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Executive Committee of
the Multilateral Fund for the
Implementation of the Montreal Protocol

Tenth Meeting
Montreal, 28-30 June 1993

PROJECT PROPOSALS: CHINA

PROJECT OUTLINE

COUNTRY	:	CHINA
SECTOR COVERED	:	Foamed Plastics
SECTORAL ODS CONSUMPTION	:	17,773 tons ODP
PROJECT TITLE	:	Tianjin Conversion to CFC-free Technology in the Manufacture of Flexible Polyurethane Foam
PROJECT DURATION	:	One year
PROJECT IMPACT	:	Phaseout of the use of 180 tons/year CFC-11 (1991) in the manufacture of flexible polyurethane foam (slabstock) (F-PUF) at Tianjin Polyurethane Plastic Factory ("Tianjin")
PROPOSED BUDGET	:	US$1,080,000
IMPLEMENTING AGENCY	:	Ministry of Light Industry (MLI) UNDP (assisting)
NATIONAL COORDINATING AGENCY	:	National Environmental Protection Agency (NEPA)

PROJECT DESCRIPTION

MLI is leading a coalition of ministries in the implementation of the phaseout of CFCs in foams in China; the largest use sector of ODS (36.8%) with the highest ODP (29.4%).

The Tianjin plant is selected by the ministry as a demonstration plant for the dissemination of ODS technology in the manufacture of F-PUF in China. Tianjin, with three production units for this type of foam, is uniquely qualified for this purpose. Representatives of Tianjin participated in a survey of technologies in December 1992, and are informed on the latest developments in this area. The senior chemical engineer will also function as the designated national expert for ODS phaseout in this sub-sector.

Tianjin will install under this project different technologies and laboratory equipment, that will allow the complete phaseout of CFCs in its flexible foam production. In addition, it will allow the company to demonstrate these technologies to other Chinese producers and to accommodate other companies in their phaseout efforts through test production and physical testing.

Tianjin's management is dedicated to the phaseout of the use of CFCs at a pace as fast as feasible. The company has already submitted a project for the phaseout of CFCs in polyol blends, and will follow shortly with projects for its various rigid PUF operations.

This particular project is designed to phaseout the use of CFCs in the production of flexible PUF (180 t/y in 1991). The company has evaluated the different available technologies for this purpose during a study tour in December 1992, in the USA. The technologies selected reflect not only the particular equipment on site, but also the fact that Tianjin will be China's dissemination center for CFC free technology in flexible PUF, and should be able to demonstrate more than one technology. The fact that the company operates three production lines allows to do so without excessive incremental costs.

For its traditional foam line (MS Foam line, named after the manufacturer of the equipment), Tianjin has selected the use of methylene chloride, in combination with softening additives and extended range polyols. For its "Vertifoam" Lines, the company has selected the "Envirocure" process, a patented curing acceleration system, that allows the production of foam without any auxiliary blowing agent.

The emission of methylene chloride will be reduced by an emission recovery system. Workers exposure will be limited through the improvement of the exhaust system.

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PROJECT COVER SHEET

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PROJECT OF THE GOVERNMENT OF CHINA

TIANJIN CONVERSION TO CFC-FREE TECHNOLOGY
IN THE MANUFACTURE OF FLEXIBLE POLYURETHANE FOAM (SLABSTOCK)

1. PROJECT OBJECTIVE

The objective of this project is (1) to phaseout the use of CFCs in the manufacture of F-PUF at Tianjin, (2) to demonstrate the technologies employed to other manufacturers and (3) to aid these manufacturers in their efforts to phaseout the use of CFCs in flexible polyurethane foam.

2. SECTOR BACKGROUND

The Chinese foam industry consumed in 1991 17,773 tons CFCs (China Country Programme). CFC-11 was the dominant substance (15,600 t, PUF), followed by CFC-12 (2,173 t, EPS/PE). No other ODS was used in statistical significant amounts, although some MCF may be used in adhesive applications. Furthermore some MCF and CFC-113 may be used in mold release agents. Production is divided between larger state owned enterprises and smaller township or private enterprises. Production and process information from state enterprises is well documented. However information on the rest of the industry is less reliable. More detailed information about the sector is provided in the following table:

Categories Subcategories	ODS (t)	Production (t)	Plants (range)
Extruded PS/PE	2,173	13,000	30- 50
Flexible Polyurethane	2,000	50,000	50-100
Pipe Insulation	600	4,000	10- 20
Sprayed PUF	600	4,000	50-200
Appliance Foams	5,000	40,000	40- 70
PUF Panels	7,400	52,000	20- 50
Total Rigid PUF	13,600	100,000	120-340
TOTAL	17,773	163,000	200-490

The Chinese Foam Industry
Selected Industry Data (1991)

Government and industry are committed to sharply reduce, and ultimately eliminate CFC utilization. MLI is responsible for the phaseout coordination in all foam categories. Ministerial responsibility is divided into two areas:

- o Refrigerating foams.
- o Non-refrigerating foams

There are other ministries involved in the refrigeration[1] foams, i.c.:

- o Ministry of Chemical Industry (MCI),
- o Ministry of Commerce (MOC),
- o Ministry of Aerospace Industry (MAI),
- o Ministry of Machinery and Electronics Industry (MMEI)[2],

Complete phaseout for non-refrigeration foams is targeted for the year 2000. Refrigerating foams are expected to be CFC free from the year 2005.

Uninhibited use of CFCs in foams for domestic refrigeration is expected to lead to an increase during 1991-1995 by 8 %/y, and after 1995 by 3 %/y. For other foams, a growth rate of 6 %/y is forecasted.

3. ENTERPRIZE BACKGROUND

Tianjin Polyurethane Plastic Product Factory ("Tianjin") is one of the leading enterprises in the foam sector in China. The company counts more than 700 employees, from which about 50 constitutes the technical staff. The production program includes the manufacture of polyols, elastomers, polyether polyol blends, different types of polyurethane foams and products from flexible foams (rolls, sheets, etc). Major equipment is imported from abroad, and relatively new. Beside the installations for polyol and elastomer production, the company operates:

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[1] "Refrigeration Foam" is defined as foam used for insulation purposes in cooling devices. The term is used in stead of the more usual distinction in "insulation" and "non-insulation" foam to accommodate to the existing ministerial responsibilities in China, where heating pipe insulation ("insulation" but not "refrigeration) is classified together with flexible and EPS/PE foams.

[2] The Chinese Government is currently restructuring some of its Ministries. The list of Ministries and Associations involved may therefore change. This list will be updated as soon as new information is available.

- o 3 continuous flexible foam lines,
- o 1 continuous panel line,
- o 1 continuous pipe insulation line,
- o 1 unit for in situ foaming.

The annual production (base year 1991) is as follows:

PRODUCTION (TONS)	PRODUCT	CFC USE (TONS)
2,000	Polyether Polyol,	-
500	Polyester Polyol,	-
3,000	Polyether Blends[3]	120
4,000	Flexible PUF,	180
600	R-PUF Panels,	75
80	R-PUF Pipe Insulation,	15
20	R-PUF In Situ Foaming,	5
1,000	PU Elastomers	-

The company has laboratories for product development and quality control on site.

4. PROJECT DESCRIPTION

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[3] Used in the production of rigid polyurethane foams. About 25% or 700 t/y is used in own production.

system, that allows the production of foam without any auxiliary blowing agent.

The emission of methylene chloride will be reduced by an emission recovery system. Workers exposure will be limited through the improvement of the exhaust system.

5. TECHNOLOGY

5.1 SELECTION

There are numerous options to replace CFCs in the manufacture of F-PUF slabstock. As a preparation on the intended phaseout, representatives of the company visited the USA and reviewed not less than eight different technologies. The visit included a technology overview and discussions on selection criteria at a major chemical manufacturer (Dow Chemical) and a discussion with representatives of USEPA's Global Change Division with the same purpose. The findings of this tour, related to the different technologies, are attached to this proposal (annex-1).

Tianjin selected the use of methylene chloride as the most economic solution for its traditional foam production line. The technology is intended to be implemented with safeguards for environment (emissions) and workers safety (exposure).

In addition, the company intends to install the capability to use softening additives and extended range polyols. The costs of such installation are relatively moderate. It will allow the company to use these technologies for demonstration purposes as well as for partial replacement of methylene chloride in very sensitive formulations (low density, super soft).

For its "Vertifoam" units, the company intends to install a combined "Envirocure" system ("combined", to avoid the costs of two separate installations). This patented system is now in production in about 10 facilities, mostly concentrated in the USA. It allows the production of a full range of foam qualities utilizing only chemical generated carbon dioxide as a blowing agent. The process requires licensing.

5.2 PROCESS MODIFICATIONS

The use of methylene chloride (MC) requires sufficient ventilation in production and curing area to limit workers exposure to an acceptable level. In addition, Tianjin intends to limit the emission of MC through the installation of a relatively simple recovery system intended for the production line only (about 40% of the total emissions).

The use of softening additives and extended range polyol requires

only the installation of storage and metering equipment. The substances are non hazardous and no special safeguards are needed.

The installation of a fast cure system will reduce the need for curing space. The available space is sufficient and suitable in location to house the "Envirocure" system. The excellent accessibility will facilitate installation and keep the related costs down. An backup generator has to be installed to avoid fire risk in case of a power outing.

Some limited test equipment is needed to monitor the properties of the CFC-free foams. The same equipment can be used later to support phaseout projects at other facilities under guidance of a national expert located at the Tianjin facility.

Safety and production training is scheduled to follow installation, prior and during start-up. Start-up will be supervised by the licensor (Envirocure) and an international foam expert (MC and additives).

6. PROJECT COSTS

6.1 TOTAL PROJECT COSTS

The following is a summary of the expected costs of investment and related activities:

ITEM	DESCRIPTION	SUBTOTAL (USD)	TOTAL (USD)
0010	**VERTIFOAM MODIFICATIONS**		**783,750**
0011	Envirocure installation (includes license)	712,500	
0012	Freight, Installation, Start-up	71,250	
0020	**MS LINE MODIFICATIONS**		**125,000**
0021	Ventilation and Recovery System (Includes Installation)	80,000	
0022	Polyol Storage and Metering System	25,000	
0023	Additive Storage and Metering System	20,000	
0030	**TESTING**		**20,000**
0031	Misc. Testing Equipment	20,000	
0040	**START-UP**		**41,500**
0041	Trial Materials	25,000	
0042	Training	16,500	
0050	**CONTINGENCY AND ROUNDING**		**109,750**
	TOTAL		**1,080,000**

Supporting documentation is provided in annex-2 and annex-3.

6.2 INCREMENTAL RECURRING COSTS/SAVINGS

The expected annual operating costs will differ only marginally from the current costs:

MS Foaming Unit	Now 36 t CFC-11 @ 2,500.....(USD	90,000)
	New 33 t MC @ 1,200.....USD	39,600
	Recovery of 10 t MC.....(USD	12,000)
	Incremental Costs (Savings) (USD	62,100)
Vertifoam Unit	Now 144 t CFC-11 @ 2,500.....(USD	360,000)
	New 141 t TDI @ 3,000.....USD	423,000
	Incremental Costs (Savings) USD	63,000
	Balance USD	**900**

There are some changes in catalysts, catalysts and stabilizer levels and in energy use to be expected, that are not included in this calculation. These will go in both directions and not expected to cause major changes in operational costs.

Therefore, incremental recurrent costs are assumed to be non existing.

6.3 UNIT ABATEMENT COSTS

a)	ODS Reduction Project Costs	USD	1,080,000
b)	Annual Incremental Costs (Benefits)	USD	-,-
c)	Project Useful Life		10 years
d)	ODS Reduction/Y (Base 1991)	kg	180,000
	Unit Abatement Costs [(a/c + b)/d]	**USD/kg/y**	**0.60**

7. FINANCING PLAN

The company requests reimbursement of the full project costs in the amount of USD 1,080,000.

8. PROJECT IMPLEMENTATION

8.1 MANAGEMENT

MLI, with assistance of UNDP-OPS will oversee the implementation of this project. The project will be carried out at the companies facilities in Tianjin. UNDP-ENR will provide technical assistance during project execution.

8.2 SCHEDULE

The following is developed for this project, following date of approval:

TASK	TIME FOR COMPLETION					
	Q1	Q2	Q3	Q4	Q5	Q6
Envirocure						
Purchase order	x					
Arrival, Customs clearing			xx			
Installation, Start-up			x			
MS Unit						
Preparation of Tenders	x					
Purchase Orders	x					
Arrival of Equipment		xx				
Installation, Start-up			xxx			
Testing Equipment						
Preparation of Tenders	x					
Purchase order(s)	x					
Arrival, Installation		x				
Training			x			
Trials with Additives and ER Polyols (attendance of Chemical manufacturers)				xxx		

8.3 PROCUREMENT

UNDP'S Office for Project Services (OPS) has offered the Chinese government assistance with the procurement of this project. OPS procures currently similar projects elsewhere.
OPS would be assisted by the local UNDP office and receive technical assistance from UNDP-ENS.

9. PROJECT IMPACT

This project will result in the elimination of the use of annually 180 tons CFC-11, based on 1991 consumption. In view of the current and expected growth in the Chines market, this figure has to be increased by at least 6% for every subsequent year.

10. ANNEXES

Annex-1: Overview of Options for the phaseout of CFCs in the Manufacture of Flexible PUF (Slabstock).

Annex-2: Detailed Budget Proposals.

Annex-3: Price Documentation.

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Annex-1

CFC REPLACEMENT TECHNOLOGIES IN FLEXIBLE POLYURETHANE FOAMS

1. INTRODUCTION

The PUF industry and its suppliers have been for more than five years involved in efforts to reduce or to eliminate the use of CFCs in the manufacture of flexible polyurethane foams.

A flood of technologies are proposed over these years, allowing manufacturers in Europe and particularly in the USA to make significant progress in the phase-out of CFCs.

The use of CFCs in the USA for the purpose of flexible PUF blowing decreased in 1991 to less than 300,000 lbs, or about 1 % of the total use of auxiliary blowing agents.

In general, the following standards of acceptance are applied to proposed replacement technologies:

- o Proven technology,
- o Commercially available,
- o Acceptable processing,
- o Sufficient safe,
- o Environmentally acceptable,
- o Economically viable.

Not all technologies that are currently applied meet these criteria, especially the environmental acceptability. These technologies provide, however, sometimes an important interim function, and allow the industry to search for better solutions, while in the mean time progressing with CFC phase-out.

This document is an attempt to summarize the industrial available and emerging technologies. It will describe the viability in the flexible PUF process and report on existing experience.

2. FUNCTION OF AUXILIARY BLOWING AGENTS

The standard blowing agent for flexible polyurethane foam is carbon dioxide, formed in the reaction between water and toluene diisocyanate (TDI).

Auxiliary blowing agents (ABAs) are used because there are limits on the foam properties that can be achieved with carbon dioxide as the sole blowing agent and because of the exothermic nature of the water/TDI reaction. Excessive heat can lead to scorch or even auto-ignition of the foam during the manufacturing process and subsequent curing.

The use of ABAs allows to:

- o Soften the foam,
- o Decrease the reaction temperature,
- o Decrease the foam density.

CFCs have for years functioned as the ABAs of choice. In view of the function of an ABA, it is clear that an ideal alternative should allow for the same or better

- o hardness variations,
- o decrease of the exotherm,
- o preservation of the existing density range.

Flexible PUF can be categorized in molded foams and slabstock foams. Traditionally, densities of molded foams have been higher than slabstock foams, reducing the function of ABAs in molding to softening alone. this has greatly facilitated the options, and virtually eliminated the use of ABAs in this category. This document will therefore focus on Slabstock applications.

3. SUMMARY OF ALTERNATIVES

UNEP and USEPA have recently published excellent descriptions of most of the available alternatives alternatives to the use of CFCs in flexible PUF (1,2,3). The following is a summary of and an update on these technologies. These technologies can be categorized as follows:

- o Conservation
- o Alternative blowing agents
- o Chemical modifications
- o Alternative manufacturing technologies.

3.1 CONSERVATION

Conservation techniques are understood to reduce the use of CFCs through;

- o Best management practices
- o Reformulation
- o Recovery/recycling.

Proper housekeeping and prudent formulation management can save a plant unto 10 % of its use of CFCs. Some recommendations:

- o Use closed loop unloading systems,
- o Do not flush with CFCs'
- o Avoid the use of CFCs for viscosity adjustments'
- o Minimize the TDI index.

Recycling/recovery is practiced in several plants in Europe on industrial scale. The ABA is first adsorbed to activated charcoal, and subsequently desorbed through steam or nitrogen regeneration. A precondition is a reduction of the process ventilation, which can lead to industrial hygienic problems. Recovery of curing emissions is not (yet) feasible, reducing the obtainable overall efficiency to less than 50 %. Investment and operational costs are high.

3.2 ALTERNATIVE BLOWING AGENTS

Methylene Chloride (MC)
MC is currently in the USA and in the UK the preferred replacement technology. Recent regulations may limit in the future allowable emissions in the US, reducing the use potentially to an interim technology. Mc is capable to replace CFCs without any significant limitations at lower costs.

Methylchloroform (MCF)
More than 10 % of the ABA used in the USA is currently MCF. It is particularly used in areas where the use of MC is restricted. However, MCF is classified as an ozone depleting substance, and subject to future phase-out. It is therefore at most an interim solution. Costs are higher than MC, and processing is more difficult.

HCFCs
HCFC 123 and HCFC 141b have proven to be technical feasible alternatives. Availability and price have restricted the use to very limited applications. It is reported that at least one manufacturer in Europe will use HCFC 141b on industrial scale in the near future.

Acetone
Acetone is reported fully capable in replacing CFC-11. Precautions must be taken in view of its flammability. Only about 60 % is needed compared to CFC-11. Capital outlays and licence fees will put the costs close or equal to those of MC.

AB Technology
This technology utilizes the reaction between TDI and formic acid to create an ABA, consisting of equal amounts of CO and CO2. As this reaction is exothermic, a complete replacement of CFCs is not feasible. Substantial equipment adjustments are needed and monitoring on CO is highly recommended. This technology is used in several European plants, but has found no acceptance in the US, due to safety concerns.

3.3 CHEMICAL MODIFICATIONS

Chemical modifications have been sofar successful applied in foam softening, but fallen short in density reduction.

Extended Range Polyols
These polyols are able to provide a larger range of foam hardness, and, in that way, able to partially replace CFC-11 as a softening agent. Some do also allow the use of lower TDI indexes, and will therefore lower the exotherm. This allows in addition a reduction of the foam density. However, a complete replacement of CFC-11, while maintaining the full production range is not (yet) possible. Additional metering systems and tanks are needed, and the price of the product is higher than conventional polyol.

Softening Additives
Several additives have been developed to modify the chemistry of the flexible PUF production process. These additives are currently exclusively softening technologies, and do not allow densities under 22 kg/m3.

3.4 ALTERNATIVE MANUFACTURING TECHNOLOGIES

Several interesting technologies have recently surfaced, that could be classified as "second generation" replacement technologies for the use of CFCs in flexible PUF (slabstock).

Many common replacement technologies are:

- Environmentally challenged (Methylene Chloride, Methyl Chloroform, Acetone, HCFCs),

or

- o Not capable to a full replacement (extended range polyols, additives).

The 1990 Clean Air Act Amendments in the USA have intensified the focus on emissions from auxiliary blowing agents, and the need to control these. This, in turn, brings up the problem of the fugitive emissions. Fugitive emissions are 45-70 % of the total emissions from the manufacture of flexible PUF (slabstock). Capture and treatment of these emissions in a traditional plant setting seems technical challenging, and most likely cost prohibitive. Traditional technologies, such as:

- o Incineration,
- o Liquid Adsorption, or
- o Carbon adsorption

are ill suited for the treatment of low concentration, high volume areas like the storage and curing rooms, from which these emissions typically originate.

The "second generation" technologies allow the integration of the curing area in the emission control, or even eliminate the use of auxiliary blowing agents altogether.

E-MAX

The E-Max process combines the production and curing steps by encapsulating the developing bunstock in a mold as the foaming mixture is introduced to the foam line. The foam mold allows for all emissions from the process to be controlled and collected, utilizing only low air flows. There is currently one pilot unit in Europe and one full scale plant in the USA. On pilot scale, 85 % recovery of ABA was reported (4). On industrial scale, recovery of Mc in the same range (80-90%) and elimination of measurable emissions of TDI are reported.

The E-MAX process is offered under licence by

Unifoam AG
P.O.Box 118
2180 Hillegom, NL
PH 31-2520-78777
FX 31-2520-20555

ENVIRO-CURE

The Enviro-Cure process is designed to eliminate the need of an auxiliary blowing agent for cooling purposes and, for that matter, for density reduction. The remaining function of an auxiliary blowing agent--softening of the foam--can relative easily be eliminated by chemical softening techniques.

