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Montreal, 26-28 July 1995

PROJECT PROPOSALS: PAKISTAN

This document includes the following project proposals:

• Phase out of CFC-11 in the manufacture of Flexible PUF Molded & Integral Skin at Master Group	World Bank
• Phase out of CFC-11 in the manufacture of Molded and Rigid PUF at Razi Sons	World Bank

THE MONTREAL PROTOCOL ON SUBSTANCES THAT DEPLETE THE OZONE LAYER

PROJECT COVER SHEET

COUNTRY	:	Pakistan	
PROJECT TITLE	:	Phase-out of CFC-11 in the manufacture of Flexible PUF Molded & Integral Skin) at Master Group.	
SECTOR COVERED	:	Foam Blowing	
ODS USE IN SECTOR	:	Minimum 675 MT of CFCs (1994)	
PROJECT IMPACT	:	Phase out of 205 MT of CFC-11 (Base 1994)	
PROJECT DURATION	:	1.5 years	
PROJECT ECONOMIC LIFE	:	10 years	
TOTAL PROJECT COST	:	ODS Reduction Investment Cost	US$ 1,223,000
		Contingency 15%	US$ 183,000
		Incremental Operating Savings	US$ 40,716
		Total Project Cost (+15% Contin.)	US$ 1,365,284
COST EFFECTIVENESS	:	Grant Effectiveness :	US$ 6.66/kg/y
		Unit Abatement Costs:	US$ 1.54/kg/y
PROPOSED OTF FINANCING[1]	:	(US$ 37,000 FA fees) Grant	US$ 1,402,284
IMPLEMENTING ENTERPRISE	:	Master Group of Enterprises (4 companies)	
CO-ORDINATING NATIONAL BODY	:	Environment and Urban Affairs Division	
IMPLEMENTING AGENCY	:	The World Bank	

PROJECT SUMMARY

This project will phase out a total of 205 MT of CFC-11 consumption at four companies of the Master Group of Enterprises namely Master Enterprises P.Ltd., Durafoam P.Ltd., Khyber Plastic and Polymer Industries Ltd., and Procon Engineering P.Ltd, who are engaged in the manufacture of Flexible Slabstock Foam (mattresses, cushions etc.) and Flexible Molded PUF (automotive seat assemblies, etc). The flexible slabstock operation will shift to methylene chloride and the molded operation to all-water blown system. The project provides for replacement of low pressure foaming units by high pressure units, addition of methylene chloride metering systems, ventilation and safety equipment, trials, technical assistance and training.

TECHNICAL ASSESSMENT

(Text to follow)

1 Includes 15 percent contingency and 3 percent financial agent fee.

PROJECT OBJECTIVE

The objective of this project is to phase out the use of CFCs in the manufacture of cold cured molded PUF seat cushions and flexible slabstock PUF at the following enterprises :

Master Enterprises P.Ltd.---------- Mattresses, automotive seats.
Durafoam P.Ltd.---------- Mattresses, cushions, furniture seats.
Khyber Plasics and Polymer Industries Ltd.---- Mattresses, cushions, pillows etc.
Procon Engineering P.Ltd.---------- Automotive seat assemblies.

The four enterprises together consume about 205 MT of CFC-11 in their manufacturing.

SECTOR BACKGROUND

The Foam Industry in Pakistan does not yet show the consumption patterns that are customary for mature markets in most countries. Typical concentration on Flexible and Refrigerator foams does exist, however there is lack of activity in Rigid foams for construction and transportation (sandwich panels, spray foam etc.). There appears to be little or no production of extruded polystyrene and polyethylene foamsheets (for foodware and packaging). On the other hand there is larger use of foam for thermoware (insulated cans, water coolers, etc.). About 500 MT of CFCs were consumed in 1994.

The foam manufacturing activities involving the use of CFCs, that have been positively identified as on date, can be divided into the following functional categories :

Non Insulating Foams	**CFC consumption (MT)**
a) Flexible/Semi Rigid Foams	
- Flexible Slabstock (Continuous)	175
- Flexible Slabstock (Box foam)	Negligible
- Flexible/Semi Rigid Molded	100
- Miscellaneous Foams	Negligible
b) Thermoplastic foams	
- Extruded Polyethylene Foam	Not known
Insulating Foams	
a) Domestic Refrigeration	230
b) Commercial Refrigeration	100
c) Thermoware	50
d) Construction	20

The above consumption figures are based on interviews with major suppliers of polyurethane chemical systems manufacturers of predominantly flexible foams and may need further verification through foaming equipment suppliers and during the country program development.

