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

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Montreal, 25-27 July 1994

PROJECT PROPOSALS: ARGENTINA

This document includes the following project proposals and the Fund Secretariat's Comments and Recommendations:

- Investment Project for Phasing-out of ODS at Bandex S.A.
- Investment Project for Phasing-out of ODS at Celpack S.A.

PROJECT EVALUATION SHEET

COUNTRY OR REGION:	Argentina	
PROJECT TITLE:	Investment Project for Phasing Out of ODS at: a) Bandex S.A. b) Celpack S.A.	
PROJECT COST:	a) Incremental capital cost Incremental operational savings	US $1,045,850 US $(528,220)[1]
	b) Incremental capital cost Incremental operational savings	US $ 954,212 US $(289,141)[1]
INCREMENTAL COST:	a) US $517,630 b) US $665,071	
ODS PHASE-OUT:	a) 22 tons of CFC-11 in 1993 192 tons of CFC-12 (Total ODP=214 tons)	
	b) 68 tons of CFC-11 in 1993 67 tons of CFC-12 (Total ODP=135 tons)	
COST EFFECTIVENESS:	a) US $ 2.42 per kg ODP saved b) US $ 4.93 per kg ODP saved	
PROJECT DURATION:	One year	
IMPLEMENTING AGENCY:	UNIDO	
NATIONAL COORDINATING AGENCY:	Ministerio del Medio Ambiente	
TECHNICAL REVIEW COMPLETED:	YES ___ NO _X_	

SECRETARIAT'S COMMENTS

1. Both companies are involved in the manufacture of expanded polystyrene foam sheets. They will substitute CFC-11/12 by using butane. These two companies represent all CFC consumption of extruded polystyrene foam sector in Argentina.

[1] Figures in the project documents do not reflect Net Present Value.

2. Capital costs relate to safety equipment, polystyrene extruder, high pressure metering system, storage silo and the construction of butane tanks. The incremental costs were adjusted against incremental operational savings. The cost effectiveness of the Bandex project is relatively good but that of Celpack was poor.

3. After the submission of these project proposals, the Secretariat analyzed them in cooperation with UNIDO and adjusted the incremental cost of Celpack S.A. to US $503,094 (cost effectiveness: US $3.73/per kg ODP saved).

4. The technical review papers were not attached but the implementing agency (UNIDO) has promised to send them as soon as possible.

SECRETARIAT'S RECOMMENDATION

5. The Fund Secretariat recommends approval for the amount of US $517,630 for Bandex and US $503,094 for Celpack.

PROJECT DOCUMENT

COUNTRY:	Argentina
PROJECT TITLE:	Investment Project for Phasing Out of ODS at BANDEX S.A.
SECTOR COVERED:	Expanded Polystyrene Foam
ODS USE BY SECTOR:	115 tons CFC 11 and 285 tons CFC 12 per year 1993
PROJECT IMPACT:	Phase out of annual consumption of 22 tons of CFC 11 and 192 tons of CFC 12 (total ODS = 214 tons/year)
PROJECT DURATION:	12 months
ECONOMIC LIFE OF PROJECT:	10 years
TOTAL PROJECT COSTS:	US$ 368,086
OVERHEADS OF IMPLEMENTING AGENCY:	US$ 47,851 - 13 %
PROPOSED FINANCING BY MULTILATERAL FUND:	US$ 415,937
COST EFFECTIVENESS:	1.94 US$/kg
COUNTERPART ENTERPRISE:	BANDEX S.A.
IMPLEMENTING AGENCY:	UNIDO
COORDINATING MINISTRY:	Ministerio del Medio Ambiente

PROJECT IMPACT

The project has been designed to phase out 100 per cent of CFC 11 and CFC 12 used when producing extruded polystyrene foam at BANDEX S.A., Buenos Aires, Republic of Argentina. The chosen alternative is N-butane as foam blowing agent. The project will be implemented through modification of existing production facilities and installation of supplementary safety equipment and instruments.

