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PROJECT PROPOSALS: THAILAND

This document includes the following project proposals which have been grouped by sector. The project proposals are presented in the order indicated below.

Aerosol

- Conversion to CFC-free Technology in the Manufacture of Aerosol Products at Packserv Co. Ltd. — UNDP
- Conversion to CFC-free Technology in the Manufacture of Aerosol Products at Sanit & Sons Co. Ltd. — UNDP

Foam

- Phase out of the use of CFCs in the manufacture of rigid PUR foam for thermoware at Krieng Thavorn Containers Co. Ltd. — UNDP

PROJECT COVER SHEET

COUNTRY:	THAILAND
PROJECT TITLE:	Conversion to CFC-free Technology in the Manufacture of Aerosol Products at PACKSERV CO. LTD.
SECTOR COVERED:	Aerosols
ODS USE IN SECTOR:	500 MT CFCs (1992)
PROJECT IMPACT:	Phase out of 155 MT of CFC-11/113 & TCA per year (1993)
PROJECT DURATION:	Six months
PROJECT ECONOMIC LIFE:	10 Year
TOTAL PROJECT COST:	Capital Cost: US$ 675,255.00 Incremental Operating Cost: Nil
PROPOSED MLF FINANCING:	US$ 675,255.00
COST EFFECTIVENESS:	Grant effectiveness - US$ 4.36/kg Unit abatement cost - US$ 0.71/kg
NATIONAL COORDINATING AGENCY:	Ministry of Industry, Department of Industrial Works (DIW)
IMPLEMENTING AGENCY:	United Nations Development Programme (UNDP)
APPRAISAL DATE :	Nov. 94

PROJECT SUMMARY

PACKSERV CO. LTD. is a 100% Thai-owned private company. It is a contract filler for more than 150 local and 20 major international clients, with no brand product of its own. Under the project, PACKSERV will eliminate the use of 155 MT of CFCs in its manufacturing process by switching completely to the use of hydrocarbons as aerosol propellant. PACKSERV has already invested over US$ 2.0 million in new land and construction of a new factory in order to fill Hcs safely. It is completing the process conversion at the present time (January 1995). The new tank farm, fire protection, gas detection and safety systems have all been installed, and new equipment is on order. This includes two new aerosol filling machines, two water baths, and a safe gassing room. The project will cover incremental capital costs and safety training and formulations/technology transfer.

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

PROJECT OF THE GOVERNMENT OF THAILAND

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

1. PROJECT OBJECTIVE

This project will phase out the use of 155 tons of CFCs annually in aerosol production by converting to hydrocarbons as aerosol propellant, a commercially viable and environmentally acceptable technology.

2. SECTOR BACKGROUND

Thailand imports all CFCs, while hydrocarbons are supplied by Esso, Shell, Unigas, and PTT. All paint and insecticide aerosols are already being filled with hydrocarbon aerosol propellant (HAPs), while the other products are divided between CFC and HAPs. A market study follows:

ANALYSIS OF THE AEROSOL MARKET IN THAILAND

I. 1992 TOTAL AEROSOL SALES WERE APPROXIMATELY 5 MILLION UNITS
II. 1992 ODS USAGE WAS APPROXIMATELY 600 M.T. OF CFC11,12, AND 113
III. THE MARKET MAY BE ANALYZED AS FOLLOWS:

A)	**Household Products**			
	Insectecides	**20.0 MM**	**HC**	
	Room Freshners		**2.7MM**	**Mostly HC (5-10% CFCs)**
	Other Household Products		**0.3MM**	**HC**
B)	**Paints**		**15.0MM**	**HC**
C)	**Personal Care (Hair Spray and Mousse Deodorants, body Sprays and Shave Creams**		**4.0MM**	**Mostly HC (5-10% CFCS)**
D)	**Industrial and automotive Products (Mold Release, Lubricants, Penetrating Oil Contact Cleaners, etc.)**		**3.0MM**	**50% HC** **50% HC**
		Total	**45.0MM**	

INAAC 1994

Major insecticide fillers are: Bayer, Shell, ARS, S.C.Johnson
Major paint fillers are: TOA Paints, Nippon Paints
The three major contract fillers: Sanit & Sons Co. Ltd., Packserv, Inchcape

The Thai aerosol market (1992) is 45,000,000 units and CFC usage in aerosols is believed to be about 600 tons. This is divided between CFC 11 (that is used as a pressure depressant and to add weight to the can), CFC 12 (used as a propellant), and CFC 113 (used in contact cleaner). Most CFC uses in aerosols have been banned, and private industry is converting as quickly as technical and financial resources permit.

3. ENTERPRISE BACKGROUND

PACKSERV, established in 1955 under the name of M.T. Manufacturing Co., is one of the pioneer contract fillers for aerosols in Thailand. It is the largest contract filler for CFCs in aerosols in Thailand (200 metric tons/year in 1992), supplying more than 33% of the market share of CFC based aerosols. PACKSERV does not have its own brands; they package almost all kinds of aerosols for the consumers, and have used CFCs in numerous products.

Packserv's old plant, located in a residential area, had five semi-automatic and manual filling lines. While they had started to fill some products with Hcs there, this could not be done safely. Land was purchased for the HCs project, and at the company's own cost, a new factory has been constructed.