ENTERPRISE BACKGROUND

The Master Group of Enterprises is the pioneer in the manufacturing of Polyurethane Foams in Pakistan. The first of its plants was established in 1966, under license from Bayer AG, Germany. Over the years the Group has modernized its plants with a variety of foaming equipment and produce slabstock and molded flexible PUF. The Master Group comprises of four companies all with 100% Pakistani ownership. A brief profile of each of these companies is as under :

Master Enterprises P.Ltd : Located at Karachi, incorporated in 1963, manufactures mattresses, automotive seats etc., has Hennecke and Viking 750 Maxfoam plants for the Flexible slabstock Foam and Impianti OMS (2001/C-12) low pressure machine for the integral skin foam and one Elastogran 200I/S-4t high pressure machine for the Molded PUF line.
Total CFC-11 consumption in 1994 : 63 MT

Durofoam P.Ltd. : Located at Lahore, incorporated in 1981, manufactures mattresses, furniture seats,cushions. Has one Viking 500 Maxfoam plant for flexible slabstock foam and one Cannon B60/FL2 & one Impianti OMS (C-12) low pressure machines for the molded PUF operations.
Total CFC-11 consumption in 1994 : 54 MT

Khyber Plastic & Polymer Industries Ltd. : Located near Peshawar, incorporated in 1989, manufactures cushions mattresses, pillows, furniture seats etc. Has one one Viking 375 Maxfoam line for the flexible slabstock foam and one Cannon B60/FL2 and one Impianti OMS (C-12) low pressure machines for the molded PUF operation.
Total CFC-11 consumption in 1994 : 76 MT

Procon Engineering P.Ltd. : Located in Karachi, incorporated in 1988, manufactures molded PUF seat assemblies as OEM supplier for major automotive manufacturers Has one Cannon low pressure B-60/FL2 & one Elastogran PU-30 high pressure machine for its molded PUF operations.
Total CFC-11 consumption in 1994 : 12 MT

PROJECT DESCRIPTION

Flexible Slabstock PUF operation

In this project, Master will convert its flexible slabstock foaming operations to increased water levels and the introduction of Methylene Chloride as the auxillary blowing agent.

Methylene Chloride as been identified as the preferred replacement for CFC-11 in slabstock foam blowing operations. The technology is commercially available. Its use will require some modifications to the production process in conjunction with safety related modifications to the production environment.

The conversion to Methylene Chloride will be supplemented by water lance system for removal of additional process heat/putting out scorch blocks. The modifications required to implement the use of Methylene Chloride are as under :

a) Increased/improved process ventilation.
b) Installation of fire safety equipment.
c) Installation of water lance cooling system.
d) Reformulation.

The project budget includes cost of an international foams process expert assist in making the necessary formulation adjustments and provide adequate safety training.

Flexible Molded PUF

The Master Group will eliminate the use of CFC-11 from its molded PUF manufacturing process by using all-water blown technology.This will require replacing the existing low pressure foaming machines by high pressure units of equivalent capacity, to meet the requirements of higher viscosities. In addition mold heating ovens, trials, training and technical assistance will be required.

Integral Skin PUF

CFC-11 will be replaced by HCFC-141b, which will involve replacement of the existing low pressure foaming unit by an equivalent high pressure one to handle higher viscosities of the new foam formulation, a premixing station, provision for trials, technical assistance etc.

Because the enterprise are all located in different economic zones and are also distinct corporate entities, and to avoid the possible wastage arising out of the need to change the formulations in the machine tanks for every change in the production program, it was found advisable not to consolidate the replacement machines to a number fewer than the above.

JUSTIFICATION FOR SELECTION OF ALTERNATIVE TECHNOLOGY

Flexible Slabstock PUF

There are numerous technologies to replace the use of CFCs in flexible PUF. Methylene Chloride constitutes the most economical solution. With the implementation of adequate safeguards, methylene chloride can also result in an environmentally acceptable solution. Methylene Chloride alone however, is not appropriate for manufacturing foams with very low densities (below 20 kg/m^3).

Trial runs with methylene chloride, increased water levels and rapid cooling are found to give satisfactory results, in a cost effective manner without unacceptable losses in performance and processing. However, a precondition is a well planned reformulation program to implement adjustments in the amounts of blowing agent and catalyst.