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1. BACKGROUND

1.1 Sector Background

* Foam Sector

Two manufacturers (BANDEX, CELPACK) are producing extruded polystyrene foams in Argentina using CFC 11 and CFC 12 as foaming agent.

* Consumption of ODS

According to the country programme of 1992 the consumption was estimated as follows:

	CFC 11	CFC 12	TOTAL (tons/year)
Extruded PSR	112	209	321
Extruded P.E.	10	-	10
Total Foams	122	209	331

The total consumption in the country in 1992 in all sectors was:

CFC 11	1338 tons
CFC 12	2408 tons
other CFC	167 tons
Total	3913 tons

* Production of ODS in Argentina

The production facilities for CFC's in Argentina were shut-down in the past. Presently, CFC's are imported crude from Brazil and distilled locally to get CFC 11 and CFC 12.

* Conversion strategy

The production facilities of the extruded polystyrene foams manufacturers will be converted in order to phase out the use of ODS. Preparatory assistance has been given to establish the needs of the companies during the complete conversion of the factories and the total elimination of CFC products from their operations.

A study of the available options for alternative blowing agents has been prepared and the effect on the operation and production process has been determined for the use of normal butane which is preferred.

* Used technologies

The company BANDEX is using both CFC's in foam operation. The existing equipment has been supplied by well known international suppliers (Gloenco, LMP) and is still, after so many years, producing goods of excellent quality meeting the demands of the Argentinean market. Some of the goods are being exported to neighbour countries.

1.2 BACKGROUND INFORMATION OF BANDEX S.A.

BANDEX is the largest producer of expanded polystyrene foams in Argentina. It is 100% owned by nationals, and the sales volume in 1993 was about US$ 12.000,000. The company employs 103 people, 12 of them are engineers and technicians. The company started its activities in early 1980.

BANDEX S.A. is the manufacturer of extruded and thermoformed polystyrene food packaging products based in the industrial zone of San Luis in Argentina. They currently operate two extrusion lines and two main thermoforming lines and consume a total of 192 tonnes of CFC 12 and 22 tonnes of CFC 11 to produce an annual extruded output of 2.376 tonnes of expanded polystyrene roll stock. The market output after thermoforming and conversion of expanded polystyrene roll stock is approximately 1.426 tones of finished goods. The balance of 950 tonnes is being recycled within the plant.

2. PROJECT OBJECTIVE

The objective of this project is to eliminate the use of CFC 11 and CFC 12 in the production of expanded polystyrene foams at BANDEX S.A. through conversion of the production equipment so that N-butane can be used.

3. PROJECT DESCRIPTION

BANDEX S.A. is prepared to phase out ODS as soon as the new technology has been acquired, the necessary machinery and equipment installed, and the technical staff trained.

In the course of the preparatory assistance given by UNIDO an exhaustive analysis of the modifications to be introduced in the plant was made. A copy of the detailed report is included in Appendix A-1.

3.1 Project modifications

The main modifications to be introduced in the existing production facilities of BANDEX S.A. will lead to improvement and changes in the following areas:

- Storage and handling of N-butane
A new external storage tank in an open area at a specified distance from the factory and the factory boundaries is needed. New loading equipment will be required.

- Extrusion area
Specific protection and safety devises are needed.

- Storage area
Significantly improved natural ventilation as well as additional forced ventilation and a sprinkler system have to be installed.

- Thermoforming
A new sprinkler area has to be created as well as the ventilation and fire extinguisher systems have to be improved.

- Final goods storage
Improvement in safety is needed (ventilation and anti-fire system).

- Factory ventilation and extra safety equipment for the whole factory have to be included in the project.

A complete description of the project and the security and safety devices needed for the factory is included in Appendix A-1.

3.2 EVALUATION OF ALTERNATIVE BLOWING AGENTS

Table 1 sets out the possible alternative blowing agents commonly considered for this type of application for the production of low density polystyrene foams (70kg/m^3). These materials can be classified into:-

(a) HCFC.
(b) Hydrocarbons.
(c) Inert gases.