Enviro-Cure achieves this through an enclosed conditioning area, designed to rapidly cool foam blocks. The process is reported to be successfully adapted to all Vertifoam units of one company in the US (5). One unit is currently in construction at a varimax plant of the same company. The process is patented, and its use will induce a licence fee of 1.5% of the chemical costs.

The economic consequences of the utilization of this process are not yet clear. In states where proposed regulations may well forbid the use of auxiliary blowing agents altogether, the inventor claims significant potential savings compared to the alternative of raising the density. Compared to the use of methylene chloride, the process will generate higher chemical costs, in addition to capital and operating costs, but provide space savings related to the elimination of the need for a curing area.

The feedback from future licensees will be needed to allow for a complete evaluation of the merits of this process.

The Enviro-Cure process is offered under licence from Crain Industries by

Canon Viking Ltd.
Hulton House-Chester Road-Hazel Grove
Stockport SK7 5NU, UK
PH 44-61-456-0095
FX 44-61-456-2001

"RAPID COOLING" PROCESS

Similar to the Enviro-Cure process, the "Rapid Cooling" process is designed to completely eliminate the need of auxiliary blowing agents, without sacrificing quality or product range. To achieve this, a two stage cooling device is directly attached to the foam production tunnel, replacing the conventional curing/cooling area.

Significant reformulation is required to implement softening techniques and to make up for reduced crosslinking, related to the elimination of unreacted TDI in the initial phase of the cooling. This reformulation process is not yet completed for all foam grades.

The "Rapid Cure"process is patented, and the employment will induce yet undisclosed licence fees. The chemical costs are reported to be very close to those of methylene chloride blown foams (6). Capital cost range around $ 500,000.

The process is sofar applied in one facility. No licences are granted as of yet.

"Rapid Cure" is offered under licence by

General Foam Division of PMC, Inc.
West 100 Century Road
Paramus, NJ 07652, USA
PH 1-201-262-7500
FX 1-201-262-3159

"WATERLILY" TECHNOLOGY

Development is in progress to produce MDI-based flexible slabstock. One manufacturer has started in 1992 to offer such a system in Europe. It is too early to evaluate response from manufacturers and users. MDI-technology is already successful applied in the flexible molding area.

Some interesting environmental features are:

- o No need for auxiliary blowing agents to achieve softness,
- o Significant lower isocyanate emissions,
- o Rapid curing,
- o Lower exotherm, allowing higher water formulations.

This technology is for the first time presented in the USA in late 1992 (7). A thorough judgment is not yet possible, but it appears that this technology is not yet capable to produce the very low densities without unacceptable sacrifices to physical performance.

"Waterlily" technology is offered by

ICI Polyurethanes
Everslaan 45
B-3078 Everberg
PH 32-2-758-9300
FX 32-2-758-9894

"VACUUM FOAM"

It is well known that the blowing efficiency increases with decreased atmospheric pressure. This allows at higher altitudes the manufacture of lower density foams with less, or no, auxiliary blowing agents. This principle can be applied at lower altitudes by encapsulation of the foam production line and subsequent reduction of the process pressure. One production unit, utilizing this principle, in currently in operation. Results are not yet available.

Further information is available from

Beamech Group Ltd.
Tenax Road, Trafford Park
Manchester, M17 1JT, UK
PH 44-61-848-0316
FX 44-61-873-7718

In summary, it can be concluded that the emerging "second generation" technologies show great promise. The technologies are new. Essential data and sufficient industrial experience are not yet available.

4. REFERENCES

1. USEPA, "Handbook for Reducing and Eliminating Chlorofluorocarbons in Flexible Polyurethane Foam Manufacturing," 1991.
2. Montreal Protocol, "1991 Assessment, Flexible and Rigid Foams," Technical Options Committee.
3. UNEP, "Protecting the Ozone Layer," Volume 4, Foams, 1992.
4. Stoute, J., "E-Max, Environmentally Friendly Foam Production," PFA Fall Meeting, 1992.
5. Ricciardi, M.A., Dai, D.G., "Crain Industries Enviro-Cure Technology Applied to the Vertifoam and Maxfoam Processes," PFA Fall Meeting, 1992.
6. Stone, H. et al, "Low Density Foams Without Auxiliary Blowing Agents for Use with Standard Foam Machines," PFA Fall Meeting, 1992.
7. Casey, M. et al, "The "Waterlily" Range of Quality Comfort Materials from ICI's MDI-based Flexible Slabstock Technology," Proceedings of the SPI Technical/Marketing Conference, 1992.

LaPorte, 11-25-1992
Veenendaal
UNEP.54

EVALUATION CHART
CFC ELIMINATION TECHNOLOGIES FOR FLEXIBLE POLYURETHANE SLABSTOCK

TECHNOLOGY	EVALUATION								REMARKS
	1	2	3	4	5	6	7	8	
Recovery/Recycling	+	+	+/-	-	+	+/-	+	NR	expensive
Methylene Chloride	++	+	++	++	+/-	+	++	R	
Methyl Chloroform	+	+/-	+/-	++	--	+/-	+	NR	ODS
Acetone	+	+	++	+/-	-	++	+	CR	explosive
HCFC 123	+	+	-	++	--	+	+/-	NR	ODS
HCFC 141B	+	+	-	++	--	+	+/-	NR	ODS
AB Process	+	+/-	+	+/-	-	+/-	+	CR	CO gas
Extended Range Polyols	+/-	+/-	+/-	+	++	+/-	+/-	CR	(1)
Additives	+	+	+	+	++	+/-	+	CR	(1)
E-Max	+/-	+/-	+/-	--	+	+	+/-	NR	expensive
Enviro-Cure	+/-	+	+	+/-	++	++	+	CR	(2)
Rapid Cure	-	+	+	+/-	++	++	+/-	NYR	(3)
Waterlily (MDI)	-	?	?	?	+	+/-	+/-	NYR	(3)
Vacuum Foam	-	?	?	?	?	?	-	NYR	(3)

R: recommended. NR: not recommended. CR: conditionally recommended.
NYR: not yet recommended.

1: maturity
2: processing
3: operating costs
4: investment costs
5: environment/safety
6: efficiency
7: availability
8: overall evaluation

Remarks: (1) No complete replacement (yet) possible. To be used in conjunction with other technologies.
(2) Suitable for Vertifoam. Not yet proven for other manufacturing processes.
(3) Insufficient industrial experience.

ANNEX-2

TIANJIN FLEXIBLE FOAM
EXPLANATIONS TO THE BUDGET

0010 **VERTIFOAM MODIFICATIONS**

Tianjin has two parallel vertifoam units, that would require separate curing tunnels. The costs for two units would exceed one million dollar, and was seen as unacceptable high. Combination of certain functions brought the price down to USD 950,000, which was still considered too high. The concept is now to have one dual purpose unit. This would cost LST 475,000 (USD 712,500). This translate in the following budget:

o	One dual purpose Envirocure unit	USD 715,500
o	Freight, Insurance	USD 15,000
o	Diesel generator (local)	USD 20,000
o	Accumulating conveyor	USD 16,250
o	Installation (local, with supervision from Cannon-Viking)	USD 20,000
	TOTAL	**USD 783,750**

0020 **MS LINE MODIFICATIONS**

The conventional line or MS line (from the manufacturer: Martin Sweets) cannot be tied in to the envirocure system. Methylene chloride (MC) is the most economic solution for this unit. In addition, for qualities that are difficult to make with MC as well as for demonstration purposes, the capability for extended range polyols and softening additives will be installed. To control MC emissions the ventilation and encapsulation needs some upgrading. Also, a standard model activated charcoal recovery unit is foreseen. Tianjin has not yet supplied backup documentation for these items. By American/European standards, the prices are low, but only Chinese labor and equipment is involved. The costs are understood as a "not to exceed": higher costs will be absorbed by the enterprize.

0030 TESTING EQUIPMENT

Tianjin has requested the purchase of;

o	One multi purpose tester	USD	21,727
o	One Laboratory foaming unit	USD	10,000
o	Miscellaneous small testers	USD	10,000[4]
	TOTAL	**USD**	**41,727**

Although this equipment is needed for testing of the new foams as well as for assistance for other projects, Tianjin will profit from it for ongoing production as well. It is therefore proposed that only about half will be budgeted (USD 20,000) and that the enterprize will carry the rest.

0040 START-UP

Tianjin intends to purchase extended range polyol and softening agent for trials:

o	30t ER Polyol (Dow) @ USD 1.00.....	USD 30,000
o	3 t Softener (Goldschmidt, Union Carbide, Arco) @ USD 7,00.....	USD 21,000
	TOTAL	**USD 51,000**

The resulting foam will have--even if not up to specification--some residual value. proposed is therefore to budget only 50% of these purchases as costs (USD 25,000).

Training costs include an international consultant:

o	Air ticket	USD	4,000
o	18 Days @ 575	USD	10,350
o	Subsistence, terminal expenses	USD	1,800
o	Training aids	USD	350
	TOTAL	**USD**	**16,500**

Tianjin will carry the costs related to their employees.

---

[4] Prices of the mini foam machine and the miscellaneous test equipment are estimates.

Annex - 3

Price Documentation

PROJECT OF THE GOVERNMENT OF CHINA

PREPARATION PROGRAM FOR THE ELIMINATION OF THE USE OF CFCS IN THE MANUFACTURE OF FOAMS

1. PROJECT OBJECTIVE

The objective of this project is (1) to collect information needed to prepare for a complete phaseout of the use of CFCs in foamed plastics in the Chinese industry, (2) to prepare a strategy and (3) to prepare a detailed action plan for such a phaseout, based on the information collected.

2. SECTOR BACKGROUND

The Chinese foam industry consumed in 1991 17,773 tons CFCs (ref.: Country Programme). CFC-11 was the dominant substance, followed by CFC-12. No other ODS was used in statistical significant amounts, although some MCF may be used in glue applications. Furthermore some MCF and CFC-113 may be used in mold release agents. More detailed information is provided in Table 1:

(sub)category	tons ODS	type ODS
Extruded Polystyrene/ethylene	2,173	CFC-12
Flexible Polyurethane	2,000	CFC-11
Rigid Polyurethane	13,600	
Pipe Insulation	600	CFC-11
Sprayed PUR	600	CFC-11
Appliance Foams	5,000	CFC-11
PUF Panels	7,400	CFC-11
TOTAL	17,773	

Table 1. ODS consumption in the foam sector (1991)

Cannon Viking Ltd 0010 Enviro cure

Hulton House Chester Road Hazel Grove Stockport SK7 5NU
Telephone 061-456 0095 Telex 665458 Fax 061-456 2001
Company Registration No. 1691576 ENGLAND

FAX
MESSAGE

To:	R.A.P.P.A.	Attention:	MR BERT VEENENDAAL
Fax No:	010-1 219 326 6047	Date:	7 May 1993
From:	CHRIS FAWLEY	Reference:	CF/VJM

Dear Bert

Thank you for your fax concerning the Enviro-Cure for Tianjin, however I think there is a little onfusion concerning our offer of 27/4/93. This offer was for two Enviro-Cure tunnels (one round and one rectangular) with combined ventilation units.

Our discussions in Beijing centred around a single Enviro-Cure tunnel which could be converted relatively simply into either a Round or Rectangular Enviro-Cure unit. With this in mind our offer of such a unit at £Stg.475,000 including Supervision of Erection, Commissioning of Licence Fee but excluding Airfare, hotel expenses and living expenses will still apply.

For budget purposes the freight and insurance quotation given on the 27 April of £Stg.10,000 will still apply.

We trust the above clear up most aspects of the offer. As I am in Shanghai from the 20 May to 25 May, I may extend my stay in China to visit Tianjin to make sure our offer is compatible with what they actually need.

In the event of further correspondence in the next two weeks, please contact Mike Cranshaw or Derek Greenwood as I shall be overseas from 9 May onwards.

Please advise as to when a decision will be made on the offer.

Best regards

Chris Fawley

CHRIS FAWLEY

cc Chew Hong - Cannon Asia

Cannon Viking Ltd

1/11
Enviro cure

Hulton House Chester Road Hazel Grove Stockport SK7 5NU
Telephone 061-456 0095 Telex 665458 Fax 061-456 2001
Company Registration No. 1691576 ENGLAND

FAX MESSAGE

To:	R.A.P.A	Attention:	MR B VEENENDAAL
Fax No:	010-1 219 326 6047	Date:	27 April 1993
From:	MIKE CRANSHAW	Reference:	MWC/VJM

Dear Sir,

Re: TIANJIN, P.R.C.

We have pleasure in submitting our quotation for a combined round and rectangular Enviro-Cure Unit for Vertifoam. This is described in the attached specifications nos CV301 and CV302. Please note that the air chiller unit and fans will be common to both units.

The total price is £594,000 F.O.B. U.K Port which converts to US $950,400 at an exchange rate of US $1.6 = £1. We will need to confirm the exact US $ price to you closer to the order.

The price quoted includes for 4 weeks of supervision of erection and commissioning but excludes the cost of airfare and land hotel and living expenses. The price also includes the one-off licence fee payment.

With regard to freight and insurance to Tianjin we estimate this will be between £10,000 and £12,000 and we would confirm this at time of order.

Should you require any further information at this stage please do not hesitate to contact us.

With best regards

Yours sincerely

pp

MIKE CRANSHAW

Cannon

Cannon Viking Limited
Hulton House
Chester Road
Hazel Grove
Stockport SK7 5NU

Viking

Telephone: 061 456 0095
Telex: 665458
Fax: 061-456 2001

SPECIFICATION
No. **CV 301**

ENVIRO-CURE UNIT

for

VERTIFOAM RECTANGULAR FOAM BLOCKS

INTRODUCTION

Enviro-cure is a Process that has been patented by Crain Industries Inc., Technical Division, 2920 South Zero Street, Fort Smith, Arkansas 72906, U.S.A. It has been developed as a continuation of the Vertifoam Process, which allows for full environmental control and the reduction, or elimination, of the auxiliary blowing agents normally required in the manufacture of polyurethane foam.

The Enviro-cure system consists of a slatted conveyor to transport the blocks through an enclosure, three sets of fans to remove the bulk of the heat from the foam blocks and a cooling system to reduce the air temperature at certain times in the Process. (Drawing 0.59671 refers).

INFEED CONVEYOR

This conveyor has two functions. The first is to provide either part, or all, of the delay time necessary to ensure that the block is not cured prematurely with consequential damage to the cell structure, and the second is to ensure that the blocks are butted together before entering the enclosure.

The blocks must be loaded, 25 cms. apart, on to the infeed conveyor. This can be done either manually, or automatically, by means of the optional accumulation conveyor. If done manually, it will be necessary to have a gravity roller conveyor in place of the accumulation conveyor.

THE ENVIRO-CURE CONVEYOR

This unit is designed to resist the forces imposed by the vacuum generated by the fans, transport the block through the enclosure via the two sets of sealing doors and provide an even flow of air through the polyurethane block.

The construction consists of a rigid steel frame, which supports a set of slats that are bolted to two widely spaced conveyor chain circuits. Each circuit is supported by a chain wheel and shaft at each end of the conveyor.

The drive is situated at the outfeed end of the conveyor, ensuring that the power of the motor is applied directly to the top circuit of the chain run.

Special boxes constructed from sheet steel mounted on a rigid frame and fitted with wear resistant sealing strips ensure that the flow of air is applied to the foam block at the correct time and place.

ENVIRO-CURE ENCLOSURE

The enclosure is constructed of sheet steel and hollow section, with access doors at each side and self adjusting sealing doors at each end. Its function is to capture the conditioned air and control the curing environment inside the enclosure.

PLASTIC FILM UNWIND

The Enviro-cure Process requires polyethylene film on both sides of the foam to complete the seal and to ensure the air flow is always downwards through the block.

The plastic film unwind mandrels are mounted on each side of the conveyor, and just prior to the entrance to the enclosure. A variable tension device is fitted to the lower part of the mandrel, whilst the upper part is held with a quick release clamp.

PLASTIC FILM REWIND

The polyethylene film is rewound after the block emerges from the tunnel by means of a second pair of mandrels, which are driven from independent AC geared motors via slipping clutches.

CHILLER UNIT

This unit provides cooling water at a temperature of between 2-4°C. (34-39°F.) which is circulated to the matrix in the cooling circuit of the Enviro-cure. The nominal size of the chiller is 10 tonnes. However, the final sizing will depend on local temperature and humidity conditions, with a consequential price adjustment.

Included with this equipment is a storage tank and a recirculating pump for the 50% Water/50% Glycol required to remove the heat.

OUTFEED CONVEYOR

This is a 2.75 metre (9 ft.) long gravity roller conveyor used to provide support for the blocks at the end of the Enviro-cure conveyor.

ELECTRICAL CONTROLS

Various instruments are supplied to monitor parameters such as the pressure and temperature of the air being circulated, so that the machine can be operated in a safe manner.

The control panel contains all the contactors, circuit breakers, overloads, switches, etc., required for the equipment.

OPTIONAL EXTRAS

1. Standby Generator

60KVA diesel generator that is capable of providing sufficient power to drive a Rectangular Vertifoam and an Enviro-cure in the event of a mains power cut.

2. Accumulating Conveyor

Its purpose is to deliver a foam block out of a Vertifoam elevator and load on to the Enviro-cure infeed conveyor, with a gap between the blocks.

The first part of the conveyor will run at two speeds to assist the unloading of the elevator, whilst the remainder will slip at high speed, but drive at low speed.

3. Gravity Roller Conveyor (Infeed)

As a substitute for the accumulating conveyor, this is offered as an alternative support for the block when transferring from the Vertifoam to the infeed conveyor.

EXCLUSIONS

1. Pipework between the chiller and the cooling circuit matrix local to the machine. (Chiller position is flexible).

2. Stacks from the two main fans that penetrate the fabric of the building.

3. Electrical connection between the chiller and the main panel.

4. Exhaust system for the generator.

5. Fuel tank and pipework for the generator.

6. Installation.

7. Commissioning.

8. Foundation bolts.

9. Civil work.

* * * * * * * * * *

Cannon

Cannon Viking Limited
Hulton House
Chester Road
Hazel Grove
Stockport SK7 5NU

Viking

Telephone: 061 456 0095
Telex: 665458
Fax: 061 456 2001

SPECIFICATION
No. CV 302

ENVIRO-CURE UNIT

for

VERTIFOAM ROUND FOAM BLOCKS

Specification : CV 302
Page : 1

Viking

INTRODUCTION

Enviro-cure is a Process that has been patented by Crain Industries Inc., Technical Division, 2920 South Zero Street, Fort Smith, Arkansas 72906, U.S.A. It has been developed as a continuation of the Vertifoam Process, which allows for full environmental control and the reduction, or elimination, of the auxiliary blowing agents normally required in the manufacture of polyurethane foam.

The Enviro-cure system consists of a slatted conveyor to transport the blocks through an enclosure, three sets of fans to remove the bulk of the heat from the foam blocks and a cooling system to reduce the air temperature at certain times in the Process. (Drawing 0.59672 refers).

INFEED CONVEYOR

This conveyor is to provide either part, or all, of the delay time necessary to ensure that the block is not cured prematurely with consequential damage to the cell structure.

The blocks must be loaded, 25 cms. apart, on to the infeed conveyor. This can be done either manually, or automatically, by means of the optional accumulation conveyor. If done manually, it will be necessary to have a gravity roller conveyor in place of the accumulation conveyor.

THE ENVIRO-CURE CONVEYOR

This unit is designed to resist the forces imposed by the vacuum generated by the fans, transport the block through the enclosure via the two sets of sealing doors and provide an even flow of air through the polyurethane block.

The construction consists of a rigid steel frame, which supports a set of slats that are bolted to two widely spaced conveyor chain circuits. Each circuit is supported by a chain wheel and shaft at each end of the conveyor.

The drive is situated at the outfeed end of the conveyor, ensuring that the power of the motor is applied directly to the top circuit of the chain run.

Special boxes constructed from sheet steel mounted on a rigid frame and fitted with wear resistant sealing strips ensure that the flow of air is applied to the foam block at the correct time and place.

ENVIRO-CURE ENCLOSURE

The enclosure is constructed of sheet steel and hollow section, with access doors at each side and self adjusting sealing doors at each end. Its function is to capture the conditioned air and control the curing environment inside the enclosure.

CHILLER UNIT

This unit provides cooling water at a temperature of between 2-4°C. (34-39°F) which is circulated to the matrix in the cooling circuit of the Enviro-cure. The nominal size of the chiller is 10 tonnes. However, the final sizing will depend on local temperature and humidity conditions, with a consequential price adjustment.

Included with this equipment is a storage tank and a recirculating pump for the 50% Water/50% Glycol required to remove the heat.

OUTFEED CONVEYOR

This is a 2.75 metre (9 ft.) long gravity roller conveyor used to provide support for the blocks at the end of the Enviro-cure conveyor.

ELECTRICAL CONTROLS

Various instruments are supplied to monitor parameters such as the pressure and temperature of the air being circulated, so that the machine can be operated in a safe manner.