It should be pointed out that some CFC filling will continue until the company can convince all its clients with the right formulations (this project is based on 155 m.t., not 200 m.t. total).

4. PROJECT DESCRIPTION

Under the project, PACKSERV will eliminate the use of about 155 tons of CFCs in its aerosol production through substitution by hydrocarbons as aerosol propellant. PACKSERV has purchased three automatic filling machines to replace the old machines. Three new machines are needed since industrial products cannot be filled on the same equipment as cosmetics. In addition, the Thai Food and Drug Administration does not permit filling anything else on a line used for insecticides. The two lines purchased for this purpose - industrial products and cosmetics - are covered in this project. The actual home-made manual machines leak too much and are not suitable to use with HCs. The third machine - for insecticides - is not being claimed, because this product has always been filled with hydrocarbons.

The project will provide each production line with a leak test tank to control leakage problem in a 100 % check and two water baths are required for this purpose. All the machinery will be pneumatic

system (not electric) and the equipment to be located in dangerous areas must be of an explosion proof type. An outside gassing room is still to be constructed based on a design to be supplied by TERCO (a U.S. supplier). Extinguishers, sprinklers, fire hoses, gas detector and an automatic shut off system will be installed as standard in all filling areas. Laboratory and test equipment are required to control the quality of propellant and to test new formulations.

Training for safety and production by an external consultant will be provided to assist PACKSERV in its technology conversion, including formulation assistance to assure maximum conversion from CFCs to HCs.

5. JUSTIFICATION FOR ALTERNATE TECHNOLOGY SELECTION

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

Aerosol grade hydrocarbon propellant (HAPs) is not available in Thailand, but the LPG that is available can be cleaned with molecular sieves for use with most products is a gas is available to lower the pressure (imported DME or n butane).

6. PROJECT COST

6.1 CAPITAL COSTS

The project incremental capital cost is $697,100.00, plus 5% contingency, for a total of $731,955.00, which in this case is the same as the economic capital cost (see "recurring costs/savings" below). The following details the project costs:

Item	Amt.	Description	Cost
1	2	Two Terco automatic aerosol filling machines	330,000.00
2	2	Terco water test baths	105,000.00
3	4	Propellant pumps	10,900.00
4	1	9,000 liter storage tank	7,400.00
5	lot	Piping	16,700.00
6	lot	Lighting, ventilation, and other explosion proof equipment	40,000.00
7	lot	Shut off safety valves	6,000.00
8	lot	Fire control, pump, and sprinkler system[1/]	10,000.00
9	lot	Gas detectors, warning and shut off systems	19,500.00
10	lot	Construct gassing room, lighting, ventilation	30,000.00
11	lot	Fire alarm control panel system	8,000.00
12	3	Sets quality control gauges (crimp diameter and depth, vacuum, pressure)	9,600.00
13	15	Column molecular sieve purification system	30,000.00
14	lot	Safety training, monitoring, safety audits	14,000.00
15	lot	Technology transfer - aerosols formulations assistance	8,000.00
		SUB TOTAL	643,100
16		+ 5% Contingencies	32,155
		TOTAL	675,255

Note: Items #1, 2, 14, 15 and 16 have not been carried out and are pending at this moment.

[1/]The cost of construction of reservoir, at about $40,000, is not included.

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 dismantling and destroying the old equipment, including transportation cost.

6.2 OPERATING COSTS/SAVINGS

There is a slight increase in maintenance cost when using HCs, and an increase in insurance costs. PACKSERV is a contract filler and

will not receive any savings. The marketers consider HC aerosols to be of inferior quality due to their flammability and their light weight. Currently some customers are willing to purchase the "inexpensive product" with hydrocarbon, and live with the flammability problem. Others willingly pay a higher price for a "quality" product with CFC. No one will pay CFC prices for hydrocarbons. There can be no tricks or confusion - CFC products are much heavier than HC products and the difference can be detected by "feel" without instruments.

For a contract filler savings will be negligible. PACKSERV charges for CFC when they fill CFC and charges for HC when they fill HC. Packserv is willing to absorb the extra costs caused by increased maintenance labor and insurance. Thus operating costs/operating savings are considered equal ($0.00) for this project. Because of its high CFC consumption, PACKSERV is able to get excellent prices for CFCs from the different suppliers. It should be noted that by changing to LPG, PACKSERV will lose some income. LPG is sold by companies such as Esso and Shell that will not give appreciable discounts, such as could be obtained with CFCs. A contract filler charges for the gas used - at CFC price for CFCs and at HC price for HCs. Usually (not always), however, the volume discount remains with the contract filler. Since PACKSERV cannot make a good estimate for the amount of this loss, it is not claiming it, but it is a real loss of income nonetheless.

6.3 UNIT ABATEMENT COST

The unit abatement cost of the PACKSERV project are calculated as follows:

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

Where C = $ 675,255.00 OC = 0
C (F) = $ 109,920.73 OS = 0
F = 0.1627 W = 155,000 Kgs.

Doing the calculation, unit abatement cost = $ 0.71 / kg.

