experimented with compressed gases such as nitrogen and nitrous oxide and the results have been negative. They have concluded that these propellants are not suitable substitutes for their CFC aerosol products.

Based on the above facts and taking into consideration that the required hydrocarbon mixture is available in the country, it was recommended to perform the phasing-out utilizing hydrocarbon propellants.

PROJECT IMPLEMENTATION

The project will be implemented by UNIDO in close cooperation with the Ministry of Tourism, Natural Resources and Environment. Local coordination will be carried out by MANSOOR DAYA.

The project will include supply of some equipment, installation materials, services for installation and commissioning and on-the-job training services of MANSOOR DAYA's staff as indicated above. In order to guarantee a proper transfer in particular of the new aerosol technology using the highly flammable hydrocarbon propellants, the selected contractor is requested to issue an "Operational Safety Statement" for the recommended technological solution.

For the operation of such technology using highly flammable and explosive materials, the authorization for the operation is needed from the related national authority; and the production lines have to be regularly controlled by the responsible local authority; which should be already involved in the stage of engineering of the plant modifications to avoid further difficulties during the construction and commissioning of the plant.

The final equipment specification, the work plan and consequently the "Operational Safety Statement" can only be elaborated after approval of the basic approach for the project implementation by the relevant local authorities.

Any construction work needed to accommodate the equipment for the new aerosol technology using hydrocarbons will have to be carried out by MANSOOR DAYA and the details are not reflected in the project budget. The specification for construction work will be elaborated by the local construction company after project approval and as an outcome of his necessary site inspection.

It is estimated that after 18 months the complete conversion of the factory will have been carried out.

The proposed tentative work plan for the project implementation is as follows:

TIME SCHEDULE.

ACTIVITIES	MONTHS 0 2 4 6 8 10 12 14 16 18
General:	
01. Project approval,receipt of funds.	X
02. Preparation of detailed work plan	X
03. Elaboration of engineering designs and consultation with local authority.	XXX
Civil Construction works	
04. Approval certificate from local authority to start the construction works.	X
05. Building of platform, roof, access and fence.	XXXX
06. Acquisition and installation of LPG storage tank.	XXXX
07. Deluge storage area and tank ready	XX
LPG storage	
08. Negotiations for deluge tank and delivery system	X
09. Purchase of local materials	XX
Gas filling equipment:	
10. Selection of equipment	X
11. Purchase of equipment	XX
12. Installation of equipment and commissioning	XXX
Training	
13. Training of the staff in situ	XX
Certification	
14. Project final report and certification	X

PROJECT COSTS

I. INVESTMENT COSTS

The investment costs will cover incremental capital investment costs for modification of manufacturing facilities, new machinery, materials, testing equipment, training, installation and consultancy services for modifications. Incremental capital investment cost breakdown is shown in Annex A.

Cost of CIF transportation and insurance of provided equipment is included in the budget.

II. INCREMENTAL OPERATING COSTS

In fully converting from CFCs to hydrocarbons, some operating costs will increase while others may decrease. As described below, MANSOOR DAYA will not realize any net incremental operating costs or savings.

The following costs per unit will increase:

- electricity;
- kerosene, US$ 1.50 per Kg.;
- amortization costs, due to the new investment;
- advertizing costs: it is necessary to convince the customers that they are receiving the same dosage and environmentally safe products, mainly when the weight of the same size can will drop almost to half of the usual one produced with CFC 11/12 mixture.

The following costs will certainly decrease:

- LPG cost (60% butane, 40% propane) will be approximately US$1.00 per kg., compared with the cost of CFC mixture which is US$3.00 per kg.

At the present time it is difficult to assure the acceptability of the newly formulated product with LPG by the consumers. The main difference in the finished cans will be that they will be of a lighter weight and the product is flammable. It is obvious that the distributors and the consumers have to be educated about the new type of formulation, otherwise they might not be willing to pay the usual prices because they could believe that the new formulation is a cheap version of the standard product. The light weight of the filled aerosol can is caused by the low density of LPG. As all ingredients for the formulation are locally available, it should be possible to produce at lower cost. The above will happen only when the technological process is perfectly assimilated and the production volume reaches the usual standard level of production in the company. There will be

a slight increase in maintenance cost when the plant converts production to the use of LPGs.