The control panel contains all the contactors, circuit breakers, overloads, switches, etc., required for the equipment.

OPTIONAL EXTRAS

1. Standby Generator

100KVA diesel generator that is capable of providing sufficient power to drive a Round Vertifoam and an Enviro-cure in the event of a mains power cut.

2. Accumulating Conveyor

Its purpose is to deliver a foam block out of a Vertifoam elevator and load on to the Enviro-cure infeed conveyor, with a gap between the blocks.

The first part of the conveyor will run at two speeds to assist the unloading of the elevator, whilst the remainder will slip at high speed, but drive at low speed.

3. Gravity Roller Conveyor (Infeed)

As a substitute for the accumulating conveyor, this is offered as an alternative support for the block when transferring from the Vertifoam to the infeed conveyor.

EXCLUSIONS

1. Pipework between the chiller and the cooling circuit matrix local to the machine. (Chiller position is flexible).

2. Stacks from the two main fans that penetrate the fabric of the building.

3. Electrical connection between the chiller and the main panel.

4. Exhaust system for the generator.

5. Fuel tank and pipework for the generator.

6. Installation.

7. Commissioning.

8. Foundation bolts.

9. Civil work.

****

TO 0030 Testing

022-621577 陶忠诚

长春试验机研究所
Changchun Research Institute for Testing Machines (CRITM) china
中国 长春 解放大路104号
No. 104, Jie Fang Road
Changchun, China

编号 (Our reference): 日期 (Date): 邮编 (P.C): 130021 电话(Tel): (0431)654461-32
页码 (Number of pages): 电报 (Telegram): 2623 传真(Fax): (0431)655566

内容 Subject

CSS-1101型电子万能试验机 Quotation: Electronic Universal Testing Mac

负荷测量精度：指示值的±1%（量程20%起）

衰减倍数：1, 2, 5, 10, 20, 50

配10KN, 2KN负荷传感器各一只。

速度范围：0.5~500 mm/min 共13档；

速度精度：±1%（空载）。

横梁位移测量：0~500 mm，分辨率为0.01 mm；

配10KN, 2KN连接件与夹具各一套，压缩试台一付。

配长城286计算机一台，LQ-1600K打印机一台、

XWT-1044S型绘图仪一台及接口。

试验过程可绘负荷-位移测量曲线

打印出试验数据（用户给出试验标准）

注：如换计算机价格另算，交货期为预付款到后8个月

总价：11.95万元。 Price: 119500 RMB yuan ≈ $21727.3/1 set

Including: 1 set computer, 1 set writer.

长春试验机研究所一部 王宝军

Tianjin polyurethane plastic factory
1993.5.

Wun Ho Ping

0048 Trial Mtls

TH. GOLDSCHMIDT AG FAR EAST

ROOM 905 OCEAN CENTRE, HARBOUR CITY, CANTON ROAD, TST, KLN.
TEL: 7358387 FAX: 852-7302861 TELEX: 32175 TEGO HX

REF. NO.: F0485/RL DATE: 29-4-93
FROM: TO:
FAX NO.: (22) 621577 TOTAL NO. OF PAGES 2/4

To: Tianjin Polyurethane Plastics Factory

Attn: Mr. Wen He Ping

We are pleased to quote your enquiry as follows:-

1) Ortegol 310

Qty	:	1 MT
Packing	:	200 kg/drum net
Price	:	USD7.00/kg
Amount	:	USD7,000.00

The above price is CNF Xingang

Total Amount	:	USD7,000.00
Validity	:	15 days from date of this issue.
Payment	:	confirmed and irrevocable L/C payable to TH. GOLDSCHMIDT AG, Goldschmidtstrasse 100, D-4300 Essen 1, Germany. Banker: Deutsche Bank, Essen. Note: please allow 15 days for document presentation and allow "transhipment".
Manufacturer	:	Th. Goldschmidt AG
Origin	:	Germany
Port of Loading	:	European port
Delivery	:	prompt after receipt of workable L/C, subject to vessel availability.

B.Rgds.
JONES WONG/TH. GOLDSCHMIDT AG FAR EAST

Chemical Prices
Methylene Chloride

南京信業股份有限公司
Nanjing Xinye Inc.
南京市中山北路202號科技中心四樓
Tel: 344042 342053
Fax:344147 Telex: 342303 NJXYI CN
Cable: 2256

TELECOPIER MESSAGE

To: Tianjix polyurethane plastic fac
From: Nanjing, china.
Fax:
Date: 1993.5.5
No. of pages: 1/1

宋宝义先生，

您好！

二氯甲烷为荷兰进口，包装为255 kg/桶

吨价7200元.

硅油 DC5230 包装200 kg/桶 吨价56000元

贵厂如需，请速回电。电话34.1035

Quotation:

MC price.

7.200 RMB Yuang/kg = 1.30 $/kg

业务八科
黄 漪
93.5.5

Tianjin polyurethane plastic factory
Wen He ping
1993.5.8.

Was $1.20 before
Have used the 1.20 price.

FROM : PHONE No. : Feb. 17 1994 11:50PM P03

elf atochem
ATO

Elf Atochem China Ltd.
2823, China World Tower
Beijing 100004, P.R. China
Fax: 5052560, 5052561

1, Jianguomenwai Avenue
Tel: 5053336
Telex: 222225 SANCH CN

Chemical Prices

TO: TAINJIN PU FOAM PLANT. FROM: EACL.

ATTN: MR. SONG BAO YI. FAX NO.: 022-621577.

RE: REFERENCE PRICE FOR F-11.

MR. SONG WE ARE VERY SORRY TO INFORM YOU THAT AT PRESENT WE CAN'T SUPPLY YOU WITH F-11. BECAUSE WE HAVE NO AVAILABILITY OF F-11. HERE I JUST CAN GIVE YOU A REFERENCE PRICE FOR F-11, THAT IS USD 1500/MT CNF CMP. THIS PRICE JUST FOR YOUR REFERENCE.

BEST REGARDS.

ZHANG HUI LIANG.

USD 1.80/kg + Tax ~ USD 2.50/kg

埃尔夫阿托化学中国有限公司北京联络处
北京建国门外大街1号国贸大厦2823室 电话:5053336 传真:5052560 电传:222225 SANCH CN

Chemical P.Mcs

SUNKYONG LTD.

BEIJING OFFICE
25/F ,CHINA WORLD TOWER, NO. 1 JIAN GUO MEN WAI AVENUE,BEIJING,CHINA.
TEL: 505-2245/49 FAX: 505-2250 TELEX: 210637 SKBJ CN

FACSIMILE NOTE		DATE: 93.5.4	
TO	CO. : TIANJIN PU PLASTIC FACTORY.	TTL (1) PAGES INCLDG COVER	
	DEPT. :	FROM	DEPT. :
	NAME : MR.SONG BAOYI		NAME :
	FAX NO. :		TEL. :
			MES NO. :

RE : TDI 80/20

WE OFFER AS UNDER:

(AA) ITEM : TDI 80/20

SHIPT: JUNE

QTTY : 200MT

PRICE: USD1900/MT CNF XINGANG

PACKG: 210KGS IN STEEL DRUM

MAKER: KOREA FINE CHEMICAL CO.

USD 1.9 / Kg
+ Tax ~ USD 3.3 / kg

(BB) RE FOREON F-11

QTTY : 10 MT

PRICE : USD1500/MT CNF XINGANG

REMARKS : SUBJECT TO OUR FINAL CONFIRMATION.

WAITTING YR REPLY.

SUNKYONG,BEIJING

5.4.

Tianjin polyurethane plastic factory

Wen He Ping

Bert Veenendaal

FOAMS CONSULTANT UNDP
104 Fieldstone Drive
LaPorte, IN 46350
PH: (219) 362-4450
FX: (219) 326-6047

MEMORANDUM

Date : May 14, 1993
Pages: 2
To : UNDP/BPPE/ENR
Att : Mr. Frank J.P. Pinto

Subject: Tianjin Flexible Foam Project

We have reviewed the information provided for the project

"Tianjin Conversion to CFC-free Technology in the Manufacture of Flexible Polyurethane Foam."

This information was comprised of:

- The original project write-up,
- The final project write-up, prepared with the help of UNDP,
- Quotations on essential equipment to be purchased,
- Discussions with the companies that own and distribute the underlying technology for the main part (Envirocure) of the project.

1. CHOICE OF TECHNOLOGY

We agree with Tianjin's choice of ODS- phaseout technology, and, as a matter of fact, have closely cooperated in the decision process to this choice. The choice should be seen under the Chinese decision to establish the Tianjin factory as the center of ODS replacement efforts in flexible PUF. It was therefore preferable--and on long term cost effective for the country program--to establish more than one technology at Tianjin. With the need to retrofit three machines and the choice of three different technologies:

- Accelerated Curing,
- Methylene Chloride,
- Extended Range Polyols/softening additives.

it is possible to provide China with a wide array of different technologies that all have their merit in specific circumstances (i.e. the type of production equipment, the product mix) without sacrificing the cost effectiveness of this particular project in an unacceptable way. The unit abatement costs of just 0.60 USD/kg/y show this.

2. PROJECT COSTS

2.1 TOTAL PROJECT COSTS

We had several discussions with Crain Industries--the owner of the technology--and with Canon-Viking--the exclusive manufacturer and distributor of the technology. These discussions have brought the costs of the Envirocure equipment down from originally USD 1,125,000 to USD 712,500. The cost reduction was obtained by combination of the two units required into one multiple purpose unit, and by Canon-Viking's willingness toa absorp the related additional engineering costs.

The costs components that are related to locally purchased equipment are somewhat poorly documented. The main barrier seems to be the translation of the quotations into the English language. These cost components constitute however the smaller part of the project. In addition, the amounts submitted are in international context very competitive.

We feel the laboratory costs justified by the future need to assist other plants in their phaseout projects.

2.2 INCREMENTAL RECURRING COSTS

Originally Tianjin calculated considerable recurring incremental costs. We have recalculated these, and found some misconceptions in the product formulations. We expect no, or unsubstantial extra costs, have, however added in the project costs some assistance to help the company in reformulating their products.

The senior engineer from Tianjin, Mr. Song Mao Ling, is recommended by us to MLI as a future national expert for flexible foams. This project will provide Mr. Song with considerable training and experience at no additional costs.

We recommend this project for approval.

The Montreal Protocol on Substances that Deplete the Ozone Layer

CHINA - SECOND MULTICOMPONENT ODS PHASEOUT INVESTMENT PROJECT

1. Background. At its Eighth Meeting in March 1993, the Executive Committee (EC) granted "permission to proceed" for China's "50% Reduced CFC Foam Project" (50% Foam Project), comprised of 13 components with requested total incremental cost of US$7,678,000. The EC noted that "permission to proceed" would in no way prejudice the final approval of the funding level when the World Bank would re-submit the project with the information requested, including individual Project Summaries for each component, and responses to EC and Ozone Operations Resource Group (OORG) queries.

2. The 50% Foam Project, at a funding level of US$1,878,000[1], was approved at the EC's Sixth Meeting in June 1992. However, the submission had been based on preliminary and incomplete cost data and analysis, and in particular did not consider recurring costs under prices prevailing in China. The Chinese enterprises were requested to re-submit each of the components after addressing issues raised in the OORG and EC review, with special attention to full justification for funding requests, including both investment and recurring costs/benefits.

3. During April 24-27, 1993, the OORG foam expert, Dr. Michael Jeffs, held discussions with 10 of the 13 enterprises participating in the 50% Foam Project in Beijing (detailed questionnaires were left for the remaining three enterprises). These discussions included the scope of projects, costs, and the eligibility of requested funding. The enterprise representatives agreed to eliminate expenses which did not meet eligibility criteria. Dr. Jeffs clarified that the projects involving production of polyol were necessary to reduce CFC-11, that proposals did not involve expansion of existing production capacity, and that chemical prices were reasonable based on prevailing conditions in China and a review of world prices. As several substantial issues for the Yantai project component were unresolved, it was agreed that NEPA would exclude the component from this submission, but would clarify the project scope and justify its eligibility in accordance with MP financing guidelines for future consideration.

4. NEPA, working with the participating enterprises, coordinated with World Bank staff to complete individual project summaries for all project components in accordance with Dr. Jeffs' comments. Project incremental costs were calculated by the Bank, using the agreed methodology based on cost and price information provided by NEPA and agreed to by the Bank and OORG. Bank consultants concurred that the quantities and composition of raw materials used the basis for recurring incremental cost calculations for the refrigerator/panel components are consistent with amounts used for production of similar products in Japan and Europe. Due to the apparent profitability of new polyol and blended polyol production at one raw material supplier (Shanghai #6), the project component is ineligible for grant financing. Thus, the revised submission includes 11 of the original 13 project components (Yantai and Shanghai #6 are excluded).

5. Funding Request. This submission amends the World Banks's *Progress Report to the 10th Meeting of the Executive Committee* regarding the project submission for China to consider final approval of the 11 component "50% Reduced CFC Foam Project" and requests, in addition to the $1,878,000 already approved for this project (June 1992), $4,058,000 in incremental costs from the Fund. This additional funding request is based on a total grant request of $5,936,000 in eligible incremental costs, including $3,079,000 in requested investment costs, $2,083,000 in recurring incremental costs net of benefits, and $744,000 contingency. A Project Summary for the complete Project is attached as well as 11 Project Summaries, one for each project component. A 15% contingency was added to the overall Project, and is excluded from the 11 component project summaries.

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[1] Excluding $480,000 subproject component transferred to UNDP.

国 家 环 境 保 护 局

CHINA NATIONAL ENVIRONMENTAL PROTECTION AGENCY

No. 115, Xizhimennei Nanxiaojie, Beijing100035, The People's Republic of China

FAX TRANSMISSION

Sign and Issue 吴宝中 Date May 20, 1993

To:

Name Mr. Donald Brown

Organization Dept. (air) No. 61310

City/Country World Bank U.S.A

Fax No. (202) 477-6619

From:

Name Wu Baozhong

Dept Pollution Control Dept, NEPA

Fax No. 8328013

Tel 8329911-3604

Total Number of Pages 5 (Including This Cover Page)

Dear Mr.Brown:

Thank you for your attached proposal, we agree that you submit the 50% Reduced CFC Foam Project for additional funding requesting $ 4,058,000 for 11 subcomponents. If possible we hope that the Yantai and Shanghai #6 subcomponents will be discussed later in order to facilitate the submission to the next MFEC meeting.

Attached is the draft Financial Agency Agreement between NEPA and CIB and the draft agreement between NEPA and MOF for your reference.

Sincerely yours

Wu Baozhong
NEPA

吴宝中 20/5-93

Ms. J. Poppele
The World Bank
Ozone Operations Coordinator
Environment Department
GECD
1818 H Street, N.W.
Washington, D.C. 20433
USA

18th May, 1993

Dear Jessica:

I have reviewed the 50% reduced CFC Foam sub-projects for the following enterprises:

Liming Research Institute
510 Research Institute
Shenyang Petrochemical Plant
Wuxi Foam Material Factory
Tianjin PU (Polyols and panels)
Shangling
Qindao Haier
Xinfei
Shuangyan
Chengde
Dalian

I confirm that I support these projects. During appraisal the following points should be taken into consideration:

- guidelines for training programmes should be established and adhered to - also training programmes aboard are not required;
- trial production runs for Liming and Tianjin should be capped at $25,000 and $50,000 respectively;
- equipment procurement should be based on competitive quotations, especially the viscosity meter for Qindao Haier and DSC for Liming;
- storage tanks for Shuangyan need justification.

Yours sincerely,

Dr. G. M. F. Jeffs - OORG MD 152
ICI Polyurethanes

THE MONTREAL PROTOCOL ON SUBSTANCES THAT DEPLETE THE OZONE LAYER

PROJECT COVER SHEET

COUNTRY:	CHINA	
PROJECT TITLE:	50% Reduced CFC Foam	
SECTOR COVERED:	Rigid Polyurethane Foam	
ODS CONSUMPTION IN SECTOR (1991):	13,000 MT CFC-11 (13,000 MT ODP)	
PROJECT DURATION:	4 years	
PROJECT IMPACT:	Phase out 372 MT CFC-11 (372 MT ODP)	
TOTAL PROJECT COST:	US$ 7,165,000	
	of which costs provided by enterprises:	US$ 2,003,000
PROPOSED OTF GRANT:	US$ 5,936,000	
	of which capital costs:	US$3,079,000
	of which recurring incremental costs net benefits:	US$2,083,000
	of which 15% contingency:	US$ 774,000
COST EFFECTIVENESS:	$4.60/kg ODP/year[1]	

IMPLEMENTING ENTERPRISES:

Design Institutions:	Liming Research Institute 510 Research Institute of the Ministry of Aeronautics and Aerospace
Chemical Producers:	Shenyang Petrochemical Plant Wuxi KZ Foam Factory Tianjin PU Plastics (also user)
Four Refrigerator Factories (Users):	Shangling Qindao Haier Xin Fei Shuang Yan
Three Panel Manufacturers (Users):	Tianjin PU Plastics Chengde Commercial Machinery Dalian

NATIONAL COORDINATING AGENCIES:	Ministry of Light Industry (MLI) and the National Environmental Protection Agency (NEPA)
IMPLEMENTING AGENCY:	World Bank

[1] For cross-country comparisons, capital costs requested from OTF were annualized over 4 years using 10% discount rate.

PROJECT SUMMARY

This project will demonstrate the commercial applicability of 50% reduced foam technology in polyurethane (PU) insulation foam applications by converting four refrigerator and three panel manufacturers. In addition, the project will adapt three domestic polyol suppliers to the production of material compatible with the reduced CFC formulation. The reduced CFC foam formulation will be phased in at the seven manufacturers resulting in a phaseout of 372 tons of CFC-11 per year at full production. Domestic production of HCFCs in China is at laboratory capacity and will not be industrially applicable for several years. Reduced CFC foam formulations have been applied commercially in Europe and other areas as short term CFC reduction measures.

SECTOR BACKGROUND

Consumption of CFC-11 in rigid PU insulation applications in China was about 13,000 tons in 1991. 50% of consumption went to rigid PU panel production, 30% to household refrigerators, 10% to other refrigeration equipment, 6% for in-situ spraying and 4% to making pipe sleeves. MLI predicts that in 1996 the consumption of CFC-11 in household refrigerators will reach 8,500 tons, panels will reach 11,200 tons, in-situ spraying will achieve 1,400 tons, and pipes will be 1,000 tons for a total of 22,100 tons in the sector.

PROJECT OBJECTIVES

The objectives are to:

1) Adopt a CFC foam formulation at three panel manufacturers and four household refrigerator factories to demonstrate the commercial applicability of low CFC formulations as an interim measure for China's rigid PU insulation applications; and

2) Using locally developed technologies, convert three domestic polyol manufactures to produce polyol and blended polyol compatible with the reduced CFC formulations.

PROJECT DESCRIPTION

The use of reduced CFC foam formulations is impeded by a lack of domestic raw material suppliers, by concerns about long-term foam stability, and by higher price. This Project will remove these barriers by demonstrating the new technology at several manufacturers and by converting domestic materials producers to the production of compatible materials.

The Liming Research Institute and the 510 Research Institute of the Ministry of Aeronautics and Aerospace (MAA) have developed polyols compatible with reduced CFC foam formulations. These institutes will transfer their new polyol technology to Wuxi KZ Foam Factory, Shenyang Petrochemical Plant, Tianjin PU Plastics and other domestic polyol/blended polyol producers. About 75% of the polyether polyols used in China are produced locally. However no local producers can yet produce a polyol compatible with a 50% reduced CFC formula. Thus, the major impact of this project will be to transform the whole rigid insulation foam industry by addressing the supply issue.

Four refrigerator plants and three panel manufacturers will adopt the reduced foam formulation. Conversion will include trial runs to optimize formula and blowing technique, training, batch production and full scale conversion. Factories will use domestic raw materials to demonstrate their performance. The new foam formulation will be used with existing foam blowing equipment.

The Beijing Household Electrical Appliances Research Center (BHEARI), will serve as a testing, evaluation and promotion center for reduced CFC technology. ICI, an multinational chemical manufacturer, has equipped the center with foam testing equipment. A UNDP-supported project will provide further technical training to BHEARI. The center will conduct performance tests to ensure product quality, set appropriate standards, provide technical assistance to factories, and promote results among all refrigerator manufacturers.

PROJECT COSTS AND INCREMENTAL COSTS

Project costs are given in the attached table, which notes price assumptions for the old chemicals and projected prices for chemicals compatible with the low CFC formulation. Incremental operating costs/benefits reflect increased quantities for certain foam raw materials (MDI) and increased prices/costs for others (polyol/blended polyol). Fifteen percent (15%) of the total project incremental cost requested from the OTF was added as contingency.