7. FINANCING PLAN

The enterprise requests a grant covering the total incremental cost of US$ 675,255.00 as calculated under 6.1 and 6.2 above.

8. PROJECT IMPLEMENTATION

The project implementation is more than 90% completed. The remaining activities involve equipment delivery and installation, safety training and audit, and technical assistance in production and formulations. These could be completed within the next 6 months. UNDP, in close consultation with DIW, will oversee the successful completion of this project.

9. REQUIRED REGULATORY ACTIONS

Many people believe that all aerosols damage the ozone layer. It will benefit the Thai aerosol industry as a whole to assure the public that Thai aerosols do not contain substances that damage the ozone layer. Once all aerosol manufacturers have had an opportunity to convert, the use of CFC in aerosols in Thailand 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, not is it carcinogenic, mutagenic, or toxic. The butane/propane mix does not pollute the soil or ground water. 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 hydrocarbon propellants must be accomplished by strict adherence to the U.S. National Fire Protection pamphlet # 58 Standard for the Storage and Handling of Liquefied Gases, as well as all applicable local regulations.

11. PROJECT IMPACT

This project will result in the immediate reduction of 155 tons of CFC usage in the first year, and more if PACKSERV's growth expectations are met.

Annex 1: Technical Review

AEROPRES
CORPORATION

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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:** Thailand

2. **Project title:** Conversion to CFC-free Technology in the Manufacture of Aerosol Products at PACKSERV CO. LTD.

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 155 MT of CFC/113 and TCA/year (ODS). GWP of HAPs is negligible. Unit abatement cost is $0.767/Kg U.S. ODP.
(b) Costs are appropriate to minimize health, safety and other environmental impacts.

7. **Project costs**

(a) All cost components identified in the project are essential for the conversion from CFCs to hydrocarbon aerosol propellants.
(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.
  (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 PACKSERV CO. 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 with this project. However, the argument that CFC filled products are conceived to be "better" because they are heavier than HC filled aerosols is not a valid argument, once all aerosol products are filled with HC.
  (iii) N/A

(e) Operating costs

(i) The operating costs are appropriate.

(ii) There are no cost savings with this project. However, the argument that CFC filled products are conceived to be "better" because they are heavier than HC filled aerosols is not a valid argument, once all aerosol products are filled with HC.

(iii) N/A

8. **Implementation time frame**

The implementation time frame of six months is not realistic. One year is more accurate.

9. **Recommendations**

As stated in the last paragraph of **3. ENTERPRISE BACKGROUND** of Mr. Nardini's project report on PACKSERV, "It should be pointed out that some CFC filling will continue until....", one should quantitate how long this time frame will be for the continued filling with CFCs. One should not allow funding for HC if one has no guarantee as to when CFC filling will be discontinued.

OORG/UNDP Technical Reviewer: Harry B. McCain

Date Review Completed: January 30, 1995

PROJECT COVER SHEET

COUNTRY:	THAILAND
PROJECT TITLE:	Conversion to CFC-free Technology in the Manufacture of Aerosol Products at Sanit & Sons Co. Ltd.
SECTOR COVERED:	Aerosols
ODS USE IN SECTOR:	600 MT of CFC-11, CFC-12 and CFC-113 (1992)
PROJECT IMPACT:	Phaseout of 194 MT CFCs per year (1994)
PROJECT DURATION:	18 months
PROJECT ECONOMIC LIFE:	10 years
TOTAL PROJECT COST:	US$670,120 Incremental Capital Cost
PROPOSED MLF FINANCING:	US$ 670,120.00
COST EFFECTIVENESS:	Grant Effectiveness - US$ 3.45/kg/yr Unit Abatement Cost - US$ 0.56/kg/yr
NATIONAL COORDINATING BODY:	Department of Industrial Works (DIW) Ministry of Industry
IMPLEMENTING AGENCY:	United Nations Development Programme
APPRAISAL DATE:	Nov. 1994 ; May 1995

PROJECT SUMMARY

SANIT & Sons Co. LTD. is a family-run Thai-owned aerosol contract filler enterprise in operation for some 24 years. Four years ago, SANIT has been progressively converting to hydrocarbons filling. The plant layout is not suitable for HC use and the plant has become congested. It is operating under very unsafe and dangerous conditions which are now hindering further progress in conversion. The project will adress the equipment needs to fill hydrocarbons properly and safely, including two aerosol filling machines, two water baths and a modular safe gassing room, and the relocation of the existing tank farm to a more suitable area. Major plant modifications will be necessary, as well as installation of a few fire protection system. Technical assistance in formulations and safety training will also be provided.

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

PROJECT OF THE GOVERNMENT OF THAILAND

Conversion to CFC-free Technology in the Manufacture of Aerosol Products at Sanit & Sons Co. Ltd.

1. PROJECT OBJECTIVE

This project will eliminate the use of 195 MT of CFCs annually by completing the conversion of Sanit's facilities to allow the safe use of HC propellants.