Further, workplace concentrations of methylene chloride have to be limited to acceptable industrial hygenic standards. Methylene Chloride is a highly volatile chlorinated substance with a relatively low acute toxicity. The volitility can trigger high concentrations in the air. The substance is classified by the USEPA and the International Agency for Research on Cancer (IARC) as a probable human carcinogen. The U.S. Occupational Safety and Health Administration has set a time weighted average (TWA) 8-hour level of 500 ppm. In several other industrialized countries the level is even more strict (upto 50 ppm). Careful handling is therefore required to avoid exposure. Examples of safety measures include proper encapsulation of the production units, ventilation of production/storage areas, safety training of personnel industrial hygenic monitoring.

Flexible Molded PUF

There are numerous technologies to replace the use of CFCs in flexible molded PUF. Available replacements fall into the following categories :

- Alternative blowing agents
- Alternative chemistry
- Alternative manufacturing technologies

The enterprise has selected alternative chemistry option, comprising of all-water blown high resilience foam. This requires lower investments than for alternative manufacturing, avoids potential quality discrepancies (as in alternative blowing agents) and allows maintaining of the foam properties.

To handle the higher viscosities of the foam mixture resulting from introduction of water as the alternative blowing agent, the existing low pressure foaming units will be replaced by high pressure one of equivalent capacity. Adequate process trials/training will be carried out under the supervision of external experts.

Integral Skin PUF

In Integral Skin foams, CFC-11 predominantly performs the function of skin formation and viscosity reduction of the system. Available options for replacement are :
- Reduced CFC technology
- HCFC technology (HCFC-22, 141b, 123)
- All water blown technology
- Hydrofluorocarbons (HFC 134a, HFC 356)
- Hydrocarbons (n-pentane, isopentane, butane)
- 'Renosol' technology (Water + HFC 134a blend)

Based on performance, safety, price and availability considerations, the company prefers the use of HCFC-141b as a replacement.

PROJECT COSTS

The total project cost (investment cost and incremental recurrent cost) is estimated at US$ 1,402,284

The investment costs of US$ 1,223,000 include capital investment in high pressure foaming units, closed system premixing stations, ventilation systems, mold heating oven, trials etc. The breakdown of these, is provided in Annexure 1.

The incremental operating savings of US$ 40,716 represent net present value of incremental operating costs/savings for two (four for flexible PUF slabstock foam) years of operation and do not reflect growth. Details are provided in Annexure 2.

Other costs of US$ include 15% contingency (US$ 183,000) for adequate funding of project costs following the project appraisal, and 3% (US$ 37,000) to cover the fees of the financial agent that will oversee procurement, disbursement and audits.

COST EFFECTIVENESS

Grant Effectiveness
The grant effectiveness (total project cost / ODS phased out) for the project works out to US$ 5.77 per kg of ODS phased out in the first year of operation. This is based on the total project costs of US$ 1,182,284 and total ODS phased out of 205 MT in the first year.

Unit abatement costs
The unit abatement cost calculated over a 10 year life span of the project is US$ 1.40 per ODP weighted kg of CFC-11 phased out. This has been derived from the incremental annualized capital costs of US$ 1,223,000 and net annualized recurrent costs of US$ 87,150 (first year), for the phase-out of about 205 ODP weighted MT of CFC-11. The cost effectiveness of this project is in line with or better than other similar projects.

REQUIRED REGULATORY ACTION

This project does not require any specific regulatory action.

RESULTS

This project will eliminate the use of atleast 205 MT of CFC-11 in the first year of implementation.

SCHEDULE

TASK	Q1	Q2	Q3	Q4	Q5	Q6
1. a) MLF Approval b) ProcurementPreparation c) Vendor Selection	X X X	X				
2. a) Transportation, arrival and customs clearance b) Installation and plant modifications.			 X	X X		
3. a) Machine Start-up b) Trials/Training c) Certification					X X	 X X

ANNEXURES

Annexure 1 : Capital Costs
Annexure 2 : Incremental Operating Costs
Annexure 3 : Unit Abatement Costs
Annexure 4 : Technical Review

ANNEXURE 1

Capital Costs

Master Enterprises P.Ltd

Flexible Slabstock PUF

1. Ventilation System ----------	US$	80,000
2. Water lance cooling system----------	US$	10,000
3. Trials----------	US$	12,000
4. Technology transfer----------	US$	5,000
5. Training----------	US$	5,000

Molded PUF

1. Mold heating oven----------	US$	10,000
2. Trials----------	US$	5,000
3. Technology Transfer----------	US$	5,000
4. Training----------	US$	5,000

Integral Skin Foam

1. High pressure foam dispenser----------	US$	100,000
2. Closed ystem premixing station----------	US$	60,000
3. Trials----------	US$	5,000
4. Technology transfer----------	US$	5,000
5. Training----------	US$	5,000

Subtotal 1	US$	312,000

Note :

The prices for major equipment mentioned above have been obtained from the current pricelist of a manufacturer and also confirmed over telephone from other manufacturers

ANNEXURE 1 (Cont'd)

Capital Costs

Durofoam P.Ltd.