Capital costs for the 11 components, foreign and domestic, total US$ 5.082 million. The project sponsors have limited their grant request to US$ 3.079 million, mainly foreign exchange costs. There are no taxes included in the capital cost estimates. Incremental costs for the chemical producers were determined on the basis that only a small increase in chemical price could be passed on under market conditions in China. The Bank concurs with this judgement and confirms that there is no double counting of eligible incremental costs in the aggregate projects.

Incremental operating costs/benefits are based on the incremental price of chemicals, the incremental quantity of chemicals consumed and the relevant quantity of CFC-11 required, discounted at 12% over a four year period. As China's domestic production capacity for CFC-11/12 is sufficient to meet projected demand through 1997, CFC-11 prices were held constant to reflect expected local conditions. For Project components, recurring costs are considered through 1997 under the presumption that enterprises will subsequently switch to a non-CFC blowing agent as non-CFC technology becomes commercially available in China.

The total grant request (incremental cost) for the 11 components including captial costs, recurring incremental costs net of benefits, and 15% contingency is US$ 5.936 million. Of this, US$ 2.083 million is requested for recurring incremental costs net of benefits for four years.

FINANCIAL AND ECONOMIC ANALYSIS

The internal rates of return calculated in financial and economic terms for the components to this subproject will be presented in the China Investment Banks's (CIB's) financial appraisal, which will also include the financial viability of the enterprises. A financing plan will be determined in the financial appraisal, and will include all sources, terms and conditions.

PROJECT IMPLEMENTATION

Project implementation will be coordinated by MLI under the Project Management office in NEPA. Eleven enterprises from five ministries namely: MLI, The Ministry of Commerce (MOC), the Ministry of Chemical Industry (MCI), MAA and the Ministry of Machinery Building Industry (MMI), will participate in the Project. The ministry responsible for the institutes and factories falling under its jurisdiction will support their activities. Each enterprise will be responsible for actual subproject implementation. CIB will supervise procurement and disbursements, and be responsible for audit reports. NEPA/CIB will be responsible for quarterly progress reports during implementation. The project employs commercially available technology in China's largest CFC use sector with sufficient technical assistance to ensure project success.

PROJECT RESULTS

This project will remove 372 tons of CFC-11 per year in the fourth year of project implementation when all components have reached full production. In addition, this project ensures a stable local supply of key foam raw materials compatible with low CFC foam formulations which will facilitate wide spread application of the reduced CFC foam technology.

TECHNICAL ASSESSMENT

Support for this project was given by the OORG reviewer, Dr. Michael Jeffs. A copy of his review is attached.

jp\db c#foam50.593
19-May-93

50% REDUCED CFC FOAM PROJECT - TABLE 1

	ODS Phased Out Per Year (mt)	Total Investment (US$1,000)	Local (US$1,000)	Foreign (US$1,000)	OTF Investment Request (US$1,000)	NPV 4 Year Cost (US$1,000)	Proposed Total OTF Financing (US$1,000)
Design Institutes:							
Liming	0	594	90	504	504	0	504
510	0	371	66	305	305	0	305
Raw Materials:							
Shenyang	0	485	NA	NA	485	-333	152
Wuxi [Tianjin]	0	741	423	318	318	-51	267
Panel:							
Chengde	32	143	26	117	117	46	163
Dalian	14	294	96	198	198	77	275
Tianjin	31	310	NA	NA	306	144	450
Refrigerator:							
Qindao	61	294	100	194	229	312	541
Xinfei	103	464	300	164	164	878	1042
Shangling	103	684	413	271	271	687	958
Shuangyan	28	702	520	182	182	323	505
SUB-TOTAL	372	5082			3079	2083	5162
(Contingency 15%)		762			462	312	774
GRAND TOTAL	372	5844			3541	2395	5936

PRICE ASSUMPTIONS (in US$/kg):

General:

1. Constant CFC-11 price 2.545 used for all price projections (China's domestic production capacity for CFC-11/12 is sufficient to meet projected demand through 1997).

Refrigerant:

1. Baseline blended polyol range: 2.454 - 2.714
2. Project blended polyol range: 2.636 - 3.067

Panel:

1. Baseline blended polyol: 2.727
2. Project blended polyol range: 2.818 - 2.909
3. Baseline polyol: 2.065
4. Project polyol: 2.182

THE MONTREAL PROTOCOL ON
SUBSTANCES THAT DEPLETE THE OZONE LAYER

PROJECT COVER SHEET

COUNTRY:	China
PROJECT TITLE:	Liming Research and Development of Polyol and Blended Polyol Production Techniques for 50% Reduced CFC Foam
SECTOR COVERED:	Rigid Polyurethane (PU) Foam
ODS USE IN SECTOR:	13,000 MT CFC-11 in 1991 (13,000 MT ODP)
PROJECT IMPACT:	Facilitate domestic production of polyols compatible with 50% reduced CFC foam
PROJECT DURATION:	2 years
PROJECT ECONOMIC LIFE:	4 years
TOTAL PROJECT COST:	US$ 90,000 Capital Costs Provided by Enterprise US$ 504,000 Capital Costs Requested from OTF US$ 0 Recurring Incremental Costs[1]
PROPOSED OTF FINANCING:	US$ 504,000
IMPLEMENTING ENTERPRISE:	Liming Chemical Research Institute (LCRI)
NATIONAL COORDINATING BODIES:	Ministry of Light Industry (MLI) and the National Environmental Protection Agency (NEPA)
IMPLEMENTING AGENCY:	The World Bank

[1] Net present value of incremental costs for the first four years discounted at 12%. Because LCRI is a research institute and does not sell products on the open market, there are no recurring incremental costs/savings for this project.

PROJECT SUMMARY

This project will enhance production techniques of polyether polyol feedstock and subsequent blended polyol compatible with reduced CFC foam formulations at the Liming Chemical Research Institute (LCRI). LCRI will refine present laboratory scale production techniques for reduced CFC compatible polyols and establish a pilot production facility to produce both the new polyols and blended polyol. After the pilot production line is optimized, this technology will be transferred to commercial manufacturers/suppliers of blended polyols.

This project will optimize and facilitate the implementation of emerging alternative technologies in China's largest CFC use sector (in both percent ODS and ODP). This project is included in China's Country Program, which was finalized in January 1993 and approved at the Ninth Meeting of the Executive Committee in Montreal, March 1993.

PROJECT OBJECTIVES

The objectives of this project are to: (i) establish a pilot plant for domestic production of 50% reduced CFC compatible polyols; (ii) establish a pilot plant for blended reduced CFC compatible polyols; and (iii) adapt pilot production techniques to industrial scale production of reduced CFC foam polyols and polyol blends.

ENTERPRISE BACKGROUND

LCRI is a comprehensive PU foams research institute under the Ministry of Chemical Industry (MCI). The Department of Polyurethane Development was established to enhance China's domestic production of PU foam feedstocks and has consistently produced products comparable to those from developed countries. LCRI has developed laboratory scale production of polyols compatible with 50% reduced PU insulation and blending processes which have produced finished PU foams meeting national standards.

PROJECT DESCRIPTION

The use of reduced CFC foam formulations is impeded by a lack of domestic raw material suppliers. Specifically, reduced CFC compatible polyols are not commercially available in China. LCRI has successfully developed polyols compatible with low CFC foam formulations. This project will demonstrate the new technology on the pilot level and facilitate the expansion of polyol production and blending processes to industrial capacity. The training included in this project consists of on-site direction from foreign chemical suppliers, and technical exchange with domestic experts.

This project consists of the following eight stages:

STAGE 1: LCRI will refine synthesis techniques for polyols and blended polyols compatible with reduced CFC foams. Synthesis techniques compatible with industrial manufacturing processes will be developed.

STAGE 2: LCRI will establish 200 MT capacity pilot plants for the manufacture of polyether polyols compatible with reduced CFC foam formulation and the blending of these polyols. Trial production will begin.

STAGE 3: LCRI will optimize polyol formulation and adjust the polyol blending process so that foaming characteristics, finished foam properties, repeatability of production and blending processes, and the blended polyol shelf life will achieve the level of 50% reduced CFC formulations currently manufactured in developed countries. Finished rigid PU foam products will also be tested for quality.

STAGE 4: LCRI will cooperate with the Shenyang Petrochemical Factory (SPF) to perform trial runs on SPF's production equipment.

STAGE 5: This stage will occur simultaneously with Stage 4. Foreign and local experts will be brought to LCRI to further optimize industrial scale production methods. The experts will also assist in training SPF's staff for the trial runs.

STAGE 6: LCRI will begin work on the manufacture of polyols and blended polyols compatible with reduced CFC foam for use in cold storage, ice cupboards, and panel insulation.

STAGE 7: LCRI will conduct life test research on foam products manufactured with the reduced CFC compatible polyol and blended polyol. Formulations will be adjusted to achieve product quality in developed countries.

STAGE 8: LCRI will expand research and development of CFC-free foam technologies. Research will focus on industrial scale manufacturing techniques for non-ODS blowing agents.

PROJECT COST

Summary of Project Costs: The total project incremental cost of US$594,000, of which US$504,000 is the total requested from OTF as grant, was calculated as the economic capital costs. There are no recurring incremental costs or benefits considered as LCRI will provide the technology to polyol manufacturers with no license fee.

Capital Costs: Capital costs of US$594,000 include capital investment in production line equipment, training, raw materials, utilities, test instruments for assessing the integrity of products and processes, and costs associated with transferring technologies developed by the project to commercial manufacturers. Costs for foreign consultants are also included. This project requests US$504,000 from OTF for capital costs. The enterprise will provide US$90,000 for counterpart financing for the project.

Incremental Recurrent Costs/Benefits: Because LCRI is a research institute and does not sell products on the open market, there are no recurring costs/benefits for this project.

PROJECT IMPLEMENTATION

Management: The Ministry of Light Industry and National Environmental Protection Agency will oversee the successful implementation of this project. The project will be carried out at Liming Chemical Research Institute.

Schedule:

TASK	1993		1994				1995				1996			
	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Project planning	x	x												
Installation of new materials		x	x	x										
Design quality control equipment		x	x											
Install quality control equipment				x	x									
Run quality control system					x	x	x	x	x	x	x	x	x	x
Popularize techniques				x	x	x	x	x						
Arrange & carry out training (foreign expert)		x	x	x										
Arrange & carry out training (domestic expert)		x	x	x	x	x								

RESULTS: This project will result in the development of industrial scale synthesis techniques for polyether polyols and blended polyol compatible with 50% reduced CFC-11 foams. The project will also develop methods for adapting this technology to a variety of refrigeration applications. The project will provide China with a source of domestic feedstocks for polyols and blended polyol compatible with reduced CFC foam technology, facilitating the adoption of reduced CFC foams.

ANNEX 1: Breakdown of Investment Costs

$US = RMB 5.5

	RMB 1,000	US$ 1,000
STAGE 1: Synthesis Techniques - Requested from OTF		
EQUIPMENT FOR NEW POLYOL		
Reactor	111	20
Reactor	233	42
Gauge Tank	17	3
Polymerizing Reactor	98	18
Refining Reactor	33	6
Storage Tank 1	6	1
Storage Tank 2	10	2
Filter	6	1
Vacuum Pump 1	4	1
Vacuum Pump 2 (2)	8	1
Buffer Tank (3)	33	6
RAW MATERIALS FOR TRIAL RUNS		
New Polyol	14	2
Blended Polyol	28	5
TRAINING		
New Polyol	47	8
Blended Polyol	47	8
FUEL AND POWER		
New Polyol	3	1
Blended Polyol	4	1
EXPERIMENTAL COSTS		
New Polyol	29	5
Blended Polyol	60	11
DEPRECIATIONS		
New Polyol	4	1
Blended Polyol	4	1
SUBTOTAL - Requested from OTF	**799**	**144**

	RMB 1,000	US$ 1,000
STAGE 2: Trial Production - Requested from OTF		
FUEL AND POWER		
New Polyol	1	0
Blended Polyol	4	1
TRAINING		
New Polyol	75	13
Blended Polyol	112	21
EXPERIMENTAL COSTS		
New Polyol	28	5
Blended Polyol	55	10
DEPRECIATIONS		
New Polyol	36	6
Blended Polyol	22	4
SUBTOTAL - Requested from OTF	**333**	**60**
STAGE 3: Testing Products - Requested from OTF		
Test Instruments		
V.P.O.	89	16
Closed Cell Meter	34	6
D.S.C.	550	100
SUBTOTAL - Requested from OTF	**673**	**122**
STAGE 4: Trial Production at Chemical Manufacturers - Requested from OTF		
Equipment	100	18
Raw Materials, Fuel & Power	120	22
Transportation	50	9
Labor	60	11
SUBTOTAL - Requested from OTF	**330**	**60**
STAGE 5: Technical Exchange & Consultants - Requested from OTF		
Training (2)	195	35
SUBTOTAL - Requested from OTF	**195**	**35**

STAGE 6 - Requested from OTF		
Techniques for Cold Storage, Ice Cupboard and Panel Insulation	165	30
SUBTOTAL - Requested from OTF	**165**	**30**
STAGE 7 - Requested from OTF		
50% Reduced Foam Life Test Research	292	53
SUBTOTAL - Requested from OTF	**292**	**53**
STAGE 8 - Provided by Institute		
Research & Development of CFC-free Foam Technologies	495	90
SUBTOTAL - Provided by Institute	**495**	**90**
TOTAL - Provided by Institute	495	90
TOTAL - Requested from OTF	2772	504
GRAND TOTAL	3267	594

THE MONTREAL PROTOCOL ON
SUBSTANCES THAT DEPLETE THE OZONE LAYER

PROJECT COVER SHEET

COUNTRY:	China
PROJECT TITLE:	No. 510 Research Institute Research and Development of Polyol and Blended Polyol Production Techniques for 50% Reduced CFC Foam
SECTOR COVERED:	Rigid Polyurethane Foam
ODS USE IN SECTOR:	13,000 MT CFC-11 in 1991 (13,000 MT ODP)
PROJECT IMPACT:	Facilitate domestic production of polyols compatible with 50% reduced CFC foam
PROJECT DURATION:	2 years
PROJECT ECONOMIC LIFE:	4 years
TOTAL PROJECT COST:	US$ 66,000 Capital Costs Provided by Institute US$305,000 Capital Costs Requested from OTF US$ 0 Recurring Incremental Costs[1]
PROPOSED OTF FINANCING:	US$305,000
IMPLEMENTING ENTERPRISE:	No. 510 Research Institute (510) of the Ministry of Aeronautics and Aerospace (MAA)
NATIONAL COORDINATING BODIES:	Ministry of Light Industry (MLI) and the National Environmental Protection Agency (NEPA)
IMPLEMENTING AGENCY:	The World Bank

[1] Net present value of incremental costs for the first four years discounted at 12%. Because 510 is a research institute and does not sell products on the open market, there are no recurring incremental costs/savings for this project.

PROJECT SUMMARY

This project will enhance production techniques for polyether polyol feedstock and subsequent blended polyol compatible with reduced CFC foam formulations at the No. 510 Research Institute (510) of the Ministry of Aeronautics and Aerospace Industry (MAA). 510 will refine present laboratory scale production techniques for reduced CFC compatible polyols and establish a pilot production facility to produce both the new polyols and blended polyol. The project will study polyol and blended polyol formulations applicable to household refrigeration, insulation panels, and in-situ spraying, as well as research on non-ODS foaming techniques. After the pilot production line is optimized, this technology will be transferred to commercial manufacturers/suppliers of blended polyols.

This project will optimize and facilitate the implementation of emerging alternative technologies in China's largest CFC use sector (in both percent ODS and ODP). This project is included in China's Country Program, which was finalized in January 1993 and approved at the Ninth Meeting of the Executive Committee in Montreal, March 1993.

PROJECT OBJECTIVES

The objectives of this project are to: (i) refine formulation of polyether polyols and blended polyol suitable for household refrigeration, panel insulation, and in-situ spraying; (ii) adapt laboratory techniques to industrial scale production; and (iii) transfer reduced CFC polyol and blended polyol technologies to commercial manufacturers/suppliers.

ENTERPRISE BACKGROUND

510 is a comprehensive research institute for vacuum and low temperature applications under MAA. In 1990, 510 developed laboratory scale production of 50% reduced CFC compatible polyols and blended polyol for use in household refrigeration, panel insulation, and in-situ spraying. The quality of finished products made with these polyols was tested at a variety of factories, and all results met national standards.

PROJECT DESCRIPTION

The use of reduced CFC foam formulations is impeded by a lack of domestic raw material suppliers. Specifically, reduced CFC compatible polyols are not commercially available in China. This project will facilitate domestic production of polyols compatible with 50%-reduced CFC foam by refining laboratory scale domestic production techniques and adapting these techniques to industrial scale production.

Trial production at commercial chemical plants will be included to optimize industrial production techniques. Trial production runs will also evaluate foaming characteristics, finished foam properties, repeatability of production and blending processes, and the blended polyol shelf life to achieve the level of 50% reduced CFC formulations currently manufactured in developed countries. The training included in this project consists of on-site direction from foreign and domestic experts.

PROJECT COST

Summary of Project Costs: The total project incremental cost of US$371,000, of which US$305,000 is the total requested from OTF as grant, was calculated as the economic capital costs. There are no recurring incremental costs or benefits to be considered.

Capital Costs: Capital costs of US$371,000 include capital investment in formulation equipment, training, raw materials, technical exchange, industrial process simulation equipment, and costs associated with trial

production. This project requests US$305,000 from OTF for capital costs. The enterprise will provide US$66,000 for counterpart financing for the project.

Incremental Recurrent Costs/Benefits: Because 510 is a research institute and does not sell products on the open market, there are no recurring costs/benefits for this project.

PROJECT IMPLEMENTATION

Management: The Ministry of Light Industry and National Environmental Protection Agency will oversee the successful implementation of this project. The project will be carried out at the No. 510 Research Institute of the Ministry of Aeronautics and Aerospace.

Schedule:

TASK	1993		1994				1995				1996			
	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Project planning	x													
Procure equipment		x												
Perfect low-CFC formulation for refrigerators		x	x											
Design and install simulation system			x											
Procure other project equipment			x											
Arrange & carry out training (foreign experts)				x										
Arrange & carry out training (domestic experts)					x									
Optimize low-CFC formulation for sandwich panel				x	x									
Optimize low-CFC formulation for in site spraying					x	x								
Trial production									x					
Production appraisal							x							
Technology transfer								x	x					
Worker training									x					

RESULTS: This project will develop industrial scale synthesis techniques for polyether polyols and blended polyol compatible with 50% reduced CFC-11 foams for application in household refrigeration, panel insulation, and in-situ spraying. The project will provide China with a source of domestic feedstock polyols and blended polyol compatible with reduced CFC foam technology, facilitating the adoption of reduced CFC foams.

ANNEX 1: Breakdown of Investment Costs

$US = RMB 5.5

	RMB 1,000	US$ 1,000
EQUIPMENT		
Provided by Institute		
General		
Hydroxyl Content Meter	3	0.5
Viscosimeter	2	0.3
Acid Content Meter	3	0.5
Quick Division Equipment	4	0.7
Cohesion Meter	28	5
Air-Foam Osmosis Meter	55	10
Hygroscpopy Testing Equipment	28	5
For In-Situ Formulation		
Little Spraying Machine	83	15
Requested from OTF		
General		
Water Content Meter	5	1
Heat Transfer Coefficient Meter	33	6
Closed cell content meter	28	5
Gas Chromatograph	110	20
Universal Testing Machine	68	12
Microphotography Equipment	344	63
Combustion-Obstruction Meter	69	13
Industrial Process Simulation Equipment		
Small High Pressure Foaming Machine	172	31
Mold Control Microcomputer	193	35
Flow Index Meter	35	6
Foam Gel Curve Meter	138	25
Design costs	226	41
SUBTOTAL - Provided by Institute	**206**	**37**
SUBTOTAL - Requested from OTF	**1421**	**258**
RAW MATERIALS		
Provided by Institute		
Polyols	28	5
Catalysts	28	5
Surfactants	28	5
Requested from OTF		
Polyols	28	5
Catalysts	28	5
Surfactants	28	5
SUBTOTAL - Provided by Institute	**84**	**15**
SUBTOTAL - Requested from OTF	**84**	**15**
TRAINING AND TECHNICAL EXCHANGE		
SUBTOTAL - Provided by Institute	**22**	**4**
SUBTOTAL - Requested from OTF	**176**	**32**

TRIAL PRODUCTION - Provided by Institute		
Polyols Production	22	4
Blended Polyol Production	22	4
Reduced CFC Formulation Test	11	2
SUBTOTAL - Provided by Institute	**55**	**10**
TOTAL - Provided by Institute	367	66
TOTAL - Requested from OTF	1681	305
GRAND TOTAL	2048	371

THE MONTREAL PROTOCOL ON
SUBSTANCES THAT DEPLETE THE OZONE LAYER

PROJECT COVER SHEET

COUNTRY:	China
PROJECT TITLE:	Shenyang Production of Blended Polyol for 50% Reduced CFC Foam
SECTOR COVERED:	Rigid Polyurethane Foam
ODS USE IN SECTOR:	13,000 MT CFC-11 in 1991 (13,000 MT ODP)
PROJECT IMPACT:	Implement large-scale commercial production of blended polyols compatible with 50% reduced CFC foam
PROJECT DURATION:	2 years
PROJECT ECONOMIC LIFE:	4 years
TOTAL PROJECT COST:	US$ 0 Capital Costs Provided by Enterprise US$ 485,000 Capital Costs Requested from OTF US$ (333,000) Recurring Incremental Costs Net of Benefits[1]
PROPOSED OTF FINANCING:	US$ 152,000
IMPLEMENTING ENTERPRISE:	Shenyang Petrochemical Factory (SPF)
NATIONAL COORDINATING BODIES:	Ministry of Light Industry (MLI) and the National Environmental Protection Agency (NEPA)
IMPLEMENTING AGENCY:	The World Bank

[1] Net present value of incremental costs net of benefits for the first four years discounted at 12%.