2. SECTOR BACKGROUND

Thailand imports all CFCs, while hydrocarbons are supplied by Esso, Shell, Unigas, and PTT. Almost all paint and insecticide aerosols are already being filled with hydrocarbon aerosol propellant (HCs), while the other products are divided between CFC and HCs. A market study follows:

ANALYSIS OF THE AEROSOL MARKET IN THAILAND

I. 1992 TOTAL AEROSOL SALES WERE APPROXIMATELY 45,000,000 UNITS.

II. 1992 ODS USAGE WAS APPROXIMATELY 600 M. T. OF CFC 11, 12, AND 113

III. THE MARKET MAY BE ANALYZED AS FOLLOWS:

A):	Household Products		
	Insecticides	20.0 MM	HC
	Room Fresheners	2.7 MM	Mostly HC (5-10% CFCs)
	Other Household Products	0.3 MM	HC
B).	Paints	15.0 MM	HC
C).	Personal Care (Hair Spray and Mousse, Deodorants, Body Sprays and Shave Creams)	4.0 MM	Mostly HC (5-10% CFCs)
D).	Industrial and Automotive Products (Mold Release, Lubricants, Penetrating Oil, Contact Cleaners, etc.)	3.0 MM	50% HC 50% CFC
	Total	45.0 MM	

INAAC

1994

Major insecticide fillers are: **Bayer, Shell, ARS, S. C. Johnson**

Major paint fillers are: **TOA Paints, Nippon Paints**

The three major contract fillers: **Sanit & Sons Co. Ltd., Packserve, Inchcape**

The Thai aerosol market was about 45,000,000 units in 1992 and CFC usage in aerosols is believed to be about 600 tons, significantly more than was identified in the Country Program. This is divided between CFC 11 (that is used as a pressure depressant and to add weight to the can), CFC 12 (used as a propellant), and CFC 113 (used in contact cleaner). Most CFC uses in aerosols have been banned, and private industry is converting as quickly as technical and financial resources permit.

3. ENTERPRISE BACKGROUND

Sanit & Sons, one of the oldest fillers of aerosols in Thailand, was started 24 years ago. Currently they fill 200-300 different products for over 100 clients using both CFCs and hydrocarbon propellants. CFC consumed in 1994 was 195 tons. Major clients include such international companies as S. C. Johnson & Co. and Bayer, as well as many local Thai companies. Sanit has over 80 workers and employees and is 100% Thai-owned. It is principally a contract filler for household products, air fresheners, personal care and industrial and automotive products. While Sanit has successfully converted some product filling with HCs, the line for contact cleaner and video head cleaner will still be CFC-filled as proper alternative formulations are not known. The existing plant conditions are unsafe for HCs filling.

4. PROJECT DESCRIPTION

Under this project, SANIT will complete the phase out of the use of CFCs in its aerosol filling operation by using hydrocarbons as propellant. The project will address five major areas.

First, equipment for hydrocarbon filling. Two pneumatic aerosol filling lines are needed, along with a safe room for filling the hydrocarbon propellant. Each line must have its water bath to

test the finished aerosol can. The enterprise actually has four filling lines, but one is dedicated to filling refrigerant cans which is outside the scope of this project. The three remaining lines are said to produce about 750,000 cans monthly, on a one shift basis, or about 75 cans per minute (cpm) effective production. Two of these would be replaced by two small pneumatic lines of about 20-30 cpm each, the same speed as the old lines. No upgrade of technology exists, and no increase in capacity. Two lines will be destroyed and one of the old lines would be used part time for the remaining CFC filling. The scrap value of about 1000 kg. of mixed metals represented by the two old lines destroyed will not cover the cost of dismantling and destroying it, and then transporting the scrap. The two existing water baths are unusable and irreparable for use with HCs, although they can still be used for CFC filling - and must thus be replaced. Both new lines would transport the cans outside, where they would be gassed in one modular safe gassing room.

Second, it was necessary to make some plant modifications to be able to fill aerosols at the plant safely. These changes are mainly structural - taking out some walls and putting in others, repairing floors, etc. and are entirely related to safety. New explosion proof lighting will be installed in all plant areas. A gas detection system (independent of the gas detectors in the safe gassing modular room) with 7-8 detectors will be installed for the plant, tank farm, and warehouse. Ventilation will be installed in the filling areas and the finished aerosols warehouse. Anti-spark flooring will be installed in the finished good warehouse.

Third, the tank farm will be moved and completely re-done - it is very unsafe as is, and the addition or the two new tanks make moving mandatory under existing regulations. Two new 5,000 liter propellant tanks will be purchased to cover the increase in HAPs usage - one will be used for DME and one for n butane. Both of these gases are used to lower the pressure of Thailand's LPG, which is actually at the 70-90 psig. (21 degrees C), far too high to allow the conversion of many pro-ducts. These tanks and the existing ones which will be moved) will be fenced and a proper driveway will allow the delivery truck for HAPs to approach the tank farm. All new piping will be installed.

Fourth, a fire control (fire fighting) system will be installed. A water reservoir will be constructed and a fire fighting system established with a high pressure pump, hydrants, hoses etc. More fire extinguishers will be purchased.

Fifth, technical services will include quality gauges for testing, a foreign safety specialist for training the plant personnel and on-going safety audits, and a specialist for formulations assistance.