Flexible Slabstock PUF

1. Ventilation System ----------	US$	80,000
2. Water lance cooling system----------	US$	10,000
3. Trials----------	US$	12,000
4. Technology transfer----------	US$	5,000
5. Training----------	US$	5,000

Molded PUF

1. High Pressure foam dispensing units(2)----	US$	200,000
2. Mold heating oven----------	US$	10,000
3. Trials----------	US$	5,000
4. Technology Transfer----------	US$	5,000
5. Training----------	US$	5,000

Subtotal 2	US$	337,000

Note :

The prices for major equipment mentioned above have been obtained from the current pricelist of a manufacturer and also confirmed over telephone from other manufacturers.

ANNEXURE 1 (Cont'd)

Capital Costs

Khyber Plastics and Polymer Industries Ltd.

Flexible Slabstock PUF

1. Ventilation System ----------	US$	80,000
2. Water lance cooling system----------	US$	10,000
3. Trials----------	US$	12,000
4. Technology transfer----------	US$	5,000
5. Training----------	US$	5,000

Molded PUF

1. High Pressure foam dispensing units(2)----	US$	200,000
2. Mold heating oven----------	US$	10,000
3. Trials----------	US$	5,000
4. Technology Transfer----------	US$	5,000
5. Training----------	US$	5,000
Subtotal 3	US$	337,000

Note :

The prices for major equipment mentioned above have been obtained from the current pricelist of a manufacturer and also confirmed over telephone from other manufacturers

ANNEXURE 1 (Cont'd)

Capital Costs

Procon Engineering P.Ltd.

Flexible Slabstock PUF

1. Ventilation System	US$	80,000
2. Water lance cooling system	US$	10,000
3. Trials	US$	12,000
4. Technology transfer	US$	5,000
5. Training	US$	5,000

Molded PUF

1. High Pressure foam dispensing unit	US$	100,000
2. Mold heating oven	US$	10,000
3. Trials	US$	5,000
4. Technology Transfer	US$	5,000
5. Training	US$	5,000

Subtotal 4	US$	237,000

Note :

The prices for major equipment mentioned above have been obtained from the current pricelist of a manufacturer and also confirmed over telephone from other manufacturers

ANNEXURE 1 (Cont'd)

Capital Costs

Summary

Master Enterprises P.Ltd.	US$ 312,000
Durafoam P.Ltd.	US$ 337,000
Khyber Plastic & Polymer Industries P.Ltd.	US$ 337,000
Procon Engineering P.Ltd.	US$ 237,000
Subtotal	US$1,223,000
Contingencies (15%)	US$ 183,000
Financial Agent Fee (3%)	US$ 37,000
TOTAL	**US$1,443,000**

ANNEXURE 2

Incremental Operating Costs

Flexible Slabstock Foam Operations (All four enterprises)

Assumptions

1. CFC-11 Price	: US$ 2.0/kg
2. Methylene Chloride Price	: US$ 0.8/kg
3. CFC : MC Ratio	: 1 : 0.9
4. Total production	: 3500 MT
5. Increased Energy Consumption	: 750,000 Kwh
6. Energy Costs	: US$ 0.1/Kwh
7. Maintenance Costs	: 5% of equipment costs
8. Net investment on equipment	: US$ 360,000 (Ref. Annexure 1)
9. No growth considered.	
10. Yield loss	: 1st year 3%, 2nd year 2%, 3rd year 1%, 4th year 0%
11. Production affected by yield loss	: 3500 MT
12. Cost of non-CFC formulation	: US$ 2.00/kg