Details of the cost of materials for the production of aerosols with LPG are indicated below.

Comparative cost analysis of aerosols production*

For 405 ml. can

MATERIAL	QUANTITY in Grams.	PRICE	COST
WITH LPG	G/360 ML filled CAN	IN US$	IN US$
Kerosene	56	2.00	0.112
Butane/Propane	153	1.00	0.153
Estimated increase in electricity cost**			0.050
Additional cost for amortization***			0.004
Estimated total cost with LPG			0.319
With CFC 11/12			
CFC 11/12 only	300	3.00	0.90

* The analysis refers only to propellant consumption and costs related to conversion.
** Due to security measures and fire extinction system
** Due to new investment

III. CONTINGENCY FUND

A contingency fund (10% of the total budget) proposed to cover unforeseen expenses which might incur during the project implementation is included in the funding requested of the Multilateral Fund for the Implementation of the Montreal Protocol.

IV. TOTAL COSTS

COST COMPONENT	US$
- Incremental investment cost, see (Annex A: "Equipment Specification and cost breakdown.....	660,000
- The net incremental operating cost(as above).....	NIL
- Executing agency's overhead cost (13% of MP financing costs).....	85,800

- For the complete cost breakdown (Annex B: "Project Budget").

- For the calculation of the unit abatement cost (Annex C:"Unit Abatement Cost").

- Requested funding by the MFMP:..... 745,800

- Contribution of Mansoor Daya to the project is indicated in Annex D.

A N N E X A

INVESTMENT WITH EQUIPMENT SPECIFICATION AND COST BREAKDOWN

Description	Qty	Unit cost US$	Total cost US$
A. FOR THE FILLING LINE			
1.-Hydrocarbon filling room, size 3mx2mx3m high with two doors and roof	1	95,000	95,000
2.-Rotary indexing gassing system with two propellant filling heads	1	70,000	70,000
3.-Automatic water test bath for the filling line with can drying system	1	130,000	130,000
4.-Drying tunnel mounted on drying conveyor with blower and motor	1	20,000	20,000
5.-Complete conveyer system for filling machine, gassing room drying, packing line (25 m.)	1	57,000	57,000
6.-Explosion proof lighting	1 set	5,000	5,000
7.-Fire extinguishers	1 set	3,000	3,000
Sub total			380,000
B. FOR LPG STORAGE AND PURIFICATION			
1.-Purification plant 12 l/min capacity with molecular sieve filter including pneumatic pump fittings and piping	1	45,000	45,000
2.-Gas detection system in bulk storage area		20,000	20,000
3.-Deluge system		115,000	115,000
Sub total			180,000
TOTAL (A+B)			560,000

Tax & customs costs are not included in the price of the machinery and will not be covered by this project.

The following equipment and installation work is not included in the specification and cost breakdown of the budget and is to be provided by MANSOOR DAYA:

	Cost in US$
- Land of 20m X 10m for outside installation of the gas house	40,000
- Construction of platform and roof	50,000
- Water tank and pump house	135,000
- Protecting fence	25,000
TOTAL:	250,000

SPECIFICATIONS FOR THE SELECTED MACHINERY

A. FOR THE FILLING LINE

A.1.- Hydrocarbon filling room, size 1.8m x 2m x 3m, with two doors functioning as pressure relief panels, built-in two speed ventilation gas detection by infrared and catalytic sensors. Pipework with self-closing valve installed, with position device for cans handling under the filling heads including electric panels.

A.2.- Rotary indexing gassing unit with two propellant fillers, 300 ml maximum volume. Two sets of can guiders for two different sizes diameter containers .