5. JUSTIFICATION FOR ALTERNATE TECHNOLOGY SELECTION

Hydrocarbon aerosol propellants have been the principal alternatives to CFC 12 and CFC 11/12 blends employed worldwide. They are approved by the 1991 UNEP Technical Options Report on Aerosols. Sterilants and Miscellaneous Uses and Carbon Tetrachloride. At this time they are the only acceptable alternate for substituting CFCs as aerosol propellants.

Aerosol grade hydrocarbon propellant (HAPs) is not available in Thailand, but the LPG that is available can be cleaned with molecular sieves for use with most products is available to lower the pressure (imported DME or n butane).

6. PROJECT COST

6.1 CAPITAL COST

The total project incremental cost is $ 609,200.00 plus 10% contingency; as indicated:

No.	Quant.	Description	Cost
1	2	Automatic aerosol filling machines	$172,000.00
2	1	Explosion proof modular gassing room	160,000.00
3	2	Water baths for testing	70,000.00
4	lot	Piping	20,000.00
5	lot	Reposition existing gas tanks and molecular sieves - construct additional molecular sieve columns for increased volume	32,000.00
6	2	New 5,000 gas tanks, fence tank farm - construct driveway	32,000.00
7	lot	Plant modifications - Move walls, repair and anti-spark coat floors, ventilation for warehouse, etc.	40,000.00
8	lot	Explosion proof lighting in plant areas	8,000.00
9	lot	Gas detection system, 7-8 detectors	12,000.00
10	lot	Reservoir, fire control, pump, and sprinkler system	38,000.00
11	1	Set of Quality Control Gauges (crimp height, crimp diameter, pressure, vacuum, etc.	3,200.00
12	lot	Formulation assistance (1 trip)	8,000.00
13	lot	Plant Safety Training, monitoring, safety audits	14,000.00
		Sub Total	609,200.00
		10% Contingency	60,920.00
		SUB TOTAL	$670,120.00

No 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 dismantling and destroying the old equipment, including transportation cost.

The enterprise requests that it should be taken into account that they have already convinced clients to switch away from CFCs to protect the ozone layer; and in order to continue with this technology conversion, they are investing in a new building in order to build a plant that is safe for use of hydrocarbons.

6.2 Operating Costs/Savings:

There is a slight increase in maintenance cost when using HCs; and also an increase in insurance costs. Sanit are contract fillers - they receive no savings. The marketers consider HC aerosols to be of inferior quality due to their flammability and their light weight. Currently some customers are willing to purchase the "inexpensive product" with hydrocarbon, and live with the flammability problem. Others willingly pay a higher price for a "quality" product with CFC. No one will pay CFC prices for hydrocarbons. There can be no tricks or confusion - CFC products are much heavier than HC products and the dif-ference can be detected by "feel" without instruments.

For a contract filler savings will be negligible. Sanit charges for CFC when they fill CFC and charges for HC when they fill HC. Sanit will absorb the extra costs caused by increased maintenance labor and insurance. Thus operating costs/operating savings are considered equal ($0.00) for this project.

6.3 UNIT ABATEMENT COSTS

The calculated unit abatement costs for this project is $0.846 per kilogram, calculated as follows:

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

Where C	= $ 670,120.00	OC = 0.00
(C)F	= $ 109,029.00	OS = 0.00
F	= 0.1627	W = 194,000

Doing the calculation, unit abatement cost = $0.56 per kg.

7. FINANCING PLAN

The enterprise requests a grant covering the total incremental cost of **US$ 670,120.00** as calculated under 6.1 and 6.2.

8. PROJECT IMPLEMENTATION

8.1 PROJECT MANAGEMENT

UNDP, in close consultation with DIW, will oversee the successful implementation of this project.

8.2 SCHEDULE

The project will be implemented and be completed in 18 months:

Task	1st Qtr	2ndQtr	3rd Qtr	4th Qtr	5th Qtr	6thQtr
Purchase filling equipment/room	XXXX					
Do plant modifications/civil works		XXXX				
Delivery & Customs clearance			XXXX			
Install machine				XXXX		
Start up / Testing / Training					XXXX	
Safety inspection & commissioning						XXXX

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 CFC in aerosols in Thailand 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 hydrocarbon propellants must be accomplished by strict adherence to the National Fire Protection pamphlet # 58 Standard for the Storage and Handling of Liquefied Gases.

The controlling concept for the proper handling of LPG is to minimize the risk of ignition to the vapor. Safety plans must be in place in the aerosol filling plant to assure that no accidents occur with this propellant.

11. PROJECT IMPACT

This project will result in the immediate reduction of a minimum of 130 M. T. of CFC 12 and CFC 11/12 mixture, and CFC 113 usage in the first year, and possibly much more. If good formulations are developed for the contact cleaner and the video head cleaner, the actual reduction will be greater.

12. ANNEX

Annex 1: Technical Review

AEROPRES
CORPORATION

Mailing Address
P.O. Box 78588
Shreveport, LA
71137-8588

Administrative Offices: • 200 Petroleum Square Two • 1924 N. Hearne • Shreveport, LA 71107 • 318-221-6282 — FAX: 318-429-6739

January 30, 1995

TO : Ms. Lawrence Reno FAX: 212-477-6619
Mr. Jacques von Engel
UNDP

FROM : Harry B. McCain

1. **Country of origin:** Thailand

2. **Project title:** Conversion to CFC-free Technology in the manufacture of Aerosol Products at Sanit & Sons Co. Ltd.

