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PROJECT PROPOSAL: BANGLADESH

This document includes the following project proposal:

•	Conversion to CFC-free Technology in the Manufacture of Aerosol Products at Advanced Chemical Industries Ltd. (ACI)	UNDP

PROJECT COVER SHEET

COUNTRY:	BANGLADESH
PROJECT TITLE:	Conversion to CFC-free Technology in the Manufacture of Aerosol Products at ADVANCED CHEMICAL INDUSTRIES LTD. (ACI)
SECTOR COVERED:	Aerosols
ODS USE IN SECTOR:	123.63 metric tons (1993)
PROJECT IMPACT:	Phase out of 123.63 tons of CFC 11/12 (1993)
PROJECT DURATION:	One Year
PROJECT ECONOMIC LIFE:	10 years
TOTAL PROJECT COST:	Capital cost: US$ 404,800.00 Incremental operating savings: US$(28,488)
PROPOSED MLF FINANCING:	US$ 376,312.00
COST EFFECTIVENESS:	Grant effectiveness - US$ 3.04/kg/yr Unit abatement cost - US$ 0.47/kg/yr
NATIONAL COORDINATING AGENCY:	Ministry of Environment and Forests (MOEF)
IMPLEMENTING AGENCY:	United Nations Development Programme (UNDP)
APPRAISAL DATE:	November 1994

PROJECT SUMMARY

The project will replace the use of CFC-11/CFC-12 by Hydrocarbon Aerosol Propellants (HAPs). The implementation of this project will result in the phase out of 124 metric tons of ODS at ACI and will complete the ODS phase out activity in the aerosol sector in Bangladesh which currently accounts for about 42% of total ODS consumption. The project will cover the related incremental capital costs, including replacement of existing filling machine which is not suitable for hydrocarbon use, a magnetic water bath for testing, some quality control instruments, construction of an open-air filling room, and safety training.

Prepared by: Mr.Geno Nardini, UNDP Aerosol Consultant
Reviewed by: Mr. Harry B. McCain, Technical Reviewer

PROJECT OF THE GOVERNMENT OF BANGLADESH

CONVERSION TO CFC-FREE TECHNOLOGY IN THE MANUFACTURE OF AEROSOL PRODUCTS AT ACI LTD.

1. PROJECT OBJECTIVE

This project will phase out the use of 124 tons of CFC 11/CFC 12 annually in aerosol production by converting to hydrocarbons as aerosol propellant, a commercially viable and environmentally acceptable technology.

2. SECTOR BACKGROUND

There are three major aerosol fillers in Bangladesh: ACI, Reckitt & Coleman ("R & C" - a large consumer products multinational corporation), and Globe (a recent Singapore - Bangladesh joint venture). All three produce aerosol insecticides. Together, they consumed tons of ODS and accounted for about 42% of the total ODS consumption in Bangladesh. Globe started recently and equipped their new plant to fill only HAPs propellant. R & C converted a year or so ago to hydrocarbons.

There is no bulk delivery of LPG in Bangladesh at this time. Since R & C and Globe have only recently started to fill with LPG, it is believed that their LPG is being supplied through portable cylinders, an undesirable situation from the standpoint of safety. This constitutes a serious safety factor, and the feasibility of establishing an LPG bulk delivery system to service the Dhakar and its neighboring areas would be investigated.

3. ENTERPRISE BACKGROUND

Advanced Chemical Industries was ICI of Bangladesh until the British firm liquidated its interests in 1992. Since then, the company has been 100% Bangladeshi-owned. ACI is a major pharmaceutical company; it employs several hundred workers of which 12 are directly involved in aerosol manufacture.

ACI's only brand is "ACI Insect Spray", which has obtained considerable acceptance by local consumers. It is considered the "high quality" product in the marketplace, and sells at a premium over the prices of the competition (approximately 170 taka per can as compared to 130 taka per can offered by the competitors).