Baseline		1995	1996	1997	1998
Cost of 175 MT CFC-11(US$)	:	350,000	350,000	350,000	350,000
Total (US$)	:	350,000	350,000	350,000	350,000
Post-Project					
Cost of 158 MT MC (US$)	:	126,400	126,400	126,400	126,400
Cost of Yield Loss	:	210,000	140,000	70,000	0
Cost of Increased Energy	:	75,000	75,000	75,000	75,000
Cost of Increased Maintenance	:	18,000	18,000	18,000	18,000
Total (US$)	:	429,400	359,400	289,400	219,400
Net Incremental Costs (US$)	:	79,400	9,400	(60,600)	(130,600)
Discount Factor	:	0.91	0.83	0.75	0.68
NPV @ 10% (US$)	:	**72,254**	**7,802**	**(45,450)**	**(88,808)**
For 4 years (US$)	:	**(54,202)**			

ANNEXURE 2 (Cont'd)

Incremental Operating Costs

Molded PUF Operations (All four companies)

Assumptions

1. CFC-11 Price : US$ 2.0/kg
2. MDI Price : US$ 2.0/kg
3. No growth considered.

Baseline		**1995**	**1996**
Cost of 28 MT CFC-11	:	56,000	56,000
Cost of 90 MT MDI	:	180,000	180,000
Total (US$)	:	236,000	236,000
Post Project			
Cost of 120 MT MDI	:	240,000	240,000
Total (US$)	:	240,000	240,000
Net Incremental Costs (US$)	:	4,000	4,000
Discount Factor	:	0.91	0.83
NPV @ 10% (US$)	:	**3,640**	**3,320**
For 2 years (US$)	:	**6,960**	

ANNEXURE 2 (Cont'd)

Incremental Operating Costs

Integral Skin Foam Operations

Assumptions

1. CFC-11 Price : US$ 2.0/kg
2. HCFC-141b Price : US$ 3.50/kg
3. No growth consider

Baseline		**1995**	**1996**
Cost of 2.5 MT CFC-11	:	5,000	5,000
Post-Project			
Cost of 2.5 MT HCFC-141b	:	8,750	8,750
Net Incremental Cost	:	3,750	3,750
Discount Factor	:	0.91	0.83
NPV @ 10%(US$)	:	**3,413**	**3,113**
For 2 years (US$)	:	**6,526**	

ANNEXURE 2 (Cont'd)

Incremental Operating Costs

SUMMARY

1. Flexible Slabstock Operations	:	US$ 54,202 (Savings)
2. Molded PUF Operations	:	US$ 6,960 (Costs)
3. Integral Skin PUF Operations	:	US$ 6,526 (Costs)
Net Total (US$)	:	**US$ 40,716 (Savings)**

ANNEXURE 3

Cost Effectiveness

Grant Effectiveness:

A. Incremental Capital Costs	US$ 1,223,000
B. Contingencies @15%	US$ 183,000
C. Incremental Operating Savings	US$ 40,716
D. Total Project Costs	US$ 1,365,284
E. ODS Phased out	KG 205,000
E. Grant Effectiveness (D/E)	**US$ 6.66/kg/y**

Unit Abatement Costs

A. Incremental Capital Costs (with Contingency)	US$ 1,406,000
B. Annualized Incremental Operating Costs	US$ 87,150 (First Year)
C. Project Useful Life	10 years
D. ODS reduction per year	205,000 kg
E. Capital Recovery Factor	0.16275
UNIT ABATEMENT COST [(A X E) + B] / D	**US$ 1.54/kg/y**

PAKISTAN - MASTER GROUP

TECHNOLOGY

The four companies in the Master Group manufacture a range of polyurethane foams - flexible slabstock, flexible moulded cushions plus integral skin components at Master Enterprise in Karachi.

The range of replacement technologies and their justifications are as follows :

- Flexible Slabstock - methylene chloride is selected as the CFC 11 replacement. This is the most widely used technology in this sector. The main issue relates to safe operation - see below.

- Flexible Moulded Foam - the enterprise has chosen all water / CO_2 technology which is now becoming the universal standard for this sub-sector.

- Integral skin - the enterprise has proposed HCFC 141b. This is certainly technically suitable and in use. However, HCFC 22 would comprise a technology in wide scale use and also has a lower ODP. The enterprise should also consider future zero ODP alternatives such as water / CO_2 which are now being implemented in USA / EU. The proposed equipment would be compatible with these lower ODP / zero ODP alternatives.

ENVIRONMENTAL ISSUES

The main issue relates to safe operation with methylene chloride. This is addressed by providing improved ventilation as specified plus cooling systems to prevent or reduce scorch.

The enterprise proposes to use about 5 te per year of HCFC 141b. This has an ODP of 0.11 and alternative / follow-on strategies are covered in the Technology section.

PROJECT COSTS

The grant effectiveness is within EC guidelines. The proposed capital items are all justified given the geographically diverse manufacturing units within the group.