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) This project will eliminate the use of 130 MT of CFCs (ODS) annually by completing the conversion of Sanit's facilities to allow the safe use of HC propellants. Global warming potential of HC aerosol propellants is negligible. Unit abatement cost is $0.846/Kg U.S.
(b) Costs are appropriate to minimize health and safety and other environmental impacts.

7. **Project costs**

(a) All cost components identified in the project are essential for the conversion from CFC to HC aerosol propellants.
(b) Some cost components should have been expected to be present in the facility prior to conversion. In this report, no accurate attempt was made to delineate them.
It should be possible for some liquid filling lines for aerosols to be updated for the conversion for CFC to HC aerosol propellants. The liquid fill apparatus is unaffected by the propellant.
(c) Cost of equipment
(i) The cost of existing equipment is addressed in a manner that is consistent with the reviewer's experience.
(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 Sanit & Sons Co. Ltd.
(d) Training cost of $20,000 is appropriate, but how many persons are to be trained is not given. Sanit has over 80 employees. Are all of them to be trained? If so, training cost is very economical.
(e) Operating costs
(i) The operating costs are appropriate.
(ii) There are no cost savings with this project. However, the argument that CFC filled products are conceived to be "better" because they

are heavier than HC filled aerosols is not a valid argument, once all aerosol products are filled with HC.

(iii) N/A

8. **Implementation time frame**

The implementation time frame of four quarters is not realistic. Eight quarters would be more accurate.

9. **Recommendations**

The report states in **3. ENTERPRISE BACKGROUND** "...the line for contact cleaner and video head cleaner will still be CFC-filled as proper alternative formulations are not known." These formulations are indeed a problem, but alternatives do exist although somewhat awkwardly. HCFC-22 can be used with hydrocarbons for these applications. HCFCs ODP is ten times less than that of CFCs. In the U.S., HCFCs cannot be used except by specific exemption, and HFC-134a and 152a are now being used in the electronic cleaner applications. HFC-134a and 152a have ODPs of **zero**. 152a is flammable, 134a is not. Both are expensive--ten to twenty times more expensive than HCs.

OORG/UNDP Technical Reviewer: Harry B. McCain

Date Review Completed: January 30, 1995

PROJECT COVER SHEET

COUNTRY:	**THAILAND**
PROJECT TITLE:	**KRIENG THAVORN CONTAINERS CO.,LTD. phaseout of the use of CFCs in the manufacture of rigid PUR foam for thermoware**
SECTOR COVERED:	Foamed Plastics
ODS USE IN SECTOR:	1510t CFCs (=ODP) in 1991
PROJECT IMPACT:	65t CFC-11/y (base 1994)
PROJECT DURATION:	1.5 years
PROJECT ECONOMIC LIFE:	**10 Years**
TOTAL PROJECT COSTS:	USD 360,000 Incremental Capital Cost USD 145,000 Incremental Recurring Costs
PROPOSED MLF GRANT:	USD 505,000
COST EFFECTIVENESS:	USD 2.20/kg/y (unit abatement cost) USD 7.77/kg/y (grant effectiveness)
NATIONAL COORDINATING BODY:	Hazardous Substances Control Division Department of Industrial Works (DIW)
IMPLEMENTING AGENCY:	UNDP
APPRAISAL DATE:	February 9,1995

PROJECT SUMMARY

Under this project, Krieng Thavorn Container Co., Ltd. ("KRIENG") will phaseout use of CFC-11 in the production of rigid PUF in the production of insulated containers through substitution by all water blown (flexible), preceded by interim use of some HCFC-141b. The project includes replacement/retrofit of production equipment, trials and technology transfer. Incremental costs for two years are also included.

PREPARED BY: Bert Veenendaal
REVIEWED BY: Dr. Hubert Creyf

PROJECT OF THE GOVERNMENT OF THE THAILAND

KRIENG THAVORN CONTAINER CO., LTD. PHASEOUT OF THE USE OF CFCs IN THE MANUFACTURE OF RIGID PUR FOAM FOR THERMOWARE

1. PROJECT OBJECTIVE

The objective of this project is to phaseout the use of CFCs in the manufacture of rigid polyurethane foam for thermoware applications at Krieng Thavorn Containers Co., Ltd. in Kratumband Samutsakorn, Thailand.

2. SECTOR BACKGROUND

ODS are used as blowing agents in the production of five types of foams in Thailand--appliance insulation, flexible foams, rigid construction insulating foams, polystyrene packaging and miscellaneous applications. Producers of foam products in Thailand used almost 1,600t of ODS in 1991, primarily CFC-11 and to a lesser extend CFC-12.

Phaseout efforts are coordinated by the Hazardous Substances Division of the Department of Industrial Works (DIW).

3. ENTERPRISE BACKGROUND

Krieng Thavorn Containers Co., Ltd. is the leading manufacturer in Thailand of insulated containers for predominantly industrial use. The company was founded in 1990 and is fully Thai-family owned.