The ACI plant is located at Narayanganj, a suburb of Dhaka in an area that is basically residential but mixed with some factories. Hydrocarbons cannot be used in the present aerosol filling locale and the operation will have to be moved to another location. ACI has a very large compound (11.5 acres), with still over 33% not occupied. Technically, the filling operation can be moved to an

empty lot at the back. The actual plot is very spacious, and well ventilated by winds, with a slight downward slope on the property which makes this an ideal place to employ the "open air filling system," where the wind is used to dissipate leaked Hcs. Because it is in a populated area, ACI is not willing to take the risk and has indicated that it will relocate and obtain a similar plot somewhere else. The company accepts that, under the open-air filling system, they will not be able to work during the monsoons, which last for about 30 days per year. This is not onerous considering the additional safety obtained. ACI will cover the cost of a new plot and a factory building.

4. PROJECT DESCRIPTION

Under this project, ACI will phase out the use of CFCs in its aerosol production through substitution by hydrocarbons as aerosol propellant. The project will cover the construction cost of an open-air filling operation area, a space of about 6 by 15 meters and well separated from the main building. It must have a cement floor, be covered with a large (12 meters by 21 meters) roof to avoid the horizontal entrance of rain, and be fenced to protect the aerosol filling machine. Explosion proof lighting must be installed.
The existing pneumatic filling machine should be replaced by a new small automatic pneumatic (and thus explosion proof) straight line filling machine required to use hydrocarbons without any increase in capacity. In addition, a three-tower molecular sieve system for gas purification will also be provided. It must include removable tops and bottoms and a manifold to permit the towers to be used in any order. A stationary gas storage tank (2,000 gallons) for clean propellant must be included. The available option at this moment for dirty propellant storage involves the purchase of about 100 portable cylinders (45 Kg.) and the construction of another small shelter for storage of hydrocarbon cylinders. This structure, to be separated from the open air filling room by at least 5 meters, would also require explosion proof lighting. This is not an attractive option from the standpoint of safety, but is the only possibility in Bangladesh at this time.

For quality and safety control, a magnetic water bath and some quality control instruments are necessary to protect against unacceptable leakage and additional fire fighting equipment must be installed. The project will also provide for safety training to plant personnel.

5. JUSTIFICATION FOR ALTERNATE TECHNOLOGY SELECTION

Hydrocarbon aerosol propellants have been the principal alternatives to CFC-11/CFC-12 employed worldwide. They are approved by the 1991 UNEP Technical Options Report on Aerosols, Sterilants and Miscellaneous Uses and Carbon Tetrachloride.

The Chittagong refinery in Bangladesh currently produces a cut of liquefied hydrocarbon (70% butane, 30% propane) that has an adequate pressure for aerosols. A careful consideration of olefin content is unnecessary when only aerosol insecticides are packaged.

As mentioned earlier, there is no bulk-delivered LPG. Bangladesh Oxygen (the LPG dealer) has been studying this possibility but has not made a decision. This means that aerosol manufacturers must at this time handle a large number of portable cylinders. This is incorrect and dangerous. A future solution to bulk transportation should be found.

6. PROJECT COST

The total project incremental cost of **$ 376.312.00** was calculated as the economic capital cost, inclusive of 10% contingency, less an adjustment of $28,488.00 that is the net present value of the net operational savings of $8,170.00 per year calculated over 4 years.

6.1 Capital Costs

The incremental capital costs are estimated at $404,800.00 covering equipment, construction, and training costs, plus 10% contingency. The detailed calculation is given in Annex I. The existing CFC-filling equipment will be destroyed or dismantled upon project completion. It is expected that any residual scrap value will be offset by the costs of transporting, dismantling and destroying the old equipment.