The only HCFC material commonly accepted and which is approved for use in contact with food is HCFC 22 and on technical grounds, it is fully acceptable; except it has an ODP of 0.055 (5% relative to CFC 11). This substance is under environmental pressure and, whilst significantly cheaper alternative non ozone depleting substances are available in the form of Hydrocarbons, it is not likely to be the permanent solution. It is, however, still widely used in developed countries by those companies preferring to offset the high incremental costs against the capital requirements of a plant equipped to a high fire and explosion standard. In some countries legislation is underway to bann HCFC consumption.

All four hydrocarbons listed are cheap, technically viable, non ozone depleting alternatives. Normal Pentane should be rejected, however, due to its high boiling point and low auto ignition temperature which give both process problems and a higher fire risk.

Iso-Butane is also viable, but due to its high vapour pressure tends to be less favoured for this application.

This leaves two viable hydrocarbons with similar properties and each would be fully acceptable as CFC replacements. These are:

(a) ISO Pentane.
(b) Normal Butane.

In colder climates ISO Pentane exists as a liquid (B.P. 23 C) and is often preferred because, in many countries, the liquid hydrocarbon storage regulations are less rigorous than those of L.P.G.

In Argentina, both ISO Pentane and Normal Butane will exist as gases for most of the time. Of the two blowing agents above, Normal Butane would be the preferred solution because it:

(a) gives some marginal improvement in product properties;
(b) is readily available and the storage technology is well established.

It is recommended that Normal Butane be used at Bandex S.A. in Argentina.

3.3 Conversion costs

With regard to the costs for conversion of the production facilities, BANDEX S.A. is eligible for financing from the Multilateral Fund as below:

I. **Incremental investment costs** used for replacement of capital goods including training, facility (re)construction, installation, start-up, etc.

II. **Incremental operating costs** for four years, to be used for labor, maintenance, insurance and feedstock.

III. **Contingency Fund**

TABLE 1

Alternatives to CFC Blowing Agents for Low Density Polystyrene Foams.

Type	Cost	ODP	Technical Suitability	Flammability
1. HCFC 22	High	0.05	OK	Nil
2. HCFC 142B	High	0.06	OK but food approval unclear	Some
3. HCFC 134A	V. High	Nil	Unproven and food approval unclear	Nil
4. HCFC 152B	V.V. High	Nil	Unproven and food approval unclear	Nil
5. Normal Pentane	Low	Nil	OK	High
6. ISO-Pentane	Low	Nil	OK	High
7. Normal Butane	Low	Nil	OK	High
8. ISO-Butane	Low	Nil	OK	High
9. CO_2	Low	Nil	Partially proven, but not as 100% replacement. Difficult technology.	Nil

Note

Blends of the above Blowing Agents are possible and sometimes used to some technical advantage.

4. OUTPUTS

4.1 Capital goods replacement

Foam system

The technology for production of expanded polystyrene foams using N-butane as blowing agent is well known and has been tested in many countries. The main equipment to be installed at the BANDEX S.A. factory is related to safety in handling and operating of raw materials and intermediate products in order to avoid any operational risks and hazards.

The items to be installed are related to:

* Gas tank storage system;
* Sprinkler system, fire extinguisher, smoke detectors, gas detectors, fire alarm system;
* High pressure metering system;
* Silos, foams and ductwork for improved material transport and ventilation;
* Fire walls with emergency exits;
* Protection.

4.2 Training

Within the framework of this project, BANDEX's personnel will be trained in the following areas:

* Management and production control;
* Abatement of risks in operation with N-butane (risk prevention);
* Maintenance of the new machinery and equipment;
* Quality assurance in relation to conversion;
* Safety rules and safety equipment.

4.3 Project Implementation

The project will be coordinated by the Secretaria de Recursos Naturales del Ministerio de Medio Ambiente. The implementation will be carried out by UNIDO in close co-operation with BANDEX S.A.

For the implementation of major components of the project (gas tank, pumping system, fire safety, silos, fans, ducts, etc.) subcontracts will be concluded based on competitive bidding. The subcontracts will include the supply of equipment, installation, commissioning and on-the-job training of BANDEX's personnel. The terms of reference for the subcontracts will be elaborated after approval of the project.