PROJECT SUMMARY

This project will convert an existing 2,000 MT facility for the production of polyol and blended polyol feedstocks compatible with 50% reduced CFC foam at Shenyang Petrochemical Factory (SPF). The blended polyol will be sold to domestic household refrigerator producers.

This project will facilitate the development and implementation of emerging technologies in China's largest CFC use sector (in both percent ODS and ODP). This project is included in China's Country Program which was finalized in January 1993 and approved at the Ninth Meeting of the Executive Committee in Montreal, March 1993.

PROJECT OBJECTIVES

The objectives of this project are to: (i) convert facilities for industrial scale domestic production of 50% reduced CFC compatible polyols and blended polyol; and (ii) make such polyols domestically available to local refrigerator factories.

ENTERPRISE BACKGROUND

SPF produces over 200 chemical products and is one of the primary commercial polyol producers in China. SPF's production line has an annual polyol production capacity of 15,000 MT, including 10,000 MT facility imported from Germany. The factory also oversees the Shenyang Polyurethane Research Institute which has successfully developed industrially feasible production techniques for a variety of commercially significant feedstock polyols.

PROJECT DESCRIPTION

The use of reduced CFC foam formulations is impeded by a lack of domestic raw material suppliers. Specifically, reduced CFC compatible polyols are not commercially available in China. For this project, SPF will adopt technology for the industrial scale synthesis of polyether polyols compatible with reduced CFC foam and the blending of these polyols. SPF will re-tool existing polyol and blended polyol operations to establish 2,000 MT production capacity of polyol and blended polyol compatible with low CFC foam, train workers, conduct trial runs and scale-up to full production.

Liming Chemical Research Institute will provide low CFC technology to SPF, and the conversion will take place over 1994-1996. The new technology requires the use of a new raw material for polyol production. Storage facilites are also required to streamline blended polyol operations.

PROJECT COST

Summary of Project Costs: The total project incremental cost of US$152,000, which is the entire amount requested from OTF as grant, was calculated as the economic capital costs requested from the OTF minus the net incremental recurring benefits for four years discounted at 12%.

Capital Costs: Capital costs of US$485,000 include the cost of equipment, installation, raw materials, trial runs, quality control equipment, training, and other costs for conversion of a 2,000 MT capacity reduced CFC compatible polyol and polyol blending production facilities. This project requests US$485,000 from OTF for capital costs.

Incremental Recurrent Costs/Benefits: The net incremental operating benefits of US$ 333,000 are equal to the net present value of the first four years of incremental operating benefits net of costs. These benefits are due primarily to the profits accrued from the sale of the polyols and blended polyols.

PROJECT IMPLEMENTATION

Management: The Ministry of Light Industry and National Environmental Protection Agency will oversee the successful implementation of this project. The project will be carried out at Shenyang Petrochemical Factory.

Schedule:

TASK	1993		1994				1995				1996			
	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Project planning	x													
Equipment installation and training		x												
Trial run			x											
Production				x	x	x	x	x	x	x	x	x	x	x

RESULTS: This project will develop industrial capacity production of polyether polyols and their blends which are compatible with 50% reduced CFC-11 foams. The project will provide China with a source of domestic feedstocks for polyols and polyol blends compatible with reduced CFC foam technology, facilitating the adoption of reduced CFC foams.

Annex 1: Breakdown of Investment Costs

$US = RMB 5.5

	RMB 1,000	US$ 1,000
POLYOL PRODUCTION EQUIPMENT - Requested from OTF		
Raw Material Storage Tank	25	5
Reactor	100	18
EO Gauge Tank	15	3
Refining Reactor	100	18
Decolorizing Reactor	30	5
V.P.O.	90	16
SUBTOTAL - Requested from OTF	**360**	**65**
BLENDED POLYOL PRODUCTION EQUIPMENT - Requested from OTF		
Polyol Storage Tank	80	15
Additive Gauge Tank	50	9
Closed Cell Content Meter	35	6
SUBTOTAL - Requested from OTF	**165**	**30**
ENGINEERING - Requested from OTF		
Equipment Installation	47	9
Start up Costs	26	5
Design	52	9
Commisioning	50	9
Consultants	25	5
Training	70	13
SUBTOTAL - Requested from OTF	**270**	**50**
TRIAL PRODUCTION - Requested from OTF	1873	340
SUBTOTAL - Requested from OTF	**1873**	**340**
TOTAL - Provided by Enterprise	0	0
TOTAL - Requested from OTF	2668	485
GRAND TOTAL	2668	485

Annex 2: Breakdown of Incremental Recurring Costs/Benefits

Table 1: BASELINE PRODUCTION COSTS FOR POLYOL

YEAR	COST PER TON POLYOL				ANNUAL PRODUCTION (TONS)	TOTAL COST (US$)
	INITIATOR	ALKYLENE OXIDE	CATALYST	NEUTRALIZING AGENT		
1994	109.09	1090.91	7.27	41.81	1,000	1,249,000
1995	109.09	1090.91	7.27	41.81	1,600	1,999,000
1996	109.09	1090.91	7.27	41.81	2,000	2,498,000
1997	109.09	1090.91	7.27	41.81	2,000	2,498,000

NPV GRAND TOTAL	6,074,000

Table 2: PRODUCTION COSTS FOR POLYOL WITH PROJECT

YEAR	COST PER TON POLYOL				ANNUAL PRODUCTION (TONS)	TOTAL COST (US$)
	INITIATOR	ALKYLENE OXIDE	CATALYST	NEUTRALIZING AGENT		
1994	255.91	1057.36	7.27	41.81	1,000	1,362,000
1995	255.91	1057.36	7.27	41.81	1,600	2,180,000
1996	255.91	1057.36	7.27	41.81	2,000	2,725,000
1997	255.91	1057.36	7.27	41.81	2,000	2,725,000

NPV GRAND TOTAL	6,625,000

Annex 3: Breakdown of Incremental Benefits

YEAR	BASELINE			WITH PROJECT			INCREMENTAL BENEFITS
	SELLING PRICE/TON BLENDED POLYOL (US$)	ANNUAL BLENDED POLYOL PRODUCTION (TON)	ANNUAL SALES (US$)	SELLING PRICE/TON BLENDED POLYOL (US$)	ANNUAL BLENDED POLYOL PRODUCTION (TON)	ANNUAL SALES (US$)	(US$)
1994	2454.5	1000	2,455,000	2636.4	1,000	2,636,000	181,000
1995	2454.5	1600	3,927,000	2636.4	1,600	4,218,000	291,000
1996	2454.5	2000	4,909,000	2636.4	2,000	5,272,000	364,000
1997	2454.5	2000	4,909,000	2636.4	2,000	5,272,000	364,000

NPV TOTAL BENEFITS	884,000

SUMMARY OF INCREMENTAL COSTS/BENEFITS

Polyol Production

Baseline (NPV of Costs 1994-1997):	6,074,000
With Project (NPV of Costs 1994-1997):	6,625,000
TOTAL INCREMENTAL COSTS:	**551,000**

SUMMARY OF INCREMENTAL BENEFITS

Polyol Production

Baseline (NPV of Benefits 1994-1997):	11,936,000
With Project (NPV of Benefits of 1994-1997):	12,820,000
TOTAL INCREMENTAL BENEFITS:	**884,000**
TOTAL INCREMENTAL COSTS NET OF BENEFITS:	**(333,000)**

RAW MATERIAL PRICES (per kg):

Old Polyol:	US$ 2.000
New Polyol:	US$ 2.355
Old Blended Polyol:	US$ 2.727
New Blended Polyol:	US$ 2.909
MDI:	US$ 2.727

THE MONTREAL PROTOCOL ON
SUBSTANCES THAT DEPLETE THE OZONE LAYER

PROJECT COVER SHEET

COUNTRY:	China	
PROJECT TITLE:	Wuxi Production of Blended Polyol for 50% Reduced CFC Foam	
SECTOR COVERED:	Rigid Polyurethane Foam	
ODS USE IN SECTOR:	13,000 MT CFC-11 in 1991 (13,000 MT ODP)	
PROJECT IMPACT:	Implement large-scale commercial production of blended polyols compatible with 50% reduced CFC foam	
PROJECT DURATION:	2 years	
PROJECT ECONOMIC LIFE:	4 years	
TOTAL PROJECT COST:	US$ 423,000 US$ 318,000 US$ (51,000)	Capital Costs Provided by Enterprise Capital Costs Requested from OTF Recurring Incremental Costs Net of Benefits[1]
PROPOSED OTF FINANCING:	US$ 267,000	
IMPLEMENTING ENTERPRISE:	Wuxi KZ Foam Factory (WKZ)	
NATIONAL COORDINATING BODIES:	Ministry of Light Industry (MLI) and the National Environmental Protection Agency (NEPA)	
IMPLEMENTING AGENCY:	The World Bank	

[1] Net present value of incremental costs net of benefits for the first four years discounted at 12%.

PROJECT SUMMARY

This project will convert a 5,000 MT facility for the production of blended polyol feedstocks compatible with 50% reduced CFC foam at Wuxi KZ Foam Factory (WKZ). The blended polyol will be sold to domestic household refrigerator producers.

This project will facilitate the development and implementation of emerging technologies in China's largest CFC use sector (in both percent ODS and ODP). This project is included in China's Country Program which was finalized in January 1993 and approved at the Ninth Meeting of the Executive Committee in Montreal, March 1993.

PROJECT OBJECTIVES

The objectives of this project are to: (i) convert production facilities to industrial scale production of 50% reduced CFC compatible blended polyol; and (ii) make such blended polyols domestically available to local refrigerator factories.

ENTERPRISE BACKGROUND

WKZ produces rigid polyurethane foam materials for household refrigeration, panel insulation, and in-situ spraying and is one of the primary commercial blended polyol producers in China. WKZ's production line has an annual production capacity of 5,000 MT with current production of 700 MT. The factory has entered into a cooperative relationship with the No. 510 Research Institute of the Ministry of Aeronautics and Aerospace to field test emerging reduced CFC compatible polyol technology. This project will build upon the results of their cooperative research.

PROJECT DESCRIPTION

The use of reduced CFC foam formulations is impeded by a lack of domestic raw material suppliers. Specifically, reduced CFC compatible polyols are not commercially available in China. For this project, WKZ will adopt technology for the industrial scale synthesis of polyether polyols compatible with reduced CFC foam and the blending of these polyols. WKZ will build a new pre-blend reactor facility and renovate their existing line for production of blended polyol for production of blended polyol compatible with low CFC formulation. The pre-blend reactor is required as the new process includes addition of viscosity reducing additives. Equipment retrofits will improve control over 50% compatible feedstocks. After the conversion, which will take place over 1994-1997, production capacity of the facility will be equal to the 5,000 MT existing capacity. The training included in this project consists of on-site direction from domestic experts, as well as training throughout China.

PROJECT COST

Summary of Project Costs: The total project incremental cost of US$690,000, of which US$267,000 is the total requested from OTF as a grant, was calculated as the economic capital costs minus the net incremental recurring benefits for four years discounted at 12%.

Capital Costs: Capital costs of US$741,000 include the cost of new equipment and equipment retrofits, installation, raw materials, trial runs, quality control equipment, training, and other costs for a 5,000 MT capacity reduced CFC compatible polyol blending line. This project requests US$318,000 from OTF for capital costs. The enterprise will provide US$423,000 for counterpart financing for the project.

Incremental Recurrent Costs/Benefits: The net incremental operating benefits of US$ 51,000 are equal to the

net present value of the first four years of incremental operating benefits net costs. These benefits are due primarily to the profits accrued from the sale of the polyols and blended polyols.

PROJECT IMPLEMENTATION

Management: The Ministry of Light Industry and National Environmental Protection Agency will oversee the successful implementation of this project. The project will be carried out at Wuxi KZ Foam Factory.

Schedule

TASK	1993		1994				1995				1996				1997
	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1-4
Project planning	x														
Capital construction & equipment installation		x													
Training		x													
Trial production		x	x												
Produce 900 MT polyether with 50%			x	x	x	x									
Produce 1,500 MT polyether with 50%							x	x	x	x					
Produce 3,000 MT polyether with 50%											x	x	x	x	
Produce 5,000 MT polyether with 50%															x

RESULTS: This project will develop industrial capacity production of polyether polyols and their blends which are compatible with 50% reduced CFC-11 foams. The project will provide China with a source of domestic feedstocks for polyols and polyol blends compatible with reduced CFC foam technology, facilitating the adoption of reduced CFC foams. This project will produce enough blended polyol to meet the demands of approximately one third of China's refrigerator factories.

Annex 1: Breakdown of Investment Costs

$US = RMB 5.5

	RMB 1,000	US$ 1,000
EQUIPMENT		
Provided by Enterprise:		
Fork Machine	40	7
Storage Container (30m³)	150	27
Measurement Pot (1m³)	30	6
Air Compressor	40	7
Groove-Wheeled Machine	250	46
Truck	60	10
Wheeled Machine	120	22
Requested from OTF:		
Machine Pumps (15)	120	22
Control Instrument (2)	80	15
Burden Pitcher (for intermediate storage)(6)	42	8
Computer Control System	200	36
Storage Container (50m³)	200	36
Polymerization Vessel	180	33
Measurement Pot (2m³)	60	10
Neutralization Vessel	40	7
Filter	150	27
Film Evaporator	120	22
Condenser	20	4
SUBTOTAL - Provided by Enterprise	**690**	**125**
SUBTOTAL - Requested from OTF	**1212**	**220**
QUALITY CONTROL INSTRUMENTATION - Requested from OTF		
Viscosimeter	5	1
Controlled Temperature Oil Bath	6	1
Hydroxyl Content Meter	5	1
Hygroscopicity Meter	4	1
Acidity Meter	3	1
Universal Testing Machine	63	12
Thermal Conductivity Meter	38	7
Desiccating Equipment	10	2
Little Foaming Machine	44	8
Molds (3)	9	2
Age Testing Equipment	20	4
Personal Computer	15	3
SUBTOTAL - Requested from OTF	**222**	**43**
ENGINEERING - Provided by Enterprise		
Equipment Installation	350	64
Design	170	31
Water System Modification	20	4
Electrical System Modification	20	4
Boiler Room Modification	20	4
SUBTOTAL - Provided by Enterprise	**580**	**107**

NEW FACILITIES - Provided by Enterprise		
Land	250	45
Production Line Building	450	82
Product Storage Building	350	64
SUBTOTAL - Provided by Enterprise	**1050**	**191**
TRAINING (25) - Requested from OTF	140	25
TRIAL RUNS - Requested from OTF	35	6
TRIALS AT REFRIGERATOR FACTORIES - Requested from OTF	100	18
DEVELOPMENT - Requested from OTF	35	6
SUBTOTAL - Requested from OTF	**310**	**55**
TOTAL - Provided by Enterprise	2320	423
TOTAL - Requested from OTF	1744	318
GRAND TOTAL	4064	741

Annex 2: Breakdown of Incremental Recurring Costs/Benefits

Table 1: BASELINE PRODUCTION COST FOR BLENDED POLYOL #1

YEAR	COST PER TON POLYOL					ANNUAL PRODUCTION (TONS)	TOTAL COST (US$)
	POLYOL	CFC-11	CATALYST	COST OF PRODUCTION	SILICA OIL		
1994	1009	436	175	380	264	900	2,038,000
1995	1009	436	175	330	264	1500	3,321,000
1996	1009	436	175	240	264	3000	6,372,000
1997	1009	436	175	207	264	5000	10,455,000

	NPV TOTAL	15,647,000

Table 2: PRODUCTION COSTS FOR BLENDED POLYOL #1 WITH PROJECT

YEAR	COST PER TON POLYOL					ANNUAL PRODUCTION (TONS)	TOTAL COST (US$)
	POLYOL	CFC-11	CATALYST	COST OF PRODUCTION	SILICA OIL		
1994	1303	175	200	460	418	900	2,300,000
1995	1303	175	200	399	418	1500	3,743,000
1996	1303	175	200	290	418	3000	7,158,000
1997	1303	175	200	249	418	5000	11,725,000

	NPV TOTAL	17,584,000

Annex 3: Breakdown of Incremental Benefits

Table 1: INCREMENTAL BENEFITS FOR BLENDED POLYOL #1 (REFRIGERATION)

YEAR	BASELINE			WITH PROJECT			INCREMENTAL BENEFITS (US$)
	SELLING PRICE/TON BLENDED POLYOL (US$)	ANNUAL BLENDED POLYOL PRODUCTION (TON)	TOTAL ANNUAL INCOME (US$)	SELLING PRICE/TON BLENDED POLYOL (US$)	ANNUAL BLENDED POLYOL PRODUCTION (TON)	TOTAL ANNUAL INCOME (US$)	
1994	2455	900	2,210,000	2727	900	2,454,000	244,000
1995	2455	1500	3,682,500	2727	1500	4,091,000	408,000
1996	2455	3000	7,365,000	2727	3000	8,181,000	816,000
1997	2455	5000	12,275,000	2727	5000	13,635,000	1,360,000

NPV OF BENEFITS	1,988,000

SUMMARY OF INCREMENTAL COSTS

Blended Polyol Production (NPV of Costs 1994-1997)

Baseline Blended Polyol Subtotal:	15,647,000
Blended Polyol With Project:	17,584,000
TOTAL BLENDED POLYOL INCREMENTAL COSTS:	**1,937,000**

SUMMARY OF INCREMENTAL BENEFITS

Blended Polyol Production (NPV of Benefits 1994-1997)

Baseline Blended Polyol Subtotal:	17,953,000
Blended Polyol With Project:	19,941,000
TOTAL BLENDED POLYOL INCREMENTAL BENEFITS:	**1,988,000**
TOTAL INCREMENTAL COSTS NET OF BENEFITS:	**(51,000)**

RAW MATERIAL PRICES (per kg)

Old Blended Polyol:	US$ 2.455
New Blended Polyol:	US$ 2.727

THE MONTREAL PROTOCOL ON
SUBSTANCES THAT DEPLETE THE OZONE LAYER

PROJECT COVER SHEET

COUNTRY:	China
PROJECT TITLE:	Chengde Conversion to 50% Reduced CFC Foam in Insulation Panel and In-Situ Foaming Formulations
SECTOR COVERED:	Rigid Polyurethane Foam
ODS USE IN SECTOR:	13,000 MT CFC-11 (13,000 MT ODS) in 1991 ODP
PROJECT IMPACT:	Phase out 32 MT CFC-11 per year[1]
PROJECT DURATION:	4 years
PROJECT ECONOMIC LIFE:	4 years
TOTAL PROJECT COST:	US$ 26,000 Capital Costs Provided by Enterprise US$117,000 Capital Costs Requested from OTF US$ 46,000 Recurring Incremental Costs[2]
PROPOSED OTF FINANCING:	US$163,000
IMPLEMENTING ENTERPRISE:	Chengde Commercial Machinery Company (CCMC)
NATIONAL COORDINATING BODIES:	Ministry of Light Industry (MLI) and the National Environmental Protection Agency (NEPA)
IMPLEMENTING AGENCY:	The World Bank

[1] In the first year of full production.

[2] Net present value of incremental costs for the first four years discounted at 12%.

PROJECT SUMMARY

This project will convert a 160,000 m^2 capacity rigid PU insulation panel production line and in-situ spray operations at Chengde Commercial Machinery Company (CCMC) to the use of 50% reduced CFC foaming techniques. This project will facilitate the implementation of mature technologies in China's largest CFC use sector (in both percent ODS and ODP). This project is included in China's Country Program, which was finalized in January 1993 and approved at the Ninth Meeting of the Executive Committee in Montreal, March 1993.

PROJECT OBJECTIVES

The objectives of this project are to: (i) convert CCMC's 160,000 m^2 capacity production line to the production of rigid PU insulating panels manufactured with 50% reduced CFC foam; and (ii) convert CCMC's in-situ foaming operations for use with 50% reduced CFC foaming techniques.