6.2 Recurring Costs/Savings

The project will result in operational savings as the HC substitute material is about U.S. $1.20 cheaper per kilogram than the CFC 11/CFC 12 it replaces. However, these savings will be largely offset by increased costs, the largest of which is the calculation of the new formulation which must be adjusted to a larger can, and with the active ingredients and perfume adjusted on a volumetric basis to be acceptable to the consumer.

The following is the formula calculation less the high cost of additional insurance coverage (pro-rated over a very small volume), and the slightly higher maintenance cost estimate (spare parts plus down-time) which good manufacturing safety requires with HC propellants.

Cost Per Can Calculation								
	CFC Product				HAPs Product			
Material	%age	Cost Per Gram	Grams Used	Cost Per Can	%age	Cost Per Gram	Grams Used	Cost Per Can
bio allethrin	0.26	0.0800	0.88	0.07	0.51	0.0800	1.55	0.12
permethrin	0.16	0.0200	0.54	0.01	0.32	0.0200	0.95	0.02
perfume	0.50	0.0400	1.70	0.07	0.99	0.0400	2.98	0.12
solvent	14.08	0.0005	46.87	0.02	14.08	0.0005	42.24	0.02
methylene								
chloride	0.00	0.0000		0.00	20.00	0.0012	60.00	0.07
CFC	85.00	0.0020	290.00	0.58	0.00		0.00	
HAPs					64.10	0.0008	192.28	0.15
Total	100.00		340.00	0.75	100.00		300.00	0.51
Can	(211 x 413)			0.25	(211 x 604)			0.30
				1.003				0.809144

While the grams filled decreases from 340 grams to 300 grams with the hydrocarbon propellant, the volume fill increases approximately 75%, which definitely makes necessary the use of a larger and more expensive can. The amount of active ingredients and perfume must be increased, so as to avoid any volumetric dilution of these ingredients, which would result in a less effective product, or a less agreeable aroma. This type of conversion of the basic formulation is in accordance with chapter #3 of the Aerosol Conversion Technology Manual, UNEP 1994 (draft version).

Doing the calculation of the CFC price per can less the hydrocarbon price per can over 300,000 cans per year gives a total savings per year of 58,170

Less increased insurance costs on ACI's very large lot and all plant buildings due to the use and storage of HAPs propellants 40,000

Less increased maintenance costs 10,000

Total operating savings per year $ 8,170, NPV(10%, 4 yrs.) = US$28,488

6.3 PROJECT COST EFFECTIVENESS

a) UNIT ABATEMENT COST

The unit abatement cost is calculated as follows :

Using the formula $A = \frac{C(F) + (OC-OS)}{W}$

Where	C = $ 404,800.00	OC =	$50,000.00
F =	0.1627	OS =	$58,170.00
C(F) =	$ 65,767.86	W =	123.630 m. t.

Doing the calculation, unit abatement cost = $ 0.47/Kg.

b) GRANT EFFECTIVENESS

MLF grant:	US$ 376,312
ODP phaseout:	123,630

Grant effectiveness = $376,312/123,630 = US$ 3.04/kg/yr

7. FINANCING PLAN

The enterprise requests a grant of **US$ 376,312** covering the net incremental costs under the project as calculated under 6.1 and 6.2.

8. PROJECT IMPLEMENTATION

8.1 MANAGEMENT

UNDP will oversee the successful implementation of this project and will provide technical assistance during project execution.

8.2 SCHEDULE

The project can be completed in 2 years:

Task	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	5th Qtr	6th Qtr	7th Qtr	8th Qtr
Purchase filling equipment	XXX							
Do civil works/ construct OAFR		XXXXXXXXXXXXXXXXXX						
Install machine/ finish construction						XXX		
Start up/Testing/ Training							XXX	
Audit								XXX

9. REQUIRED REGULATORY ACTIONS

Once all aerosol manufacturers have had an opportunity to convert, and once the technical expert contracted to do the training had certified that plant personnel are fully trained, the use of CFCs in aerosols in Bangladesh should be prohibited.

10. ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

The substitute propellant, a mixture of butane and propane, does not damage the ozone layer. It does not contribute to acid rain, nor is it carcinogenic, mutagenic, or toxic. This mixture is a volatile organic compound (VOC) that contributes somewhat to ground level contamination. This mixture does have a global warming potential, albeit very low.

Hydrocarbons are extremely flammable, and explosive. The storage of the HC propellants must be accomplished by strict adherence to the National Fire Protection pamphlet # 58 Standard for the Storage and Handling of Liquefied Gases (U. S. A.) or similar; as well as all local pertinent regulations.

The controlling concept for the proper handling of LPG is to minimize the risk of ignition to the vapor. Serious safety plans must be in place in the aerosol filling plant before beginning operations with this propellant.

11. PROJECT IMPACT

11. PROJECT IMPACT

This project will result in the immediate reduction of 123,650 kilograms of CFC 11/CFC 12 usage in the first year. If this company's volume grows as expected, the actual reduction will be greater.

12. ANNEXES

Annex 1: Incremental Capital Costs
Annex 2: Technical Review

ANNEX I: INCREMENTAL CAPITAL COSTS

Item	Amt.	Description	Sub total	Total
1.	1	Automatic Aerosol Filling Machine (straight line pneumatic) including 1 product filler (300 CC. min.), one vacuum crimper (complete with vacuum source), and 2 (300 CC. min.) gassing stations separated from the liquid/crimping stations by at least 3 meters)		$80,000.00
2.	1	Propellant handling system consisting of pneumatic pump, and propellant accumulator (Greer or equivalent)		4,000.00
3.	1	15' (minimum) magnetic rail water bath		25,000.00
4.	1	Molecular sieve purification system consisting of 3 each towers 6" y 10' filled with 13 X molecular sieve pellets, each with filtering media on the top (outlet) side to prevent powder flow through, each with test/purge valve on the outlet, with top and bottom easily removable for loading/unloading of pellets, top mounted pressure gauge, and manifolded to permit using the 3 towers in any order desired		100,000.00
5.	lot	Quality Control Instruments		4,000.00
6.	lot	Shipping		20,000.00
7.	lot	Construct open air filling room		
		- planing land	500.00	
		- 40 square meter concrete floor	4,000.00	
		- anti-spark resin coating	500.00	
		- 185 sq. meters roofing	3,000.00	
		- 30 linear meters cyclone fencing with door	2,500.00	
		- explosion proof lighting	2,000.00	12,500.00
8.		Construct portable cylinder storage area		
		- planing land	500.00	
		- 40 square meter concrete floor	4,000.00	
		- anti-spark resin coating	500.00	
		- 185 sq. meters roofing	3,000.00	

		- 30 linear meters cyclone fencing with door	2,500.00	
		- explosion proof lighting	2,000.00	
		- tank rack for 10 LPG cylinders	2,000.00	
		- all piping	4,000.00	18,500.00
9.	1	Clean gas stationary storage tank (2,000 gallon)		12,000.00
10.	lot	Complete fire fighting system including		
		- sprinkler over stationary tank	3,000.00	
		- emergency water pump	1,000.00	
		- 10,000 gallon emergency water storage	6,000.00	
		- electric and other installation costs	3,000.00	
		- 4 X 12 kg. dry powder fire extinguishers	1,000.00	14,000.00
11.		Alarm & gas detection systems		17,000.00
12.	100	45 kg. LPG cylinders		4,000.00
13.	lot	Transportation and all installation expenses		25,000.00
14.	lot	Safety training/start-up supervision		12,000.00
15.	lot	Pre/post safety audit/commissioning		20,000.00
		Sub Total		368,000.00
16.	lot	10% Contingencies		36,800.00
		TOTAL		$404,800.00