The final equipment specification and workplan can only be elaborated after approval of the basic approach for the project implementation by the Ministerio del Medio Ambiente and BANDEX S.A.

UNIDO as Implementing Agency has the necessary experience and capabilities for successful implementation of projects on the enterprise level. Upon approval by the Multilateral Fund for the implementation of the Montreal Protocol (MFMP), the project's budget will be transferred to UNIDO. The respective project allotment document will then be issued by UNIDO's Finance Section. Any substantive or financial deviation is subject to approval by the Executive Committee of the Multilateral Fund for the implementation of the Montreal Protocol.

For the project implementation, milestones are set hereunder.

4.4 Milestones

	months												
Duration	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Sign project rec. funding	1		*										
2. Prep. of workplan	1		*										
3. Initial trg. of management	1		*										
4. Specification of equipment	1			*									
5. Bids	1				*								
6. Purchase of equipment	1						*						
7. Supply/instal. comm. equipment	6						*	*	*	*	*	*	*
8. Training	2						*	*					
9. Start-up test	1												*
10. Operation with N-Butane													

5. PROJECT COSTS

5.1 Incremental investment costs

Investment costs will be used for modification of manufacturing facilities, new machinery, safety equipment (see Annex A: Equipment Specification and Cost Breakdown), training, installation and consultancy services for modifications (see Annex B: Project Budget for BANDEX).

5.2 Incremental operating costs

The incremental operating costs is based on the price difference between the ODS to be phased out and their replacements as well as several other factors incurred in the production costs which are higher because of the requirements of the new process installed.

BANDEX S.A. TABLE II 29.June.94
INCREMENTAL OPERATING COSTS

Year	One	Two	Three	Four
Tonnes of PSR	2376	2376	2376	2376
% of CFC	9	9	9	9
Tonnes of CFC	213.84	213.84	213.84	213.84
% of Butane	7	7	7	7
Tonnes of Butane	166.32	166.32	166.32	166.32
Price with CFC (US$/Kg.)	2.2	2.2	2.2	2.2
Cost per year US$	470448	470448	470448	470448
Price with Butane (US$/Kg.)	0.8	0.8	0.8	0.8
Cost per year US$	133056	133056	133056	133056
Savings with Butane (A)	-337392	-337392	-337392	-337392
Insurance	40000	40000	40000	40000
Employment	0	0	0	0
Electricity	26000	26000	30000	30000
Maintenance	36175	36175	36175	36175
Training costs	30000	0	0	0
Packaging	43776	43776	43776	43776
Trial production	50000			
Extra product cost (B)	225951	145951	149951	149951
INCR. COST PER YEAR (A)+(B)	-111441	-191441	-187441	-187441
TOTAL INCREM. COST	-677764			

ANNEX A: EQUIPMENT SPECIFICATION AND COST BREAKDOWN
FOR BANDEX .

Item	Description		Total cost US$
1.	Gas Tank Storage System (25 tonnes capacity) complete with all discharge pipework, valves, fittings and filters to provide an adequate supply quantity at 5 Bar above vapour pressure at the inlet to the high pressure metering system. To include all the necessary equipment for safety and filling of the tank.	USD	130.000
2.	One set of Fire Safety Security Measures to include a Sprinkler System, Fire Extinguishers, Fire Hose Reels, Smoke Detectors, Gas Detectors, Fire Alarm System, to meet the necessary standards as outlined by and to include the services of a Specialist Industrial Fire Defence Supply Company or Consultant.	USD	134.000
3.	One Factory Survey by Heating & Ventilation Consulting Co. to establish the requirements to obtain the necessary number of air changes per hour in all areas.	USD	20.000
4.	New High Pressure Metering System and Refurbishment of Old System complete with two sets of anti static protections and extrusion system interlocks.	USD	100.000
5.	Silos, Fans & Ductwork for Improved Material Transport and Ventilation comprising:-		
	(a) Two Fluff Silos 2mØ x 5m high with Screw Extraction on base and Cyclone effect on Top.		
	(b) Pipes from existing Thermoformers to new Silos with static bonding.		
	(c) Pipe and Fan from Extrusion Scrap Granulator to new Silos with static bonding.		
	(d) Pipes and Fan from Fluff Silos to Reclaim Extruder Hopper complete with Cyclone discharge, complete with static bonding on pipework.		
	(e) Set of Five Local Ventilation Fans and Ductwork extraction and panel pressurisation in key extrusion areas.		
	(f) Forced ventilation in the reel store area.	USD	127.500