Its products are used for transportation and storage of food items such as fish and fruit, but also for other items that needs to be kept cool, such as cut-flowers. Recently a product line for smaller containers for private consumers have been started, banking on existing experience and capacity in the rotational molding and insulation of plastic containers.

The company consumed in 1994 about 350t PUR components, including about 65t CFC-11. The components are purchased as a system, but CFC-11 is separately blended in by hand-operation. A copy of relevant parts of a company brochure are attached (**Annex-1**).

4. PROJECT DESCRIPTION

KRIENG utilized in 1994 about 65 tons CFC-11 in the manufacture of thermoware. Management of the company has been approached by DIW to participate in the ODS phaseout program and has declared its

committed to contribute to this program, which needs participants that are capable and willing to evaluate the CFC-free rigid PUF systems in non refrigeration applications.

The introduction of all water blown foam is identified as the preferred pathway to CFC phaseout at the enterprise, and the phaseout program/costs is based on this decision. However, it is expected that HCFC-141b, will be needed for a short interim period until all the technical challenges related to the use of all water blown rigid foam (viscosity, mixing, flow characteristics, vault building) are overcome.

The three existing low pressure foam dispensing units--output between 12 and 30 kg/min--will have to be replaced by high pressure systems, capable to meter at different component ratio's.

Initial formulation development will be performed by the system manufacturer, followed by extensive in-house production trials. Product testing will be done during the evaluation phase by suppliers, followed by outside certification testing for the purpose of independent verification of the insulation values achieved.

Incremental recurrent costs are expected, initially based on the use of HCFC-141b, followed by higher use of isocyanate after moving to all water based formulations.

5. TECHNOLOGY

5.1 OVERVIEW

There are currently three main directions in the development of CFC-free systems for thermoset insulation foams:

- o CFC-11 > partial water/HCFC-141b > liquid HFCs (?)
- o CFC-11 > partial water/ HCFC-22, 142b > HFC-134a, 152a
- o CFC-11 > (Cyclo) Pentane

In addition, compounds such as perfluoroalkanes, HCFC 123, fluorinated ethers and 2-chloropropane have been suggested, but are immature in technology, limited available or toxicologically contested.

The first solution--also called the "liquid" solution-- employs technology that is closely related to the existing one. The final step in this process is not yet decided. One potential solution is HFCs such as -245, -356 and -365, but full water blown foam with improved cell structure remains an option, specifically in "lesser demanding" systems such as water heaters and thermoware, where dimensional changes--although costly-- are possible.

The second one--also called the "gas" solution--utilizes a gaseous mixture of physical blowing agents, requires high pressure equipment, and sometimes extensive adjustments. The final step in this process is seen as the introduction of (gaseous) HFC's.

Pentane technologies originate form Europe and have in the mean time achieved an established position in the manufacture of rigid PUR foam for domestic refrigerators (cyclopentane). On smaller scale, n-pentane is used in panels for cold storage. The flammable character o hydrocarbons requires safety conditions and limits its use. In KRIENG's case, the use of pentane would be cost prohibitive from a safety standpoint.

5.2 SELECTION

KRIENG has decided for a solution employing only carbon dioxide generated from the water/isocyanate reaction. The interim use of HCFC-141b until all process details are worked out remains a likely interim option. The reason is an economical one as well as an ecological one: all water blown systems--although more expensive currently than CFC-blown--are less costly then systems employing HCFCs or--even worse--HFCs. In addition, carbon dioxide--the resulting blowing agent--has no residual ODP; HCFCs have.

5.3 IMPACT ON THE PRODUCTION PROCESS

The lack of CFCs or HCFCs will increase the viscosity of the polyol blend, which cannot be well metered and mixed by the low pressure equipment.

In addition, the ratio between the material components (polyol blend and isocyanate) will change. Equipment with fixed gear ratio's will have to be modified to the new ratio's, or--better--variable rate dispensing equipment should be used.

Vault-free material is essential and viscosity and reactivity changes will influence the filling patterns. The higher viscosities and different reaction times of the new systems will therefore require extensive trials, initially at the suppliers site, followed by industrial evaluation.

6. PROJECT COSTS

6.1 SUMMARY OF PROJECT COSTS

Incremental Capital Costs	USD	360,000
Incremental Recurrent Costs	USD	145,000
TOTAL PROJECT COSTS	**USD**	**505,000**

The company requests an MLF grant for the same amount.

6.2 CAPITAL COSTS

The following incremental capital costs are expected, related to this project:

o	3 30 kg/min HP foam dispensing units incl. freight & installation, @ USD 100,000...USD	300,000
o	Trials, testing, training.....USD	15,000
o	Technology transfer.....USD	10,000
o	Contingency/Rounding.....USD	35,000
	TOTAL INCREMENTAL CAPITAL COSTS.....USD	**360,000**

6.3 RECURRENT INCREMENTAL COSTS

The company expects recurrent incremental costs based on higher material cost from formulation changes. These costs are expected to amount to USD 84,250/y over the two years following implementation. Net present value of these costs at 10% discount amounts to:

USD 145,000

Annex-B provides more detailed information.