ENTERPRISE BACKGROUND

CCMC is an enterprise under the Ministry of Commerce and has an annual production capacity of 160,000 m^2 for rigid PU insulation panel as well as over 100,000 m^2 annual capacity for in-situ foaming operations. Production totaled 180,000 m^2 of foam in 1992, consuming 400 tons CFC-11, up from 100,000 m^2 in 1991. CCMC exports products to countries in Europe, Asia, and Africa. CCMC's rigid PU insulating panel production line was imported from Finland and West Germany. CCMC has been repeatedly honored for its comprehensive financial, engineering, and manufacturing management performance and for the quality of its products. Standard techniques are used for production of sandwich panels and spray foam operations. Cold storage facilities are the most common end-use. Customers select spray or panel application depending on individual requirements.

PROJECT DESCRIPTION

CCMC will convert its 160,000 m^2 capacity production line to the manufacture of rigid PU insulation panels with 50% reduced CFC-11 foam. CCMC will also convert its 100,000 m^2 capacity in-situ foaming operations to the use of 50% reduced CFC technologies. Conversion costs include new foaming equipment, testing instruments, trial runs, and training. however, OTF financing requests are limited to trail production, testing and training costs. CCMC will use domestic raw materials to demonstrate their performance. This project includes on-site training from foreign chemical suppliers and United Nations experts. CCMC's production line and in-situ foaming operations will be converted over the period 1994-1997, resulting in annual ODS savings of 32 MT per year in the first year of full production.

PROJECT COST

Summary of Project Costs: The total project incremental cost of US$189,000, of which US$163,000 is the total requested from the OTF as grant, was calculated as the economic capital costs plus the net incremental recurring costs for four years discounted at 12%.

Capital Costs: Capital costs of US$143,000 include the cost of test instruments, installation, trial runs, training, and other costs for a 160,000 m^2 capacity rigid PU insulation panel production line and a 100,000 m^2 capacity in-situ foaming production line using 50% reduced CFC-11 foaming technology. US$26,000 will be provided by the enterprise and US$117,000 is requested from the OTF for capital costs.

Incremental Recurrent Costs/Benefits: The net incremental operating costs of US$46,000 are equal to the net present value of the first four years of incremental operating costs, discounted at 12%. These costs are due primarily to increases in operating costs resulting from higher prices of certain foam raw materials (new polyol and blended polyol), and increased quantities of others (isocyanate).

PROJECT IMPLEMENTATION

Management: The Ministry of Light Industry and National Environmental Protection Agency will oversee the successful implementation of this project. The project will be carried out at Chengde Commercial Machinery Company.

Schedule:

TASK	1993		1994				1995				1996				1997
	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1-4
Project planning	x														
Arrange & carry out training (foreign expert)		x	x	x											
Procure & install equipment			x	x											
Trial runs				x	x										
Trial production						x									
Solve problems found with raw material manufacturer						x	x								
Produce 65,000 m^2 with new material						x									
Produce 85,000 m^2 with new material							x	x	x	x					
Produce 102,000 m^2 with new material											x	x	x	x	
Full production of 260,000 m^2 with new material															x

RESULTS: This project will result in the phaseout of 32 MT of CFC-11 in the first year of full production.

Annex 1: Breakdown of Investment Costs

$US = RMB 5.5

	RMB 1,000	US$ 1,000
TEST INSTRUMENTS - Provided by Enterprise		
Acidity Meter	20	4
Magnetic Heating and Stirring Machine	20	4
Thermal Conductivity Meter	40	7
Viscosity Meter	10	2
Constant Temperature and Humidity Control Box	30	5
Transportation Costs	25	4
SUBTOTAL - Provided by Enterprise	**145**	**26**
TRIAL PRODUCTION - Requested from OTF		
Lost Panel Production (80 % of 200 m^2/day for 5 days)	320	58
Lost In-Situ Production (80 % of 120 m^2/day for 5 days)	105	19
Trial Product Testing	39	7
SUBTOTAL - Requested from OTF	**464**	**84**
TRAINING - Requested from OTF	127	23
SUBTOTAL - Requested from OTF	**127**	**23**
COMMUNICATIONS - Requested from OTF	55	10
SUBTOTAL - Requested from OTF	**55**	**10**
TOTAL- Provided by Enterprise	145	26
TOTAL - Requested from OTF	646	117
GRAND TOTAL	791	143

Annex 2: Breakdown of Incremental Recurring Costs/Benefits

Net Present Value of First Four Years Incremental Operating Cost Discounted at 12% $46,253

100% CFC USAGE
(panel & in situ)

Baseline Assumptions	1994	1995	1996	1997	
Prices:					
CFC-11	2.55	2.55	2.55	2.55	
Polyol	2.762	2.76	2.76	2.76	
MDI	2.73	2.73	2.73	2.73	
Blended "old" polyol	2.727	2.73	2.73	2.73	
Composition of Mixture:					
CFC-11 (16%)	0.085	0.09	0.09	0.09	
Polyol (84%)	0.447	0.45	0.45	0.45	
MDI	0.468	0.47	0.44	0.44	
Component Weight Per m^2 (kg):					
CFC-11	0.25	0.25	0.25	0.25	
Polyol	1.30	1.30	1.30	1.30	
MDI	1.36	3.33	3.33	3.33	
Kg Foam Used Per m^2:	2.91	2.91	2.91	2.91	
Production (1,000 m^2):	65	85	102	260	
Cost:					
CFC-11	$0.63	0.63	0.63	0.63	
Polyol	$3.59	3.59	3.59	3.59	
MDI	$3.72	3.72	3.72	3.72	
Total Cost/m^2	$7.94	$7.94	$7.94	$7.94	
TOTAL OPERATING COSTS ($1,000)	**$516**	**$675**	**$810**	**$2,065**	**$2,888**

50% CFC USAGE

50% Foam Assumptions	1994	1995	1996	1997	
Prices:					
CFC-11	2.545	2.545	2.545	2.545	
Polyol	2.845	2.84	2.84	2.84	
MDI	2.73	2.73	2.73	2.73	
Blended "new" polyol	2.82	2.82	2.82	2.82	
Composition of Mixture:					
CFC-11 (90%)	0.043	0.04	0.04	0.04	
Polyol (9%)	0.437	0.44	0.44	0.44	
MDI	0.520	0.52	0.52	0.52	
Component Weight Per m^2 (kg):					
CFC-11	0.125	0.13	0.13	0.13	
Polyol	1.273	1.27	1.27	1.27	
MDI	1.514	1.51	1.51	1.51	
Kg Foam Used Per m^2:	2.91	2.91	2.91	2.91	
Production (1,000 m^2):	65	85	102	260	
Cost:					
CFC-11	$0.32	0.32	0.32	0.32	
Polyol	$3.62	3.62	3.62	3.62	
MDI	$4.13	4.13	4.13	4.13	
Total Cost/m^2	$8.07	$8.07	$8.07	$8.07	
TOTAL OPERATING COSTS ($1,000)	**$524**	**$686**	**$823**	**$2,098**	**$2,934**
TONS CFC-11 PHASED OUT PER YEAR	**8**	**10**	**13**	**32**	

THE MONTREAL PROTOCOL ON
SUBSTANCES THAT DEPLETE THE OZONE LAYER

PROJECT COVER SHEET

COUNTRY:	China	
PROJECT TITLE:	Dalian Conversion to 50% Reduced CFC Foam in Insulation Panel	
SECTOR COVERED:	Rigid Polyurethane Foam	
ODS USE IN SECTOR:	13,000 MT CFC-11 (13,000 MT ODS) in 1991 ODP	
PROJECT IMPACT:	Phase out 14 MT CFC-11 per year[1]	
PROJECT DURATION:	2 years	
PROJECT ECONOMIC LIFE:	4 years	
TOTAL PROJECT COST:	US$ 96,000	Capital Costs Provided by Enterprise
	US$198,000	Capital Costs Requested from OTF
	US$ 77,000	Recurring Incremental Costs[2]
PROPOSED OTF FINANCING:	US$275,000	
IMPLEMENTING ENTERPRISE:	Dalian Refrigeration Works (DRW)	
NATIONAL COORDINATING BODIES:	Ministry of Light Industry (MLI) and the National Environmental Protection Agency (NEPA)	
IMPLEMENTING AGENCY:	The World Bank	

[1] In the first year of full production.

[2] Net present value of incremental costs for the first four years discounted at 12%.

PROJECT SUMMARY

This project will phase out 44 tons of CFC-11 by converting a 110,000 m^2 capacity rigid polyurethane insulation panel manufacturing facility at Dalian Refrigerator Works (DRW) to the production of rigid PU insulation panels using 50% reduced CFC foam. This project will facilitate the implementation of mature technologies in China's largest CFC use sector (in both percent ODS and ODP). This project is included in China's Country Program, which was finalized in January 1993 and approved at the Ninth Meeting of the Executive Committee in Montreal, March 1993.

PROJECT OBJECTIVES

The objective of this project is to convert DRW's 110,000 m^2 capacity production line to the production of rigid PU insulating panels manufactured with 50% reduced CFC foam.

ENTERPRISE BACKGROUND

DRW is an enterprise under the Ministry of Machinery Building Industry (MEI) and is one of China's 500 largest enterprises. DRW has an annual production capacity of 110,000 m^2 of rigid PU insulation panel and is one of the largest suppliers of rigid PU insulation panel in China. DRW's rigid PU insulating panel production line was imported from Japan. DRW has been repeatedly honored for its comprehensive financial, engineering, and manufacturing management performance and for the quality of its products.

PROJECT DESCRIPTION

DRW will convert its 110,000 m^2 capacity production line to the manufacture of rigid PU insulation panels with 50% reduced CFC-11 foam. Conversion cost include funds for new foaming equipment, quality control instruments, trial runs, and training. DRW will use domestic raw materials, including a special flame-resistant blended polyol, to demonstrate their performance. The training included in this project consists of on-site direction from foreign chemical suppliers.

Production of models using reduced CFC foam will be phased in over 1994-1997. Starting in 1997, 110,000 m^2 of panels using 50% reduced foam will be manufactured, for annual ODS savings of 14 MT.

PROJECT COST

Summary of Project Costs: The total project incremental cost of US$371,000, of which US$275,000 is the total requested from the OTF as grant, was calculated as the economic capital costs plus the net incremental recurring costs for four years discounted at 12%.

Capital Costs: Capital costs of US$294,000 include the cost of quality control instrumentation, installation, trial runs, training, and other costs for a 110,000 m^2 capacity rigid PU insulation panel factory using 50% reduced CFC-11 foaming technology. This project requests US$198,000 from OTF for capital costs. The enterprise will provide US$ 96,000 for counterpart financing for the project.

Incremental Recurrent Costs/Benefits: The net incremental operating costs of US$77,000 are equal to the net present value of the first four years of incremental operating costs, discounted at 12%. These costs are due primarily to increases in operating costs resulting from higher prices of certain foam raw materials (new polyol and blended polyol), and increased quantities of others (isocyanate).

PROJECT IMPLEMENTATION

Management: The Ministry of Light Industry and National Environmental Protection Agency will oversee the successful implementation of this project. The project will be carried out at Dalian Refrigerator Works.

Schedule:

TASK	1993		1994				1995				1996				1997
	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1-4
Project planning	x														
Import equipment		x													
Install new equipment			x	x											
Arrange & carry out training (foreign experts)			x	x	x										
Technological testing				x	x										
Produce 90,000 m^3 of panel per year			x	x	x	x									
Produce 100,000 m^3 of panel per year							x	x	x	x	x	x	x	x	
Produce 110,000 m^3 of panel per year															x

RESULTS: This project will result in the phaseout of 14 MT of CFC-11 in the first year of full production.

Annex 1: Breakdown of Investment Costs

$US = RMB 5.5

	RMB 1,000	US$ 1,000
ENGINEERING DEVELOPMENT - Provided by enterprise	10	2
SUBTOTAL - Provided by Enterprise	**10**	**2**
EQUIPMENT		
Provided by Enterprise:		
Production Control Equipment		
Acidity Meter	20	4
Magnetic Agitator	20	4
Flammability Meter	10	2
Equipment Transportation	42	8
Requested from OTF:		
Foaming Equipment	303	55
Production Control Equipment		
Rotational Viscosity Meter	69	13
Heat Conductivity Meter	358	65
SUBTOTAL - Provided by Enterprise	**92**	**18**
SUBTOTAL - Requested from OTF	**730**	**133**
INSTALLATION - Provided by Enterprise	215	39
SUBTOTAL - Provided by Enterprise	**215**	**39**
TRAINING - Requested from OTF	195	35
SUBTOTAL - Requested from OTF	**195**	**35**
CONSULTANTS & ENGINEERING - Provided by Enterprise	110	20
SUBTOTAL - Provided by Enterprise	**110**	**20**
TRIAL RUNS		
Provided by Enterprise:		
Quality Control Tests	10	2
Curing Measures	50	9
Requested from OTF:		
Lost Production (500m²)	138	25
Raw Materials Loss	30	5
SUBTOTAL - Provided by Enterprise	**60**	**11**
SUBTOTAL - Requested from OTF	**168**	**30**
EXAMINATION AND POPULARIZATION - Provided by Enterprise	30	6
SUBTOTAL - Provided by Enterprise	**30**	**6**
TOTAL - Provided by Enterprise	**517**	**96**
TOTAL - Requested from OTF	**1093**	**198**
GRAND TOTAL	**1610**	**294**

Annex 2: Breakdown of Incremental Recurring Costs/Benefits

Net Present Value of First Four Years Incremental Operating Cost Discounted at 12% $76,613

100% CFC USAGE

Baseline Assumptions	1994	1995	1996	1997	
Prices:					
CFC-11	2.55	2.55	2.55	2.55	
Polyol	2.762	2.76	2.76	2.76	
MDI	2.73	2.73	2.73	2.73	
Blended "old" polyol	2.727	2.73	2.73	2.73	
Composition of Mixture:					
CFC-11 (16%)	0.085	0.09	0.09	0.09	
Polyol (84%)	0.447	0.45	0.45	0.45	
MDI	0.468	0.47	0.44	0.44	
Component Weight Per m^2 (kg):					
CFC-11	0.25	0.25	0.25	0.25	
Polyol	1.30	1.30	1.30	1.30	
MDI	1.36	3.33	3.33	3.33	
Kg Foam Used Per m^2:	2.91	2.91	2.91	2.91	
Production (1,000 m^2):	90	100	100	110	
Cost:					
CFC-11	$0.63	0.63	0.63	0.63	
Polyol	$3.59	3.59	3.59	3.59	
MDI	$3.72	3.72	3.72	3.72	
Total Cost/m^2	$7.94	$7.94	$7.94	$7.94	
TOTAL OPERATING COSTS ($1,000)	**$715**	**$794**	**$794**	**$874**	**$2,392**

50% CFC USAGE

50% Foam Assumptions	1994	1995	1996	1997	
Prices:					
CFC-11	2.545	2.545	2.545	2.545	
Polyol	2.945	2.94	2.94	2.94	
MDI	2.73	2.73	2.73	2.73	
Blended "new" polyol	2.91	2.91	2.91	2.91	
Composition of Mixture:					
CFC-11 (90%)	0.043	0.04	0.04	0.04	
Polyol (9%)	0.437	0.44	0.44	0.44	
MDI	0.52	0.52	0.52	0.52	
Component Weight Per m^2 (kg):					
CFC-11	0.125	0.13	0.13	0.13	
Polyol	1.273	1.27	1.27	1.27	
MDI	1.514	1.51	1.51	1.51	
Kg Foam Used Per m^2:	2.91	2.91	2.91	2.91	
Production (1,000 m^2):	90	100	100	110	
Cost:					
CFC-11	$0.32	0.32	0.32	0.32	
Polyol	$3.75	3.75	3.75	3.75	
MDI	$4.13	4.13	4.13	4.13	
Total Cost/m^2	$8.20	$8.20	$8.20	$8.20	
TOTAL OPERATING COSTS ($1,000)	**$738**	**$820**	**$820**	**$901**	**$2,468**
TONS CFC-11 PHASED OUT PER YEAR	**11**	**12**	**12**	**14**	

THE MONTREAL PROTOCOL ON
SUBSTANCES THAT DEPLETE THE OZONE LAYER

PROJECT COVER SHEET

COUNTRY:	China
PROJECT TITLE:	Tianjin Conversion to 50% Reduced CFC Foam in Insulation Panel
SECTOR COVERED:	Rigid Polyurethane Foam
ODS USE IN SECTOR:	13,000 MT CFC-11 (13,000 MT ODS) in 1991 ODP
PROJECT IMPACT:	Phase out 31 MT CFC-11 per year[1]
PROJECT DURATION:	2 years
PROJECT ECONOMIC LIFE:	4 years
TOTAL PROJECT COST:	US$ 4,000 Capital Costs Provided by Enterprise US$ 306,000 Capital Costs Requested from OTF US$ 144,000 Recurring Incremental Costs[2]
PROPOSED OTF FINANCING:	US$ 450,000
IMPLEMENTING ENTERPRISE:	Tianjin Polyurethane Plastic Factory (TPU)
NATIONAL COORDINATING BODIES:	Ministry of Light Industry (MLI) and the National Environmental Protection Agency (NEPA)
IMPLEMENTING AGENCY:	The World Bank

[1] In the first year of full production.

[2] Net present value of incremental costs for the first four years discounted at 12%.

PROJECT SUMMARY

Tianjin Polyurethane Plastic Factory (TPU) manufacturers polyurethane (PU) foam raw materials and rigid PU insulation panels. This project will convert TPU's operations to production of feedstocks compatible with low CFC foam formulations and products with reduced CFC, including 2000 MT capacity for polyol production, 3,300 MT capacity for blended polyol and 250,000 m^2 capacity for panels. This project will facilitate the implementation of mature technologies in China's largest CFC use sector (in both percent ODS and ODP). This project is included in China's Country Program, which was finalized in January 1993 and approved at the Ninth Meeting of the Executive Committee in Montreal, March 1993.

PROJECT OBJECTIVES

The objectives of this project are to: (i) convert TPU's 250,000 m^2 capacity production line to the production of rigid PU insulating panels manufactured with 50% reduced CFC foam; and (ii) convert TPU's 2,000 ton capacity polyol production operations and 3,300 MT blended polyol operations to the production of materials compatible with 50% reduced CFC foaming formulations.

ENTERPRISE BACKGROUND

TPU produces rigid PU pipe sleeves and sandwich panels. Annual insulation panel capacity is 250,000 m^2. TPU also produces polyol and blended polyol feedstocks for these products. Annual polyol capacity is 2,000 tons while blended polyol capacity is 3,300 tons. TPU's products are sold abroad to Hong Kong and Japan.

PROJECT DESCRIPTION

TPU will acquire production technology for polyether polyols compatible with reduced CFC foam formulations from the Liming Chemical Research Institute. TPU will adapt this technology to their current polyol and blended polyol production operations, perform trial runs, and finally convert to production of polyol and blended polyol compatible with reduced CFC foam. This project will also convert TPU's 250,000 m^2 capacity insulation panel production line to the manufacture of rigid PU insulation panels with 50% reduced CFC-11 foam. The training included in this project consists of on-site direction from foreign chemical suppliers and domestic experts.

Tianjin will reach full production of models using reduced CFC foam starting in 1994. 250,000 m^2 will be manufactured, for annual ODS savings of 31 metric tons.

PROJECT COST

Summary of Project Costs: The total project incremental cost of US$ 454,000, of which US$ 306,000 is the total requested from OTF as a grant, was calculated as the economic capital costs plus the net incremental recurring costs for four years discounted at 12%.

Capital Costs: Capital costs of US$ 310,000 include the cost of test instruments, installation, trial runs, training, and other costs for a 250,000 m^2 capacity rigid PU insulation panel production line, 2,000 ton capacity polyol production and 3,300 tons blended polyol operations for 50% reduced CFC-11 foaming technology. This project requests 306,000 from OTF for capital costs. The enterprise will provide US$ 4,000 for counterpart financing for the project.

Incremental Recurrent Costs/Benefits: The net incremental operating costs of US$144,000 are equal to the net present value of the first four years of incremental operating costs, discounted at 12%. These costs are primarily due to increases in operating costs resulting from higher prices of certain raw materials (new polyol and blended polyol), and increased quantities of others (isocyanate). The increased prices for new polyol and blended polyol

offsets all incremental operating costs, so only operating costs for the manufacture of panels with reduced CFC foam formulation is considered.

PROJECT IMPLEMENTATION

Management: The Ministry of Light Industry and National Environmental Protection Agency will oversee the successful implementation of this project. The project will be carried out at Tianjin Polyurethane Plastics Factory.

Schedule

TASK	1993		1994				1995				1996			
	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Project planning	x													
Importation negotiations	x													
Install safety systems		x												
Training at Liming C.I.		x												
Trial production of new type of polyether			x											
Experimentation with new type of polyether				x										
Summary production of polyether					x									
Instrument installation and trial production					x									
Arrange & carry out training (foreign experts)						x								
Technical summary for panel production							x							
Full production of 25,000 m^2 per year							x	x	x	x	x	x	x	x

RESULTS: This project will result in the phaseout of 31 MT of CFC-11 in the first year of full production.