A.3.- Automatic waterbath with electronic heating min. 25 KW. Set of can guiders, safety system, automatic temperature control and regulation unit. To be connected to the filling installation and capable to be converted to different container diameters.

A.4.- One drying tunnel mounted on conveyor with blower and motor. Blowing section with 3 slot nuzzlers.

A.5.- Conveyor system consisting of 2 conveyors, each of 8m length, plus 1 conveyor of 5m length and one of 3m length; with two explosion proof motors coupled with variable speed drive.

A.6.- Explosion proof lighting for filling room by strip-lights.

A.7.- Fire extinguishers

B. FOR LPG STORAGE AND PURIFICATION

B.1.- Purification plant with molecular sieve filter with two columns of 12 l per minute capacity with filter on exit side and all required pipes and valves for mounting and operation. Also one pneumatic pump of 15 l/m flow and 15 bars pressure should be included.

B.2.- Gas detection system with five channels and five sensing heads for the bulk storage area.

B.3.- Deluge system comprising of:

- One electrical driven main deluge pump capacity 50 litres per sec;
- One diesel driven stand by deluge pump of same output as main pump;
- One jockey pump to maintain the water pressure;
- One main deluge valve;
- One compressor for air detection;
- One flow providing system;
- One main feed pipe length of 30 meters, diameter 5 inches;
- Pipe work over LPG tanks and off loading zone;
- Two sets of spare heads and six spares;
- One set of control and isolating valves;
- Two solenoid dump valves;
- Two manual dump valves;
- One control panel for electric and diesel pump sets;
- One distribution board for pump house excluding main supplies;
- Two pump controllers and control panel;

A N N E X B

PROJECT BUDGET

Budget line	Description	Duration w/m	Budget US$
	I. CONSULTANCY SERVICES*		
	Consultancy services for design, construction, commissioning, installation, and training of personnel	2.0	40,000
	II. EQUIPMENT		
	Filling line equipment as indicated in annex A.		380,000
	LPG storage and purification as indicated in Annex A		180,000
	III. MISCELLANEOUS		
	Contingency Fund (10% of the costs of all equipment and services)		60,000
Sub total (I+II+III)			660,000
Agency's overheads (13%)			85,800
	TOTAL		745,800

* The above indicated costs include fees, air fare, hotel accommodation costs and subsistence costs during the missions.

NOTES:

Tax and customs duty are not included in the price of the equipment and will not be covered by this project.

A N N E X C

CALCULATION OF UNIT ABATEMENT COST

A	ODS PHASE-OUT		TOTAL PROJECT
A1	Average use of CFC 11	MT	75
A2	ODP of CFC 11		1
A3	ODP-weighted CFC 11 phased out (A1xA2)	MT	75
A4	Average of CFC 12 per year	MT	75
A5	ODP of CFC 12		1
A6	ODP weighted CFC 12 phased out (A4xA5)	MT	75
A7	Average use of CFC 114 per year	MT	0
A8	ODP of CFC 114		1
A9	ODP weighted CFC 114 phased out	MT	0
A10	Total ODP weighted phased out	Mt	150
B	Annualized capital cost		
B1	Total investment cost (model redefinition + production conversion)	US$	745,800
B2	Equipment life	Year	10
B3	Discount rate	%	10
B4	Annualized capital cost (B1x0.1627)	US$	121,342
C	Annual incremental recurrent cost (1/2)	US$	-0-
D	Unit Abatement cost		
D1	Annualized capital cost per Kg ODs phased out (B4/(A10x1000)	$/Kg.	0.809
D2	Annual 1/2 incremental recurring cost per ODS phased out (C/A7x1000)	$/Kg.	
D3	Unit abatement cost (D1+D2)	$/Kg.	0.809

A N N E X D

CONTRIBUTION OF MANSOOR DAYA TO THE PROJECT

	Cost in US$
- Land of 20m X 10m for outside installation of the gas house	40,000
- Construction of platform and roof	50,000
- Water tank and pump house	135,000
- Protecting fence	25,000
TOTAL:	250,000