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January 30, 1995

TO : Ms. Lawrence Reno
Mr. Jacques von Engel
UNDP

FAX: 212-477-6619

FROM : Harry B. McCain

1. **Country of origin:** Bangladesh

2. **Project title:** Conversion to CFC-free Technology in the Manufacture of Aerosol Products at ADVANCED CHEMICAL INDUSTRIES LTD. (ACI)

3. **Sector/sub-sector:** Aerosols

4. **Relationship to country programme**

5. **Technology**

(a) Hydrocarbon propellants have long been the preferred substitute for CFCs when used as an aerosol propellant. Hydrocarbon propellants are selected because of their zero ozone depleting potentials. The only environmental shortcoming of the hydrocarbon aerosol propellants (HAPs) is their flammability which can be correctly handled with the appropriate and now well established HAP technology. The U.S.A. has been using HAPs in aerosols instead of CFCs since 1978. In 1994 approximately 2.6 billion aerosol cans were filled with HAPs.

(b) The technology for the use of HAPs as a substitute for CFCs in aerosol products is well established, permanent, and not transitional. There are no transitional technologies that could be used in the aerosol sector that would be appropriate.

(c) It is totally feasible that the HAP technology required for this project can be transferred from Western Europe and the U.S.A. using the free market system.

(i) No technology transfer agreement is required.
(ii) There is no licensing agreement required.

(iii) The reviewer agrees with the determination to use HAPs as a replacement technology for CFCs used as propellants in aerosol products.
(iv) HAP is the most cost effective technology for this conversion.

6. **Environmental impact**

(a) Project will result in the reduction of 123.63 MT of CFC-11/13 (ODS). GWP of HAPs is negligible. Unit abatement cost is $0.47/Kg U.S.
(b) Costs are appropriate.

7. **Project costs**

(a) All cost components identified in the project are essential for the conversion except ***Item 4, Molecular sieve purification system, $140,000.00.*** This cost is approximately $40,000.00 too expensive. 6" by 10' sieves are simply made of 6" Schedule 80 piping. This cost plus the cost of sieve pellets does not justify the $140,000.00 expense. One must ask, "Will there be a system for regeneration of sieves?" This is important in that it will prolong the life of the sieves. If the $140,000.00 includes regeneration of sieves, then the cost of $140,000.00 is appropriate. If not, $100,000.00 should be the cost.
(b) Some cost components should have been expected to be present in the facility prior to conversion. However, in this report, no accurate attempt was made to delineate them. For instance, some liquid filling lines for aerosols could have been updated. The liquid fill apparatus is unaffected by the conversion of CFCs to HC aerosol propellants.
(c) Cost of equipment
  (i) The cost of existing equipment is addressed in a manner that is consistent with the reviewer's experience except for ***7(a) Project costs*** *above.*
  (ii) The reviewer agrees with the finding that all of the base line equipment in the report should be replaced.
  (iii) No additional equipment requests are essential for the conversion.
  (iv) The base line equipment for this conversion cannot be modified to perform functions needed in the conversion, but this concept should be reviewed.
  (v) The fate of scrapped equipment is not properly addressed in a manner which ensures it will not be redeployed.
  (vi) There is no calculation of the salvage value of scrapped equipment.
  (vii) It is not clear from this report what effect this conversion will have on the capacity with new equipment installation at Advanced Chemical Industries Ltd.
(d) Training cost of $8,000 seems appropriate, but the number of persons to be trained was not given.
(e) Operating costs
  (i) The operating costs are appropriate.

(ii) There are no cost savings in this project.

8. **Implementation time frame**

The implementation time frame of one year is inappropriate Two years is more accurate.

9. **Recommendations**

The funding of this project should be done with the understanding that small cylinders (45 Kg) will be used in the production process. This is an unsafe procedure and bulk storage must be instituted in order to supply the gassing area properly. Failure to do so poses a significant safety violation.

OORG/UNDP Technical Reviewer: Harry B. McCain

Date Review Completed: January 30, 1995