6.4 COST EFFECTIVENESS

a)	Incremental Capital Costs.....USD	360,000
b)	Project Life Time.....10 years	
c)	Incremental Recurrent Costs.....USD	85,250
d)	CFC Consumption (1994).....kg	65,000
f)	Capital Recovery Factor (@ 10% interest).....0.16275	
	UNIT ABATEMENT COSTS [{a(f) + c}/d].....USD/kg/y	**2.20**

a)	Requested MLF Grant.....USD	505,000
b)	CFC Consumption (1994).....kg	65,000
	GRANT EFFECTIVENESS (a/b).....USD/kg/y	**7.77**

7. FINANCING PLAN

The requested disbursement of **USD 505,000** as a grant represents all financial costs related to this project and constitutes so with the entire required financing.

8. PROJECT IMPLEMENTATION

8.1 MANAGEMENT

It is proposed that UNDP will oversee the this project.

8.2 PROCUREMENT

It is proposed that the United Nations Office of Project Management (UNOPS) will arrange the project procurement. UNOPS would cooperate with the local UNDP office and with DIW.

8.3 SCHEDULE

TASK	TIME FOR COMPLETION					
	Q1	Q2	Q3	Q4	Q5	Q6
1. Preparation						
MLF Approval	x					
Procurement preparation	xx	x				
Vendor selection		x				
2. Installation						
Arrival, Customs			x			
Installation				x		
3. Start-up,						
Machine Start-up				x		
Trials, Training, Phase-in				xx	xxx	
Certification						x

9. REQUIRED REGULATORY ACTION

The project requires no regulatory action.

10. PROJECT IMPACT

This project will eliminate the use of at least 15 tons of CFC-11 in the first year of implementation. Market growth indicates that this may increase by 10-15% annually in subsequent years. The project employs commercially and environmentally acceptable technology.

11. ANNEXES

ANNEX A: Detailed calculation of recurrent incremental costs
ANNEX B: Technical Assessment

ANNEX-A

INCREMENTAL OPERATING COSTS (IOC)

The replacement of CFC-11 by HCFC-14b or by all water blown foam triggers price consequences, related tot eh use of a different foam formulation and/or different chemical prices.

ASSUMPTIONS

- CFC-11 price - USD 1.75/kg[1]
  HCFC-14b price - USD 3.60/kg
  MDI - USD 2.20/kg

- 1 part CFC-11 replaced by water/CO_2 requires about 1.5 parts of MDI

- 1 part CFC-11 replaced by HCFC-14b requires about 0.85 parts of HCFC-14b

- 20% of the CFC is lost in the blending operation

MATERIAL COST

Before: 65t CFC-11 @ USD 1,750	USD 113,750
After: 97.5 MDI @ USD 2,200	USD 214,500
Additional Material Costs/y	**USD 100,750**

or

After: 55t HCFC-14b @ USD 3,600	USD 198,000
Additional Material Costs/y	**USD 84,250**

As HCFC-14b is assumed to be initially used, the latter calculation has been used to calculate the IOC. This amounts at a discount rate of 10% over 2 years of operation to a Net Present Value (NPV) of **USD 145,000.**

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[1] Prices are obtained from the company's purchase records and converted to USD (original prices in Baht) or obtained from chemical manufacturers (HCFC-14b).

TECHNICAL REVIEW.

1.Country:

Thailand.

2.Project Title:

KRIENG THAVORN CONTAINERS CO., LTD. phaseout of the use of CFCs in the manufacture of rigid PUR foam for thermoware.

3.(Sub)Sector:

Foamed plastics.

4.CP-Relationship:

Phaseout efforts of ODS are coordinated by the Hazardous Substances Division of the Thai Department of Industrial Works.
No other data are known to the reviewer.

5.Technology:

The company wants to change to all-water blown formulations in the manufacture of rigid PU foam for thermoware.
In a short interim period however, HCFC 141b will be used. It must be stressed to the firm that this period must be kept as short as possible.
All-waterblown formulations are best mixed with high pressure equipment.
The choice for this technological approach is justified.

6.Environmental impact.

The ODP of HCFC 141b is 0.11; the ODP of CFC 11 being 1.0. The GWP of HCFC 141b is 10% of the GWP of CFC 11.
When HCFC 141b is used, its concentration must be monitored, and kept below all required legal and health (50ppm) levels.
CO_2 has only a small effect on GWP(0.025% of the GWP of CFC 11).

7.Project costs.

The incremental capital costs are correctly justified and presented.
The incremental operating costs on the other hand are, as represented

in Annex A of the project, difficult to understand:
-65 tons of CFC 11 at USD 1.75 should read USD 113,750.
This basic mistake(?) confuses the whole calculation.It is therefore proposed to clearly display the way of calculation followed in the IOCs.
In view of the uncertainty in the calculation of the incremental operating costs, no calculation of the cost to eliminate 1 kg of ODS could be made.

corrected.

8.Implementation.

Can be accepted as proposed.

9.Recommendation.

It is recommended to recalculate the incremental operating costs, and hereafter to approve the project.

Prepared by Hubert Creyf, UNDP Foam Sector Reviewer.
Date:060595.