The operating costs / savings are well displayed. There is a minor point relating to HCFC 141b usage - because of its lower molecular weight it has a higher blowing efficiency than CFC 11 and its usage is thus reduced by about 10% (4.5 te instead of 5 te).

IMPLEMENTATION TIMEFRAME

This is acceptable.

RECOMMENDATION

Approval.

Issue on integral skin technology should not be hold up proceeding with this project.

GMFJ/kd/12/6/95

THE MONTREAL PROTOCOL ON SUBSTANCES THAT DEPLETE THE OZONE LAYER

PROJECT COVER SHEET

COUNTRY	:	Pakistan	
PROJECT TITLE	:	Phase-out of CFC-11 in the manufacture of Molded and Rigid PUF at Razi Sons.	
SECTOR COVERED	:	Foam Blowing	
ODS USE IN SECTOR	:	Minimum 675 MT of CFCs (1994)	
PROJECT IMPACT	:	Phase out of 60 MT of CFC-11 (Base 1994)	
PROJECT DURATION	:	1.5 years	
PROJECT ECONOMIC LIFE	:	10 years	
TOTAL PROJECT COST	:	ODS Reduction Investment Cost	US$ 420,000
		Contingencies @15%	US$ 63,000
		Incremental Operating Costs	US$ 33,060
		Total Project Cost	US$ 516,060
		FA Fees 3%	US$ 13,000
COST EFFECTIVENESS	:	Grant Effectiveness:	US$ 8.60/kg/y
		Unit Abatement Costs:	US$ 1.63/kg/y
PROPOSED OTF FINANCING [1]	:	US$ 529,060 as grant	
IMPLEMENTING ENTERPRISE	:	Razi Sons.	
CO-ORDINATING NATIONAL BODY	:	Environment and Urban Affairs Division	
IMPLEMENTING AGENCY	:	The World Bank	

PROJECT SUMMARY

This project will phase out a total of 60 MT of CFC-11 consumption (45 MT in the production of cold cured molded automotive seat cushions and 15 MT in the rigid foam insulation products), at Razi Sons. The foam operations for the molded foam category will be converted to all water blown system. In rigid PUF category also, all water blown systems will be the replacement technology. The project will require the replacement of existing low pressure foaming units by high pressure units, mold heating oven, trials, technology transfer and training.

TECHNICAL ASSESSMENT

(Text to follow)

1 Includes 15 percent contingency and 3 percent financial agent fee.

PROJECT OBJECTIVE

The objective of this project is to phase out the use of CFCs in the manufacture of cold cured molded PUF seat cushions and rigid PUF products at Razi Sons, Karachi, Pakistan.

SECTOR BACKGROUND

The Foam Industry in Pakistan does not yet show the consumption patterns that are customary for mature markets in most countries. Typical concentration on Flexible and Refrigerator foams does exist, however there is lack of activity in Rigid foams for construction and transportation (sandwich panels, spray foam etc.). There appears to be little or no production of extruded polystyrene and polyethylene foamsheets (for foodware and packaging). On the other hand there is larger use of foam for thermoware (insulated cans, water coolers, etc.). About 500 MT of CFCs were consumed in 1994.

The foam manufacturing activities involving the use of CFCs, that have been positively identified as on date, can be divided into the following functional categories :

Non Insulating Foams	**CFC consumption (MT)**
a) Flexible/Semi Rigid Foams	
- Flexible Slabstock (Continuous)	175
- Flexible Slabstock (Box foam)	Negligible
- Flexible/Semi Rigid Molded	100
- Miscellaneous Foams	Negligible
b) Thermoplastic foams	
- Extruded Polyethylene Foam	Not known
Insulating Foams	
a) Domestic Refrigeration	230
b) Commercial Refrigeration	100
c) Thermoware	50
d) Construction	20

The above consumption figures are based on interviews with major suppliers of polyurethane chemical systems manufacturers of predominantly flexible foams and may need further verification through foaming equipment suppliers and during the country program development.

ENTERPRISE BACKGROUND

Razi Sons is a partnership enterprise established in 1948. The company has a total of about 200 employees of which 35 are engaged in the foam operations. The company manufactures flexible PUF automotive seat cushions/assemblies, Rigid PUF panels for false ceiling (acoustic purposes), etc. In 1994, the company consumed about 400 MT of polyurethane chemicals. The total CFC consumption for all product lines was about 60 MT.
The company has the following low pressure foaming machines :

OMS Impianti Model C-35-8F (1984) Capacity 800gm/sec : Rigid Foam products
OMS Impianti Model 2001/C-35 (1988) Capacity 800gm/sec : FPUF Moldings
OMS Impianti Model 2001/C-60 (1988) Capacity 1400 gm/sec : FPUF Moldings

The company consumed about 45 MT CFC-11 in the molded FPUF operations and 15 MT in the Rigid PUF operations in 1994.