Annex 1: Breakdown of Investment Costs

$US = RMB 5.5

	RMB 1,000	US$ 1,000
I. POLYOL CONVERSION		
SAFETY EQUIPMENT - Requested from OTF		
Automatic Fire Protection System	55	10
Automatic Gas Alarm System	28	5
Automatic Pressure and Explosion Control System	28	5
SUBTOTAL - Requested from OTF	**111**	**20**
COOLING EQUIPMENT - Requested from OTF		
Cooling Machine Redesign	111	20
SUBTOTAL - Requested from OTF	**111**	**20**
POLYOL LINE REFORMING EQUIPMENT - Requested from OTF		
Polymer Tank w/Temperature Pressure Recording System and Small Cooling System	28	5
Microscale Determination Instrument	28	5
Flame Photometer	55	10
SUBTOTAL - Requested from OTF	**111**	**20**
TRIAL PRODUCTION - Requested from OTF		
Utilities	28	5
Worker Training	48	9
Equipment Cleaning	11	2
Raw Material	105	19
SUBTOTAL - Requested from OTF	**192**	**35**

II. RIGID PANEL PRODUCTION

RESEARCH AND DEVELOPMENT		
Requested from OTF		
Raw Materials	110	20
Testing Fee	33	6
Provided by Enterprise		
Salary	22	4
EQUIPMENT		
Requested from OTF		
Small Foaming Machine (cannon)	275	50
Heat Conducting Meter (domestic)	44	8
Closed Cell Content Meter	22	4
Vertical Flame Meter	17	3
SUBTOTAL - Provided by Enterprise	**22**	**4**
SUBTOTAL - Requested from OTF	**501**	**91**
TRAINING - Requested from OTF	111	20
SUBTOTAL - Requested from OTF	**111**	**20**
TRIAL PRODUCTION - Requested from OTF		
One Week Lost Production (6000 m^2 raw materials)	528	96
Color Metal	198	36
Labor	28	5
Utilities	99	18
SUBTOTAL - Requested from OTF	**853**	**155**
USABLE VALUE	-303	-55
SUBTOTAL - Due back to OTF	**-303**	**-55**
TOTAL - Provided by Enterprise	**22**	**4**
TOTAL - Requested from OTF	**1687**	**306**
GRAND TOTAL	**1709**	**310**

Annex 2: Breakdown of Incremental Recurring Costs/Benefits for Insulation Panels

Net Present Value of First Four Years Incremental Operating Cost Discounted at 12% 143,683

100% CFC USAGE

Baseline Assumptions	1994	1995	1996	1997	
Prices:					
CFC-11	2.55	2.55	2.55	2.55	
Polyol	2.065	2.07	2.07	2.07	
MDI	2.73	2.73	2.73	2.73	
Blended "old" polyol	2.142	2.14	2.14	2.14	
Composition of Mixture:					
CFC-11 (16%)	0.085	0.09	0.09	0.09	
Polyol (84%)	0.447	0.45	0.45	0.45	
MDI	0.468	0.47	0.44	0.44	
Component Weight Per m^2:					
CFC-11	0.25	0.25	0.25	0.25	
Polyol	1.30	1.30	1.30	1.30	
MDI	1.36	3.33	3.33	3.33	
Kg Foam Used Per m^2:	2.91	2.91	2.91	2.91	
Production (1,000 m^2):	250	250	250	250	
Cost:					
CFC-11	$0.63	0.63	0.63	0.63	
Polyol	$2.69	2.69	2.69	2.69	
MDI	$3.72	3.72	3.72	3.72	
Total Cost per m^2	$7.03	$7.03	$7.03	$7.03	
TOTAL OPERATING COSTS ($1,000)	**$1,759**	**$1,759**	**$1,759**	**$1,759**	**$5,342**

50% CFC USAGE

50% Foam Assumptions	1994	1995	1996	1997	
Prices:					
CFC-11	2.545	2.545	2.545	2.545	
Polyol	2.181	2.18	2.18	2.18	
MDI	2.73	2.73	2.73	2.73	
Blended "new" polyol	2.21	2.21	2.21	2.21	
Composition of Mixture:					
CFC-11 (90%)	0.043	0.04	0.04	0.04	
Polyol (9%)	0.437	0.44	0.44	0.44	
MDI	0.520	0.52	0.52	0.52	
Component Weight Per m^2:					
CFC-11	0.125	0.13	0.13	0.13	
Polyol	1.273	1.27	1.27	1.27	
MDI	1.514	1.51	1.51	1.51	
Kg Foam Used Per m^2:	2.91	2.91	2.91	2.91	
Production (1,000 m^2):	250	250	250	250	
Cost:					
CFC-11	$0.32	0.32	0.32	0.32	
Polyol	$2.78	2.78	2.78	2.78	
MDI	$4.13	4.13	4.13	4.13	
Total Cost/Unit	$7.22	$7.22	$7.22	$7.22	
TOTAL OPERATING COSTS ($1,000)	**$1,806**	**$1,806**	**$1,806**	**$1,806**	**$5,485**
TONS CFC-11 PHASED OUT PER YEAR	**31**	**31**	**31**	**31**	

Annex 3: Breakdown of Incremental Costs/Benefits for Polyol

Table 1: BASELINE PRODUCTION COSTS FOR POLYOL

YEAR	COST PER TON POLYOL				ANNUAL PRODUCTION	TOTAL COST
	INITIATOR	ALKYLENE OXIDE	CATALYST	NEUTRALIZING AGENT	(TONS)	(US$)
1994	629	1400	15.5	20.5	800	1,652,000
1995	629	1400	15.5	20.5	800	1,652,000
1996	629	1400	15.5	20.5	800	1,652,000
1997	629	1400	15.5	20.5	800	1,652,000

NPV TOTAL COSTS	5,018,000

Table 2: PRODUCTION COSTS FOR POLYOL WITH PROJECT

YEAR	COST PER TON POLYOL				ANNUAL PRODUCTION	TOTAL COST
	INITIATOR	ALKYLENE OXIDE	CATALYST	NEUTRALIZING AGENT	(TONS)	(US$)
1994	673	1470	16.5	22.5	800	1,746,000
1995	673	1470	16.5	22.5	800	1,746,000
1996	673	1470	16.5	22.5	800	1,746,000
1997	673	1470	16.5	22.5	800	1,746,000

NPV TOTAL COSTS	5,303,000

NPV GRAND TOTAL COSTS	286,000

Table 3: BASELINE AND WITH PROJECT SALE PRICE FOR BLENDED POLYOL

YEAR	BASELINE			WITH PROJECT			INCREMENTAL BENEFITS (US$)
	SELLING PRICE/ton (US$)	TOTAL ANNUAL PRODUCTION (ton)	ANNUAL SALES (US$)	SELLING PRICE/ton (US$)	TOTAL ANNUAL PRODUCTION (ton)	ANNUAL SALES (US$)	
1994	2065	800	1,652,000	2182	800	1,745,600	93,600
1995	2065	800	1,652,000	2182	800	1,745,600	93,600
1996	2065	800	1,652,000	2182	800	1,745,600	93,600
1997	2065	800	1,652,000	2182	800	1,745,600	93,600

NPV GRAND TOTAL BENEFITS	286,000

SUMMARY OF INCREMENTAL COSTS

Baseline:

Rigid PU Panels (NPV of costs/benefits 1994-97):	5,342,000
Blended Polyol (NPV of costs/benefits 1994-97):	5,018,000

With Project:

Rigid PU Panels (NPV of costs/benefits 1994-97):	5,485,000
Blended Polyol (NPV of costs/benefits 1994-97):	5,303,000

TOTAL INCREMENTAL COSTS/BENEFITS:	
Rigid PU Panels	**144,000**
Blended Polyol	**286,000**

SUMMARY OF INCREMENTAL BENEFITS

Baseline: Blended Polyol	5,018,000
With Project: Blended Polyol	5,303,000
TOTAL INCREMENTAL BENEFITS:	**286,000**
GRAND TOTAL COST/BENEFIT:	**144,000**

RAW MATERIAL PRICES (per kg)

Old polyol:	**US$ 2.065**
New polyol:	**US$ 2.182**
MDI:	**US$ 2.727**
CFC-11:	**US$ 2.545**

THE MONTREAL PROTOCOL ON
SUBSTANCES THAT DEPLETE THE OZONE LAYER

PROJECT COVER SHEET

COUNTRY:	China
PROJECT TITLE:	Qindao Haier Conversion to 50% Reduced CFC Foam in Freezer Cabinets
SECTOR COVERED:	Rigid Polyurethane Foam
ODS USE IN SECTOR:	13,000 MT CFC-11 (13,000 MT ODS) in 1991 ODP
PROJECT IMPACT:	Phase out 61 MT CFC-11 per year[1]
PROJECT DURATION:	2 years
PROJECT ECONOMIC LIFE:	4 years
TOTAL PROJECT COST:	US$ 65,000 Capital Costs Provided by Enterprise US$229,000 Capital Costs Requested from OTF US$312,000 Recurring Incremental Costs[2]
PROPOSED OTF FINANCING:	US$541,000
IMPLEMENTING ENTERPRISE:	Qindao Haier Refrigerator Factory (QHRF)
NATIONAL COORDINATING BODIES:	Ministry of Light Industry (MLI) and the National Environmental Protection Agency (NEPA)
IMPLEMENTING AGENCY:	The World Bank

[1] In the first year of full production.

[2] Net present value of incremental costs for the first four years discounted at 12%.

PROJECT SUMMARY

This project will convert a 200,000 unit capacity production line at Qindao Haier Refrigerator Factory (QHRF) to the production of refrigerators using 50% reduced CFC-11 foam. This project will facilitate the implementation of mature technologies in China's largest CFC use sector (in both percent ODS and ODP). This project is included in China's Country Program, which was finalized in January 1993 and approved at the Ninth Meeting of the Executive Committee in Montreal, March 1993.

PROJECT OBJECTIVES

The objective of this project is to convert a 200,000 unit capacity production line at QHRF to the production of refrigerators using 50% reduced CFC-11 foam.

ENTERPRISE BACKGROUND

QHRF is one of China's largest household refrigerator manufacturers with production capacity of 600,000. The factory's facilities consist of three refrigerator production lines with three foaming lines. Eighty-three percent of QHRF's products are distributed in Northeast China and the remaining 17% are exported to more than 30 countries in Europe, North America, and Southeast Asia. QHRF has produced some models (mainly for export) with reduced CFC formulations since 1991 using imported materials. QHRF has won the national gold medal for light industrial products for five consecutive years.

PROJECT DESCRIPTION

QHRF will convert a 200,000 unit capacity assembly line to the production of three refrigerator models, BD-194, BD-132, and BD-92, using 50% reduced CFC-11 foam. The annual production for each model is 20,000, 30,000, and 50,000 units respectively. QHRF has been producing some models with reduced CFC foam formulations since 1991. This project will extend use of reduced CFC formulations to whole production.

Conversion will consist of prototype evaluation, batch production, trial runs, and finally full-scale production. Conversion cost include funds for new foaming equipment, training, and test instruments. Training for this project includes on-site training by both foreign chemical manufactures and domestic experts. QHRF will use domestic raw materials to demonstrate their performance.

Qindao will reach full production of models using reduced CFC foam starting in 1994. 200,000 units will be manufactured, for annual ODS savings of 61 MT.

PROJECT COST

Summary of Project Costs: The total project incremental cost of US$606,000, of which US$541,000 is the total requested from the OTF as grant, was calculated as the economic capital costs plus the net incremental recurring costs for four years discounted at 12%.

Capital Costs: Capital costs of US$294,000 include the cost of new equipment, training, and other costs for converting a 200,000 unit capacity refrigerator line for use with 50% reduced CFC-11 foaming technology. This project requests US$229,000 from OTF for capital costs. The enterprise will provide US$65,000 for counterpart financing for the project.

Incremental Recurrent Costs/Benefits: The net incremental operating costs of US$312,000 are equal to the net present value of the first four years of incremental operating costs, discounted at 12%. These costs are due primarily to increases in operating costs resulting from higher prices of certain foam raw materials (new polyol and blended polyol), and increased quantities of others (isocyanate).

PROJECT IMPLEMENTATION

Management: The Ministry of Light Industry and National Environmental Protection Agency will oversee the successful implementation of this project. The project will be carried out at Qindao Haier Refrigerator Factory.

Schedule:

TASK	1993		1994				1995				1996			
	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Project planning	x													
Importation negotiations		x												
Arrange and carry out training (foreign expert)			x	x										
Produce 200,000 refrigerators per year on original production line			x	x	x	x	x	x	x	x	x	x	x	x

RESULTS: This project will result in the phaseout of 61 MT of CFC-11 in the first year of full production.

Annex 1: Breakdown of Investment Costs

$US = RMB 5.5

	RMB 1,000	US$ 1,000
QUALITY CONTROL INSTRUMENTS		
Provided by Enterprise		
Thermal Conductivity Meter	358	65
Requested from OTF		
Moisture Meter	6	1
F-L Sclerometer	55	10
Closed Cell Content Meter (2)	70	13
Surface Thermometer (2)	3	1
Viscosity Meter	626	114
CFC Leak Detection Meter	55	10
SUBTOTAL - Provided by Enterprise	**358**	**65**
SUBTOTAL - Requested form OTF	**815**	**149**
INSTALLATION - Requested from OTF	28	5
SUBTOTAL - Requested from OTF	**28**	**5**
TRAINING - Requested from OTF		
Foreign Experts (5 person/months in China)	413	75
SUBTOTAL - Requested from OTF	**413**	**75**
TOTAL - Provided by Enterprise	358	65
TOTAL - Requested from OTF	1256	229
GRAND TOTAL	1614	294

Annex 2: Breakdown of Incremental Recurring Costs/Benefits

Net Present Value of First Four Years Incremental Operating Cost Discounted at 12% $311,672

100% CFC USAGE

Baseline Assumptions	1994	1995	1996	1997	
Prices:					
CFC-11	2.55	2.55	2.55	2.55	
Polyol	2.425	2.43	2.43	2.43	
MDI	2.73	2.73	2.73	2.73	
Blended "Old" Polyol/CFC	2.455	2.46	2.46	2.46	
Composition of Mixture:					
CFC-11 (25%)	0.139	0.14	0.14	0.14	
Polyol (75%)	0.418	0.42	0.42	0.42	
MDI	0.442	0.44	0.44	0.44	
Component Weight Per Unit (kg):					
CFC-11	0.58	0.58	0.58	0.58	
Polyol	1.75	1.75	1.75	1.75	
MDI	1.85	3.33	3.33	3.33	
Kg Foam Used Per Unit:	4.19	4.19	4.19	4.19	
Production (1,000 units):	200	200	200	200	
Cost:					
CFC-11	$1.49	1.49	1.49	1.49	
Polyol	$4.25	4.25	4.25	4.25	
MDI	$5.05	5.05	5.05	5.05	
Total Cost/Unit	$10.79	$10.79	$10.79	$10.79	
TOTAL OPERATING COST ($1,000)	**$2,158**	**$2,158**	**$2,158**	**$2,158**	**$6,555**

50% CFC USAGE

50% Foam Assumptions	1994	1995	1996	1997	
Prices:					
CFC-11	2.545	2.545	2.545	2.545	
Polyol	2.757	2.76	2.76	2.76	
MDI	2.73	2.73	2.73	2.73	
Blended "New" Polyol	2.73	2.73	2.73	2.73	
Composition of Mixture:					
CFC-11 (14%)	0.067	0.07	0.07	0.07	
Polyol (86%)	0.413	0.41	0.41	0.41	
MDI	0.520	0.52	0.52	0.52	
Component Weight Per Unit (kg):					
CFC-11	0.279	0.28	0.28	0.28	
Polyol	1.711	1.71	1.71	1.71	
MDI	2.155	2.16	2.16	2.16	
Kg Foam Used Per Unit:	4.15	4.15	4.15	4.15	
Production (1,000 units):	200	200	200	200	
Cost: -					
CFC-11	$0.71	0.71	0.71	0.71	
Polyol	$4.72	4.72	4.72	4.72	
MDI	$5.88	5.88	5.88	5.88	
Total Cost/Unit	$11.30	$11.30	$11.30	$11.30	
TOTAL OPERATING COSTS ($1,000)	**$2,261**	**$2,261**	**$2,261**	**$2,261**	**$6,866**
TONS CFC-11 PHASED OUT PER YEAR	**61**	**61**	**61**	**61**	

THE MONTREAL PROTOCOL ON
SUBSTANCES THAT DEPLETE THE OZONE LAYER

PROJECT COVER SHEET

COUNTRY:	China
PROJECT TITLE:	Henan Xinfei Conversion to 50% Reduced CFC Foam in Refrigerators
SECTOR COVERED:	Rigid Polyurethane Foam
ODS USE IN SECTOR:	13,000 MT CFC-11 (13,000 MT ODS) in 1991 ODP
PROJECT IMPACT:	Phase out 103 MT CFC-11 per year[1]
PROJECT DURATION:	2 years
PROJECT ECONOMIC LIFE:	4 years
TOTAL PROJECT COST:	US$ 300,000 Capital Costs Provided by Enterprise US$ 164,000 Capital Costs Requested from OTF US$ 878,000 Recurring Incremental Costs[2]
PROPOSED OTF FINANCING:	US$1,042,000
IMPLEMENTING ENTERPRISE:	Henan Xinfei Electric Appliance Group (HXEAG)
NATIONAL COORDINATING BODIES:	Ministry of Light Industry (MLI) and the National Environmental Protection Agency (NEPA)
IMPLEMENTING AGENCY:	The World Bank

[1] In the first year of full production.

[2] Net present value of incremental costs for the first four years discounted at 12%.

PROJECT SUMMARY

This project will convert a 400,000 unit capacity facility at Henan Xinfei Electric Appliance Group (HXEAG) to the production of household refrigerators to the use of 50% reduced CFC-11 foam. This project will facilitate the implementation of mature technologies in China's largest CFC use sector (in both percent ODS and ODP). This project is included in China's Country Program, which was finalized in January 1993 and approved at the Ninth Meeting of the Executive Committee in Montreal, March 1993.

PROJECT OBJECTIVES

The objective of this project is to convert HXEAG's 400,000 unit capacity production line to the production of four household refrigerators models for use with 50% reduced CFC-11 foam.

ENTERPRISE BACKGROUND

HXEAG produced over 150,000 refrigerator/freezer units in 1991, 230,000 in 1992 and expects to produce 400,000 units in 1993. HXEAG is the only modern household refrigerator manufacturer in Henan province. HXEAG's production line has an annual production capacity of 400,000 units and was imported from IRE Co., Italy and went into production in 1989. HXEAG has been awarded many prizes from both the provincial and central governments for the quality of its products.

PROJECT DESCRIPTION

HXEAG will convert its 400,000 unit capacity assembly line to the production of refrigerators with 50% reduced CFC-11 foam. Conversion cost include funds for quality control instruments, trial runs to optimize formula and blowing technique, and batch production. Factories will use domestic raw materials to demonstrate their performance. The new foam formulation will be used with existing foam blowing equipment. The training for this project includes on-site direction from foreign chemical suppliers.

Production of models using reduced CFC foam will be phased in over 1994-1996. Starting in 1996 400,000 units will be manufactured per year, for annual ODS savings of 103 MT.

PROJECT COST

Summary of Project Costs: The total project incremental cost of US$1,342,000, of which US$1,042,000 is the total requested from the OTF as grant, was calculated as the economic capital costs plus the net incremental recurring costs for four years discounted at 12%.

Capital Costs: Capital costs of US$464,000 include the cost of quality control instrumentation, installation, trial runs, training, and other costs for a 400,000 unit capacity household refrigerator factory using 50% reduced CFC-11 foaming technology. This project requests US$164,000 from OTF for capital costs. The enterprise will provide US$300,000 for counterpart financing for the project.

Incremental Recurrent Costs/Benefits: The net incremental operating costs of US$878,000 are equal to the net present value of the first four years of incremental operating costs, discounted at 12%. These costs are due primarily to increases in operating costs resulting from higher prices of certain foam raw materials (new polyol and blended polyol), and increased quantities of others (isocyanate).

PROJECT IMPLEMENTATION

Management: The Ministry of Light Industry and National Environmental Protection Agency will oversee the successful implementation of this project. The project will be carried out at Henan Xinfei Electric Appliances Group.

Schedule:

TASK	1993		1994				1995				1996			
	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Project planning	x													
Arrange & carry out training (foreign expert)		x												
Training (domestic expert)		x	x											
Produce 10,000 refrig. with new materials	x	x												
Produce 150,000 refrig. with new materials			x	x	x	x								
Produce 200,000 refrig. with new materials							x	x	x	x				
Technical training (foreign expert)									x	x				
Produce 400,000 refrig. with new materials											x	x	x	x

RESULTS: This project will result in the phaseout of 103 MT of CFC-11 in the first year of full production using the reduced CFC-11 foam technology.