6.	Modification of existing building;		
	(a) Fire walls with 3 Emergency Fire Roller Shutter Doors (110m Total Length).		
	(b) Additional Emergency Personnel Exits.		
	(c) External High Pressure Pump House with Ventilation Fans, Explosion Proof Lighting and Electrics.	USD	108.000
7.	Protections to Extruder Scrap Granulator comprising;		
	(a) Belt to Feed Unit.		
	(b) Explosion Hatch/Blast Tunnel.		
	(c) Interlocks to:-		
	(i) Pressure - Extrusion Duct.		
	(ii) Fan Motor Running	USD	24,000
8.	One Training Package for;		
	(i) Management (2 people for 1 week)	USD	12,000
	(ii) Operator Training (6 people for 3 weeks each)	USD	45,000
9.	Project Technical Consultant	USD	29,000
10.	Refurbishment of LMP equipment	USD	172,500
	TOTAL	USD	902,000

All prices specified above include transportation, insurance, installation and commissioning (where appropriate).

ANNEX B: PROJECT BUDGET FOR BANDEX S.A.

		m/m	USD
BL 11-01	Expert in ODS phase-out in foam sector	1.0	15,000
BL 11-51	Consultant in production layout for foamed PSR production	0.3	4,000
BL 11-52	Consultant in design of foamed PSR system	0.3	4,000
BL 11-53	Consultant in safety and security in C4 operation	0.4	6,000
BL 21-00	Subcontract for:		
	* provision of equipment for gas storage with all necessary equipment for safety and filling of tank. Incl. installation, commissioning and on-the-job-training of BANDEX staff. (1 specialist for 1 week)		130,000
	* provision of equipment for fire safety, i.e. sprinkler system, fire extinguishers, fire hoses, smoke detectors, gas detectors, fire alarm systems incl. services of a specialist from an industrial fire defence supply company.		134,000
	* provision of a new high pressure metering system with two sets of antistatic protection and extension system interlocks.		100,000
	* provision of silos, fans and ductwork for improved material transport and ventilation, incl. a factory survey by a ventilation consulting company to establish the requirements to obtain the necessary number of air changes per hour in all areas.		147,500
	* modification of existing building incl. fire walls, emergency roller shutter doors, emergency personnel exits, external high pressure pump house with ventilation fans and ex-proof electric.		108,000
	* modification of extruder scrap granulator incl. belt to feed unit, explosion hatch/blast tunnel, and interlocks.		24,000

BANDAK

	* modification of LMP equipment	172,500
BL 32-01	Training of two technicians and six staffmembers in use of foaming machine facilities for technical inspection and on-the-job-training.	57,000
BL 51-00	Miscellaneous (15 % contingency fund)	143,850
	Subtotal I	1,045,850
	Incremental operating costs (negative)	(-677,764)
	Subtotal II	368,086
	13 % overhead cost	47,851
	TOTAL	415,937

PROJECT DOCUMENT

COUNTRY:	Argentina
PROJECT TITLE:	Investment Project for Phasing Out of ODS at CELPACK S.A.
SECTOR COVERED:	Expanded Polystyrene Foam
ODS USE BY SECTOR:	115 tons CFC 11 and 285 tons CFC 12 per year 1993
PROJECT IMPACT:	Phase out of annual consumption of 68 tons of CFC 11 and 67 tons of CFC 12 (total ODS = 135 tons/year)
PROJECT DURATION:	12 months
ECONOMIC LIFE OF PROJECT:	10 years
TOTAL PROJECT COSTS:	US$ 577,460
OVERHEADS OF IMPLEMENTING AGENCY:	US$ 75,070 = 13 %
PROPOSED FINANCING BY MULTILATERAL FUND:	US$ 652,570
COST EFFECTIVENESS:	4.83 US$/kg
COUNTERPART ENTERPRISE:	CELPACK S.A.
IMPLEMENTING AGENCY:	UNIDO
COORDINATING MINISTRY:	Ministerio del Medio Ambiente