PROJECT DESCRIPTION

In this project Razi Sons will phase out the use of CFC-11 from their manufacturing process. In the molded FPUF operation as well as the rigid PUF operation, all-water blown system will be adopted.

Flexible Molded PUF Operations :The existing two low pressure foaming machines (the 2001/C-35and 2001/C-60) will be replaced by high pressure machines of equivalent capacity, to handle the increased viscosities of the foam formulation resulting from use of all water blown system. Mold heating ovens, trials, training and technical assistance will also be provided.

Rigid Foam Operations :The existing low pressure machine (C-35-8F) will be replaced by an equivalent high pressure machine, to handle the increased viscosities of the water based formulation.Trials, technical assistance and training shall also be provided.

JUSTIFICATION FOR SELECTION OF ALTERNATIVE TECHNOLOGY

Flexible Molded PUF

There are numerous technologies to replace the use of CFCs in flexible molded PUF. Available replacements fall into the following categories :

- Alternative blowing agents
- Alternative chemistry
- Alternative manufacturing technologies

The enterprise has selected alternative chemistry option, comprising of all-water blown high resilience foam. This requires lower investments than for alternative manufacturing, avoids potential quality discrepancies (as in alternative blowing agents) and allows maintaining of the foam properties.

To handle the higher viscosities of the foam mixture resulting from introduction of water as the alternative blowing agent, the existing low pressure foaming units will be replaced by high pressure one of equivalent capacity. Adequate process trials/training will be carried out under the supervision of external experts.

Rigid PUF

The ODS phase-out technologies for rigid insulating foams are as under :

Low ODS Technologies (Interim) > Reduced CFC
> HCFCs (22, 141b, 22+142b)

ODS free Technologies(Long term) > Chemically generated CO_2 (Water blown)
> Pentanes
> HFCs (134a, 152a, 356)

The selection of the alternative technology would be governed by the following considerations :

a) Proven and reasonably mature technology.
b) Cost effective conversion.
c) Easy availability of substitute blowing agent, at favorable pricing.
d) Support from local system suppliers in terms of making the right formulation/blend available.
e) Critical properties that have to obtained in the end product
f) Operational safety.

The enterprise has selected all water-blown technology. The products that it makes are mainly for acoustic insulation application (false ceiling panels) hence the K-value etc. are not of primary importance.

PROJECT COSTS

The total project cost (investment cost and incremental recurrent cost) is estimated at US$ 529,060 as grant

The investment costs of US$ 420,000 include capital investment in 3 high pressure foaming units, one mold heating oven, trials etc. The breakdown of these, is provided in Annexure 1.

The incremental operating costs of US$ 33,060 represent net present value of incremental operating costs for two years of operation and do not reflect growth. Details are provided in Annexure 2.

Other costs of US$ 76,000 include 15% contingency (US$ 63,000) for adequate funding of project costs following the project appraisal, and 3% (US$ 13,000) to cover the fees of the financial agent that will oversee procurement, disbursement and audits.

COST EFFECTIVENESS

Grant Effectiveness

The grant effectiveness (total project cost/ODS Phased out) for the project works out to US$ 8.60 per kg of ODS C-11 phased out in the first year of operation. This is based on the total project costs of US$ 483,000 and total phase-out of about 60 MT in the first year.

Unit Abatement Costs

The unit abatement cost calculated over a 10 year life of the project is US $ 1.63 per ODP weighted kg of CFC-11 phased out. This has been derived from the incremental annualized capital costs of US $ 483,000 and net annualized recurrent costs of US $ 19,000 for the phase-out of about 60 ODP weighted MT of CFC-11. The cost effectiveness of the project is in line with other similar projects.

REQUIRED REGULATORY ACTION

This project does not require any specific regulatory action.

RESULTS

This project will eliminate the use of atleast 60 MT of CFC-11 in the first year of implementation.