Annex 1: Breakdown of Investment Costs

$US = RMB 5.5

	RMB 1,000	US$ 1,000
EQUIPMENT - Requested from OTF		
LANZEN Mold	34	6
Thermal Conductivity Meter	358	65
Universal Test Instrument	63	11
Compression Strength Meter	48	9
SUBTOTAL - Requested from OTF	**503**	**91**
EQUIPMENT - Provided by Enterprise		
Isocyanate Chlorine Meter	10	2
Isocyanate Acidity Meter	10	2
SUBTOTAL - Provided by Enterprise	**20**	**4**
INSTALLATION - Provided by Enterprise	10	2
LAB EXPANSION - Provided by Enterprise	25	4
SUBTOTAL - Provided by Enterprise	**35**	**6**
TRAINING - Requested from OTF	231	42
TRIAL RUNS		
Requested from OTF		
Materials Costs	173	31
Provided by Enterprise		
Test Costs	1595	290
SUBTOTAL - Requested from OTF	**404**	**73**
SUBTOTAL - Provided by Enterprise	**1595**	**290**
TOTAL- Requested from OTF	**907**	**164**
TOTAL- Provided by Enterprise	**1650**	**300**
GRAND TOTAL	**2557**	**464**

Annex 2: Breakdown of Incremental Recurring Costs/Benefits

Net Present Value of First Four Years Incremental Operating Cost Discounted at 12% **$877,530**

100% CFC USAGE

Baseline Assumptions	1994	1995	1996	1997	
Prices:					
CFC-11	2.50	2.50	2.50	2.50	
Polyol	2.43	2.43	2.43	2.43	
MDI	2.96	2.96	2.96	2.96	
Blended "Old" Polyol/CFC	2.454	2.45	2.45	2.45	
Composition of Mixture:					
CFC-11 (25%)	0.139	0.14	0.14	0.14	
Polyol (75%)	0.418	0.42	0.42	0.42	
MDI	0.442	0.44	0.44	0.44	
Component Weight Per Unit (kg):					
CFC-11	0.52	0.52	0.52	0.52	
Polyol	1.57	1.57	1.57	1.57	
MDI	1.66	3.33	3.33	3.33	
Kg Foam Used Per Unit:	3.76	3.76	3.76	3.76	
Production (1,000 units):	150	200	400	400	
Cost:					
CFC-11	$1.31	1.31	1.31	1.31	
Polyol	$3.82	3.82	3.82	3.82	
MDI	$4.93	4.93	4.93	4.93	
Total Cost/Unit	$10.06	$10.06	$10.06	$10.06	
TOTAL OPERATING COSTS ($1,000)	**$1,509**	**$2,012**	**$4,025**	**$4,025**	**$8,374**

50% CFC USAGE

50% Foam Assumptions	1994	1995	1996	1997	
Prices:					
CFC-11	2.500	2.500	2.500	2.500	
Polyol	2.658	2.66	2.66	2.66	
MDI	2.97	2.97	2.97	2.97	
Blended "New" Polyol	2.64	2.64	2.64	2.64	
Composition of Mixture:					
CFC-11 (14%)	0.067	0.07	0.07	0.07	
Polyol (86%)	0.413	0.41	0.41	0.41	
MDI	0.520	0.52	0.52	0.52	
Component Weight Per Unit (kg):					
CFC-11	0.266	0.27	0.27	0.27	
Polyol	1.635	1.63	1.63	1.63	
MDI	2.059	2.06	2.06	2.06	
Kg Foam Used Per Unit:	3.96	3.96	3.96	3.96	
Production (1,000 units):	150	200	400	400	
Cost:					
CFC-11	$0.67	0.67	0.67	0.67	
Polyol	$4.35	4.35	4.35	4.35	
MDI	$6.11	6.11	6.11	6.11	
Total Cost/Unit	$11.12	$11.12	$11.12	$11.12	
TOTAL OPERATING COSTS ($1,000)	**$1,667**	**$2,223**	**$4,446**	**$4,446**	**$9,252**
TONS CFC-11 PHASED OUT PER YEAR	**39**	**52**	**103**	**103**	

THE MONTREAL PROTOCOL ON
SUBSTANCES THAT DEPLETE THE OZONE LAYER

PROJECT COVER SHEET

COUNTRY:	China
PROJECT TITLE:	Shangling Conversion to 50% Reduced CFC Foam in Refrigerators
SECTOR COVERED:	Rigid Polyurethane Foam
ODS USE IN SECTOR:	13,000 MT CFC-11 (13,000 MT ODS) in 1991 ODP
PROJECT IMPACT:	Phase out 103 MT CFC-11 per year[1]
PROJECT DURATION:	2 years
PROJECT ECONOMIC LIFE:	4 years
TOTAL PROJECT COST:	US$ 413,000 Capital Costs Provided by Enterprise US$ 271,000 Capital Costs Requested from OTF US$ 687,000 Recurring Incremental Costs[2]
PROPOSED OTF FINANCING:	US$ 958,000
IMPLEMENTING ENTERPRISE:	Shanghai Shangling General Refrigerator Factory (SSGRF)
NATIONAL COORDINATING BODIES:	Ministry of Light Industry (MLI) and the National Environmental Protection Agency (NEPA)
IMPLEMENTING AGENCY:	The World Bank

[1] In the first year of full production.

[2] Net present value of incremental costs for the first three years discounted at 12%.

PROJECT SUMMARY

This project will convert a 400,000 unit capacity production line at Shanghai Shangling General Refrigerator Factory (SSGRF) to the production of household refrigerators using 50% reduced CFC-11 foam. Production of units with low CFC foam will be phased in over four years. This project will facilitate the implementation of mature technologies in China's largest CFC use sector (in both percent ODS and ODP). This project is included in China's Country Program which was finalized in January 1993 and approved at the Ninth Meeting of the Executive Committee in Montreal, March 1993.

PROJECT OBJECTIVES

The objective of this project is to convert a 400,000 unit capacity production line at SSGRF to the production of household refrigerators using 50% reduced CFC-11 foam.

ENTERPRISE BACKGROUND

SSGRF's is one of China's largest household refrigerator manufacturers, producing 320,000 units in 1991 and 350,000 in 1992, consuming about 210 tons of CFC-11. SSGRF's production line was imported from Mitsubishi Electronics (Japan) and has an annual production capacity of 400,000 units. SSGRF has been awarded many prizes from both the provincial and central governments for consistently exceeding national product standards.

PROJECT DESCRIPTION

SSGRF will convert its 400,000 unit capacity assembly line to the production of refrigerators with 50% reduced CFC-11 foam. Conversion will consist of prototype evaluation, batch production, trial runs, worker training, and finally full-scale production. SSGRF will renovate the mixing head on its existing HP foaming machine to produce quality foam with low CFC foam materials. Conversion cost include funds for new foaming equipment and modification of existing equipment, lost productivity during conversion, and batch production. SSGRF will use raw materials produced by the Shanghai No.6 Plastics Factory to demonstrate their performance. The training included in this project consists of on-site direction from foreign chemical suppliers.

Production of models using reduced CFC foam will be phased-in over 1994-1997. In 1997, 400,000 units will be manufactured for an annual ODS saving of 103 metric tons.

PROJECT COST

Summary of Project Costs: The total project incremental cost of US$1,371,000, of which US$958,000 is the total requested from the OTF as grant, was calculated as the economic capital costs plus the net incremental recurring costs for four years discounted at 12%.

Capital Costs: Capital costs of US$684,000 include the cost of new equipment, equipment retrofits, trial runs, training, and other costs for a 400,000 unit capacity household refrigerator factory using 50% reduced CFC-11 foaming technology. This project requests US$271,000 from OTF for capital costs. The enterprise will provide US$413,000 for counterpart financing for the project.

Incremental Recurrent Costs/Benefits: The net incremental operating costs of US$687,000 are equal to the net present value of the first three years of incremental operating costs, discounted at 12%. These costs are due primarily to increases in operating costs resulting from higher prices of certain foam raw materials (new polyol and blended polyol), and increased quantities of others (isocyanate).

PROJECT IMPLEMENTATION

Management: The Ministry of Light Industry and National Environmental Protection Agency will oversee the successful implementation of this project. The project will be carried out at Shanghai Shangling General Refrigerator Factory.

Schedule

TASK	1993		1994				1995				1996				1997
	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
Project planning	x														
Importation negotiation		x													
Arrange & carry out training (foreign experts)			x												
Install new equipment				x											
Stability testing of new materials			x	x	x										
Trial runs						x									
Solve problems found on trial runs							x								
Produce 100,000 refrigerators with new materials per year						x	x	x	x	x					
Produce 300,000 refrigerators with new materials per year											x	x	x	x	
Full production of 400,000 refrigerators with new materials per year															x

RESULTS: This project will result in the phaseout of 103 MT of CFC-11 in the first year of full production.

Annex 1: Breakdown of Investment Costs

$US = RMB 5.5

	RMB 1,000	US$ 1,000
EQUIPMENT		
Provided by Enterprise		
New Molds	1100	200
Auxiliary Foaming Machine	550	100
Domestic Instruments	275	50
Freight and Insurance	72	13
Requested from OTF		
Thermal Conductivity Meter	358	65
Infrared Thermal Phacometer	674	123
Measuring Instruments for Closed Hole of Foams	48	9
Aging Test Instrument for Plastic Foam	48	9
Water Absorbing Test Instrument for Rigid Plastic Foam	48	9
Universal Test Machine	63	11
SUBTOTAL - Provided by Enterprise	**1997**	**363**
SUBTOTAL - Requested from OTF	**1239**	**226**
TRIAL RUNS - Provided by Enterprise	275	50
SUBTOTAL - Provided by Enterprise	**275**	**50**
TRAINING - Requested from OTF	247	45
SUBTOTAL - Requested from OTF	**247**	**45**
TOTAL - Provided by Enterprise	2272	413
TOTAL - Requested from OTF	1486	271
GRAND TOTAL	3758	684

Annex 2: Breakdown of Incremental Recurring Costs/Benefits

Net Present Value of First Four Years Incremental Operating Cost Discounted at 12% $686,860

100% CFC USAGE

Baseline Assumptions	1994	1995	1996	1997	
Prices:					
CFC-11	2.55	2.55	2.55	2.55	
Polyol	2.770	2.77	2.77	2.77	
MDI	2.73	2.73	2.73	2.73	
Blended "Old" Polyol/CFC	2.714	2.71	2.71	2.71	
Composition of Mixture:					
CFC-11 (25%)	0.139	0.14	0.14	0.14	
Polyol (75%)	0.418	0.42	0.42	0.42	
MDI	0.442	0.44	0.44	0.44	
Component Weight Per Unit (kg):					
CFC-11	0.52	0.52	0.52	0.52	
Polyol	1.57	1.57	1.57	1.57	
MDI	1.66	3.33	3.33	3.33	
Kg Foam Used Per Unit:	3.76	3.76	3.76	3.76	
Production (1,000 units):	100	100	300	400	
Cost:					
CFC-11	$1.34	1.34	1.34	1.34	
Polyol	$4.36	4.36	4.36	4.36	
MDI	$4.54	4.54	4.54	4.54	
Total Cost/Unit	$10.23	$10.23	$10.23	$10.23	
TOTAL OPERATING COSTS ($1,000)	**$1,023**	**$1,023**	**$3,069**	**$4,093**	**$6,515**

50% CFC USAGE

50% Foam Assumptions	1994	1995	1996	1997	
Prices:					
CFC-11	2.545	2.545	2.545	2.545	
Polyol	3.072	3.07	3.07	3.07	
MDI	2.73	2.73	2.73	2.73	
Blended "New" Polyol	3.00	3.00	3.00	3.00	
Composition of Mixture:					
CFC-11 (14%)	0.067	0.07	0.07	0.07	
Polyol (86%)	0.413	0.41	0.41	0.41	
MDI	0.520	0.52	0.52	0.52	
Component Weight Per Unit (kg):					
CFC-11	0.266	0.27	0.27	0.27	
Polyol	1.634	1.63	1.63	1.63	
MDI	2.058	2.06	2.06	2.06	
Kg Foam Used Per Unit:	3.96	3.96	3.96	3.96	
Production (1,000 units):	100	100	300	400	
Cost:					
CFC-11	$0.68	0.68	0.68	0.68	
Polyol	$5.02	5.02	5.02	5.02	
MDI	$5.61	5.61	5.61	5.61	
Total Cost/Unit	$11.31	$11.31	$11.31	$11.31	
TOTAL OPERATING COSTS ($1,000)	**$1,131**	**$1,131**	**$3,393**	**$4,524**	**$7,202**
TONS CFC-11 PHASED OUT PER YEAR	**26**	**26**	**78**	**103**	

THE MONTREAL PROTOCOL ON
SUBSTANCES THAT DEPLETE THE OZONE LAYER

PROJECT COVER SHEET

COUNTRY:	China
PROJECT TITLE:	Shuangyan Conversion to 50% Reduced CFC Foam in Refrigerators
SECTOR COVERED:	Rigid Polyurethane Foam
ODS USE IN SECTOR:	13,000 MT CFC-11 (13,000 MT ODS) in 1991 ODP
PROJECT IMPACT:	Phase out 28 MT CFC-11 per year[1]
PROJECT DURATION:	2 years
PROJECT ECONOMIC LIFE:	4 years
TOTAL PROJECT COST:	US$520,000 Capital Costs Provided by Enterprise US$182,000 Capital Costs Requested from OTF US$323,000 Recurring Incremental Costs[2]
PROPOSED OTF FINANCING:	US$505,000
IMPLEMENTING ENTERPRISE:	Shuangyan General Refrigerator Factory (SGRF)
NATIONAL COORDINATING BODIES:	Ministry of Light Industry (MLI) and the National Environmental Protection Agency (NEPA)
IMPLEMENTING AGENCY:	The World Bank

[1] In the first year of full production.

[2] Net present value of incremental costs for the first four years discounted at 12%.

PROJECT SUMMARY

This project will convert its 250,000 unit capacity facility at Shuangyan General Refrigerator Factory (SGRF) for the production of household refrigerators using 50% reduced CFC-11 foam. This project will facilitate the implementation of mature technologies in China's largest CFC use sector (in both percent ODS and ODP). This project is included in China's Country Program, which was finalized in January 1993 and approved at the Ninth Meeting of the Executive Committee in Montreal, March 1993.

PROJECT OBJECTIVES

The objective of this project is to establish a 100,000 unit capacity production line at SGRF for production of five household refrigerators models using 50% reduced CFC-11 foam.

ENTERPRISE BACKGROUND

SGRF's production line has an annual production capacity of 250,000 units and was imported from Sharp Corporation, Japan. SGRF has been awarded many prizes from both the provincial and central governments for consistently exceeding national product standards. 1991 production was 80,000. It reached 100,000 units in 1992 and is expected to be 80,000 units in 1993.

A limited number of SGRF's refrigerators are sold abroad to the newly independent states of the former USSR, Afghanistan, and Hong Kong.

PROJECT DESCRIPTION

SGRF will convert its refrigerator 250,000 capacity refrigerator assembly line for the production of five refrigerator models with 50% reduced CFC-11 foam. The 50% foam formulation, which requires a smaller increase in the amount of MDI required for reduced CFC formulations (traditional 1.3:1.0 MDI:polyol, this project 1.08:1.0), will be based on technology developed by the 510 Research Institute. Conversion cost include funds for quality control instruments, trial runs to optimize formula and blowing technique, and batch production. This project will further demonstrate the performance of 510's reduced CFC formulation based on domestic raw materials. The training included in this project consists of on-site direction from foreign experts.

Production of low-CFC foam units will be 80,000 in 1994-95 and increase to 100,000 for 1996-97, for annual ODS savings of 28 MT.

PROJECT COST

Summary of Project Costs: The total project incremental cost of US$1,025,000, of which US$505,000 is the total requested from the OTF as grant, was calculated as the economic capital costs plus the net incremental recurring costs for four years discounted at 12%.

Capital Costs: Capital costs of US$702,000 include the cost of quality control instrumentation, installation, trial runs, training, and other costs for a 250,000 unit capacity household refrigerator factory using 50% reduced CFC-11 foaming technology. This project requests US$182,000 from OTF for capital costs. The enterprise will provide US$520,000 for counterpart financing for the project.

Incremental Recurrent Costs/Benefits: The net incremental operating costs of US$323,000 are equal to the net present value of the first four years of incremental operating costs, discounted at 12%. These costs are due primarily to increases in operating costs resulting from higher prices of certain foam raw materials (new polyol and blended polyol), and increased quantities of others (isocyanate).

PROJECT IMPLEMENTATION

Management: The Ministry of Light Industry and National Environmental Protection Agency will oversee the successful implementation of this project. The project will be carried out at Shuangyan General Refrigerator Factory.

Schedule:

TASK	1993		1994				1995				1996				1997
	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
Project planning	x														
Procure equipment		x													
Install equipment			x												
Begin production with new materials			x	x											
Arrange and carry out training (foreign expert)					x	x									
Produce 80,000 refrigerators per year					x	x	x	x	x	x					
Finish testing application of new materials in refrigerators							x	x							
Produce 100,000 refrigerators per year											x	x	x	x	x

RESULTS: This project will result in the phaseout of 28 MT of CFC-11 in the first year of full production.

Annex 1: Breakdown of Investment Costs

$US = RMB 5.5

	RMB 1,000	US$ 1,000
EQUIPMENT & QUALITY CONTROL		
Requested from OTF		
Storage Tanks (2)	482	88
Closed Cell Meter	34	6
Thermal Conductivity Meter	207	38
Personal Computer	110	20
SUBTOTAL - Requested from OTF	**833**	**152**
TRIAL PRODUCTION RUNS		
Provided by Enterprise	2860	520
TRAINING - Requested from OTF	165	30
SUBTOTAL - Provided by Enterprise	**2860**	**520**
SUBTOTAL - Requested from OTF	**165**	**30**
TOTAL - Provided by Enterprise	**2860**	**520**
TOTAL - Requested from OTF	**998**	**182**
GRAND TOTAL	**3858**	**702**

Annex 2: Breakdown of Incremental Recurring Costs/Benefits

Net Present Value of First Four Years Incremental Operating Cost Discounted at 12% $323,124

100% CFC USAGE
(Constant CFC Price)

Baseline Assumptions	1994	1995	1996	1997	
Prices:					
CFC-11	2.55	2.55	2.55	2.55	
Polyol	2.425	2.43	2.43	2.43	
MDI	2.73	2.73	2.73	2.73	
Blended "Old" Polyol/CFC	2.455	2.46	2.46	2.46	
Composition of Mixture:					
CFC-11 (25%)	0.139	0.14	0.14	0.14	
Polyol (75%)	0.418	0.42	0.42	0.42	
MDI	0.442	0.44	0.44	0.44	
Component Weight Per Unit (kg):					
CFC-11	0.56	0.56	0.56	0.56	
Polyol	1.68	1.68	1.68	1.68	
MDI	1.78	3.33	3.33	3.33	
Kg Foam Used Per Unit:	4.03	4.03	4.03	4.03	
Production (1,000 units):	80	80	100	100	
Cost:					
CFC-11	$1.43	1.43	1.43	1.43	
Polyol	$4.08	4.08	4.08	4.08	
MDI	$4.85	4.85	4.85	4.85	
Total Cost/Unit	$10.37	$10.37	$10.37	$10.37	
TOTAL OPERATING COSTS ($1,000)	**$829**	**$829**	**$1,037**	**$1,037**	**$2,798**

50% CFC USAGE

50% Foam Assumptions	1994	1995	1996	1997	
Prices:					
CFC-11	2.545	2.545	2.545	2.545	
Polyol	2.757	2.76	2.76	2.76	
MDI	2.73	2.73	2.73	2.73	
Blended "New" Polyol	2.73	2.73	2.73	2.73	
Composition of Mixture:					
CFC-11 (14%)	0.067	0.07	0.07	0.07	
Polyol (86%)	0.413	0.41	0.41	0.41	
MDI	0.52	0.52	0.52	0.52	
Component Weight Per Unit (kg):					
CFC-11	0.285	0.28	0.28	0.28	
Polyol	1.750	1.75	1.75	1.75	
MDI	2.205	2.20	2.20	2.20	
Kg Foam Used Per Unit:	4.24	4.24	4.24	4.24	
Production (1,000 units):	80	80	100	100	
Cost:					
CFC-11	$0.73	0.73	0.73	0.73	
Polyol	$4.82	4.82	4.82	4.82	
MDI	$6.01	6.01	6.01	6.01	
Total Cost/Unit	$11.56	$11.56	$11.56	$11.56	
TOTAL OPERATING COSTS ($1,000)	**$925**	**$925**	**$1,156**	**$1,156**	**$3,121**
TONS CFC-11 PHASED OUT PER YEAR	**22**	**22**	**28**	**28**	