PROJECT IMPACT

The project has been designed to phase out 100 per cent of CFC 11 and CFC 12 used when producing extruded polystyrene foam at CELPACK S.A., Buenos Aires, Republic of Argentina. The chosen alternative is N-butane as foam blowing agent. The project will be implemented through modification of existing production facilities and installation of supplementary safety equipment and instruments.

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1. BACKGROUND

1.1 Sector Background

* Foam Sector

Two manufacturers (BANDEX S.A., CELPACK S.A.) are producing extruded polystyrene foams in Argentina using CFC 11 and CFC 12 as foaming agent.

* Consumption of ODS

According to the country programme of 1992 the consumption was estimated as follows:

	CFC 11	CFC 12	TOTAL (tons/year)
Extruded PSR	112	209	321
Extruded P.E.	10	-	10
Total Foams	122	209	331

The total consumption in the country in 1992 in all sectors was:

CFC 11	1338 tons
CFC 12	2408 tons
other CFC	167 tons
Total	3913 tons

* Production of ODS in Argentina

The production facilities for CFC's in Argentina were shut-down in the past. Presently, CFC's are imported crude from Brazil and distilled locally to get CFC 11 and CFC 12.

* Conversion strategy

The production facilities of the extruded polystyrene foams manufacturers will be converted in order to phase out the use of ODS. Preparatory assistance has been given to establish the needs of the companies during the complete conversion of the factories and the total elimination of CFC products from their operations.

A study of the available options for alternative blowing agents has been prepared and the effect on the operation and production process has been determined for the use of normal butane which is preferred.

* Used technologies

The company CELPACK S.A. is using both CFC's in foam operation. The existing equipment has been supplied by well known international suppliers (Illig, LMP) and is still, after so many years, producing goods of excellent quality meeting the demands of the Argentinean market. Some of the goods are being exported to neighbour countries.

1.2 BACKGROUND INFORMATION OF CELPACK S.A.

CELPACK is the second largest producer of expanded polystyrene foams in Argentina. It is 100% owned by nationals and the sales volume in 1993 was about US$ 4.000,000. The company employs 65 people, 8 of them are engineers and technicians. The company started its activities in early 1985.

CELPACK S.A. is the manufacturer of extruded and thermoformed polystyrene food packaging products based in the industrial zone of San Luis in Argentina. They currently operate two LMP extrusion lines and two main thermoforming lines (Illig) and consume a total of 67 tonnes of CFC 12 and 68 tonnes of CFC 11 to produce an annual extruded output of 1.500 tonnes of expanded polystyrene roll stock. The market output after thermoforming and conversion of expanded polystyrene roll stock is approximately 900 tonnes of finished goods. The balance of 600 tonnes is being recycled within the plant.

2. PROJECT OBJECTIVE

The objective of this project is to eliminate the use of CFC 11 and CFC 12 in the production of expanded polystyrene foams at CELPACK S.A. through conversion of the production equipment so that N-butane can be used.

3. PROJECT DESCRIPTION

CELPACK S.A. is prepared to phase out ODS as soon as the new technology has been acquired, the necessary machinery and equipment installed, and the technical staff trained.

In the course of the preparatory assistance given by UNIDO an exhaustive analysis of the modifications to be introduced in the plant was made. A copy of the detailed report is included in Appendix A-1.

3.1 Project modifications

The main modifications to be introduced in the existing production facilities of CELPACK S.A. will lead to improvement and changes in the following areas:

- Storage and handling of N-butane
A new external storage tank in an open area at a specified distance from the factory and the factory boundaries is needed. New loading equipment will be required.