SCHEDULE

TASK	Q1	Q2	Q3	Q4	Q5	Q6
1. a) MLF Approval b) ProcurementPreparation c) Vendor Selection	X X X	X				
2. a) Transportation, arrival and customs clearance b) Installation and plant modifications.			 X	X X		
3. a) Machine Start-up b) Trials/Training c) Certification					X X	 X X

ANNEXURES

Annexure 1 : Capital Costs
Annexure 2 : Incremental Operating Costs
Annexure 3 : Unit Abatement Costs
Annexure 4 : Technical Review

ANNEXURE 1

Capital Costs

Rigid Foam Operations

1. High Pressure Foam Dispenser (50kg/min capacity	US$ 115,000

Molded Foam Operations

3. High Pressure Foam Dispenser (50kg/min capacity)	US$ 115,000
4. High Pressure Foam Dispenser (90kg/min capacity) (Including freight, installation, etc.)	US$ 150,000
5. Mold heating Oven	US$ 10,000

Common

6. Trials	US$ 10,000
7. Training	US$ 10,000
8. Technology Transfer	US$ 10,000
Subtotal	US$ 420,000
Contingencies, Financial agents' fee, etc.	US$ 76,000
Incremental Capital Costs	**US$ 496,000**

Note :

The prices for foam dispensing machines/premixing stations, are based upon the price list of one equipment supplier and have been confirmed by telephone enquiries with other suppliers.

ANNEXURE 2

Incremental Operating Costs

Assumptions

1. CFC-11 Price : US$ 2.0/kg
2. MDI Price : US$ 2.0/kg

Baseline		1995	1996
A. Rigid Foam Operation			
Cost of 15 MT CFC-11(US$)	:	30,000	30,000
B. Molded Foam Operation			
Cost of 45 MT CFC-11	:	90,000	90,000
Cost of 150 MT MDI (US$)	:	300,000	300,000
Total (US$)	:	420,000	420,000

Post-Project			
A. Rigid Foam Operation			
Cost of 19.5 MT of MDI	:	39,000	39,000
B. Molded Foam Operation			
Cost of 200 MT MDI	:	400,000	400,000
Total (US$)	:	439,000	439,000
Net Incremental Costs (US$)	:	19,000	19,000
Discount Factor	:	0.91	0.83
NPV @ 10% (US$)	:	**17,290**	**15,770**
For 2 years (US$)	:	**33,060**	

ANNEXURE 3

Cost Effectiveness

Grant Effectiveness

A. Incremental Capital Costs----------	US$ 420,000
C. Contingencies @15%----------	US$ 63,000
C. Incremental Operating Costs (2 yrs-NPV)-------	US$ 33,060
D. Total Project Costs ----------	US$ 516,060
E. ODS reduction per year----------	60,000 kg
GRANT EFFECTIVENESS (D/E)	**US$ 8.60/kg/y**

Unit Abatement Costs

A. Incremental Capital Costs (with contingencies)------	US$ 483,000
B. Annualized Incremental Operating Cost----------	US$ 19,000
C. Project Useful Life----------	10 years
D. ODS reduction per year----------	60,000 kg
E. Capital Recovery Factor----------	0.16275
UNIT ABATEMENT COST [(A X E) + B] / D	**US$ 1.63/kg/y**

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TECHNOLOGY

The enterprise is proposing to convert from CFC 11 to water / CO_2 technology in its production of moulded flexible and rigid panel polyurethane production.

For moulded cold cure (MDI-based) foam all water / CO_2 blowing is now the universal standard. Its use requires high pressure equipment because of the higher viscosities of the formulations.

The particular rigid foam operation which the enterprise is engaged in does not require an optimum insulation value and hence water / CO_2 technology will be adequate. This represents a long term solution. Although a high pressure dispenser is required to cope with the higher viscosity formulations a closed system pre blender is not and should be deleted. This is only required if low boiling blowing agents such as HCFC 22 are being preblended or if HCFC 141b is to be used and then such a blender can prevent any atmospheric emissions. In this case the CO_2 is generated by the reaction of the MDI with the water in the polyol formulation after the mixing head.

ENVIRONMENTAL ISSUES

The technologies chosen are of zero ODP and do not involve flammable liquids or other safety considerations.

PROJECT COSTS

The grant cost effectiveness is just above the rigid foam limit but well below the integral skin / moulded flexible foam limit.

The capital items are justified with the exception of the closed system pre blender as noted under the TECHNOLOGY section.

The incremental operating costs are well displayed and justifiable.

IMPLEMENTATION TIMEFRRAME

This is acceptable.

RECOMMENDATION

Approval with the omitting of the closed pre-mixing equipment for the rigid foam operation.

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