- Extrusion area
Specific protection and safety devises are needed.
LMP extruders have to be modified.

- Storage area
Significantly improved natural ventilation as well as additional forced ventilation and a sprinkler system have to be installed.

- Thermoforming
A new sprinkler area has to be created as well as the ventilation and fire extinguisher systems have to be improved.

- Final goods storage
Improvement in safety is needed (ventilation and anti-fire system).

- Factory ventilation and extra safety equipment for the whole factory have to be included in the project.

A complete description of the project and the security and safety devices needed for the factory is included in Appendix A-1.

3.2 EVALUATION OF ALTERNATIVE BLOWING AGENTS

Table 1 sets out the possible alternative blowing agents commonly considered for this type of application for the production of low density polystyrene foams (70kg/m^3). These materials can be classified into:

(a) HCFC.
(b) Hydrocarbons.
(c) Inert gases.

The only HCFC material commonly accepted which is approved for use in contact with food is HCFC 22, and on technical grounds it is fully acceptable; except it has an ODP of 0.055 (5% relative to CFC 11). This substance is under environmental pressure and whilst significantly cheaper alternative non ozone depleting substances are available in the form of Hydrocarbons, is not likely to be the permanent solution. It is, however, still widely used in developed countries by those companies preferring to offset the high incremental costs against the capital requirements of a plant equipped to a high fire and explosion standard. In some countries legislation is underway to bann HCFC consumption.

All four hydrocarbons listed are cheap, technically viable, non ozone depleting alternatives. Normal Pentane should be rejected, however, due to its high boiling point and low auto ignition temperature which give both process problems and a higher fire risk.

Iso-Butane is also viable, but due to its high vapour pressure tends to be less favoured for this application.

This leaves two viable hydrocarbons with similar properties and each would be fully acceptable as CFC replacements. These are:-

(a) ISO Pentane.
(b) Normal Butane.

In colder climates ISO Pentane exists as a liquid (B.P. 23 C) and is often preferred because, in many countries, the liquid hydrocarbon storage regulations are less rigorous than those of L.P.G.

In Argentina, both ISO Pentane and Normal Butane will exist as gases for most of the time. Of the two blowing agents above, Normal Butane would be the preferred solution because it:

(a) gives some marginal improvement in product properties;
(b) is readily available and the storage technology is well established.

It is recommended that Normal Butane be used at Celpack S.A. in Argentina.

3.3 Conversion costs

With regard to the costs for conversion of the production facilities, CELPACK S.A. is eligible for financing from the Multilateral Fund as below:

I. Incremental investment costs used for replacement of capital goods including training, facility (re)construction, installation, start-up, etc.

II. Incremental operating costs for four years, to be used for labor, maintenance, insurance and feedstock.

III. Contingency Fund

TABLE 1

Alternatives to CFC Blowing Agents for Low Density Polystyrene Foams.

Type	Cost	ODP	Technical Suitability	Flammability
1. HCFC 22	High	0.05	OK	Nil
2. HCFC 142B	High	0.06	OK but food approval unclear	Some
3. HCFC 134A	V. High	Nil	Unproven and food approval unclear	Nil
4. HCFC 152B	V.V. High	Nil	Unproven and food approval unclear	Nil
5. Normal Pentane	Low	Nil	OK	High
6. ISO-Pentane	Low	Nil	OK	High
7. Normal Butane	Low	Nil	OK	High
8. ISO-Butane	Low	Nil	OK	High
9. CO_2	Low	Nil	Partially proven, but not as 100% replacement. Difficult technology.	Nil

Note

Blends of the above Blowing Agents are possible and sometimes used to some technical advantage.

4. OUTPUTS

4.1 Capital goods replacement

Foam system

The technology for production of expanded polystyrene foams using N-butane as blowing agent is well known and has been tested in many countries. The main equipment to be installed at the CELPACK S.A. factory is related to safety in handling and operating of raw materials and intermediate products in order to avoid any operational risks and hazards.

The items to be installed are related to:

* Gas tank storage system;
* Sprinkler system, fire extinguisher, smoke detectors, gas detectors, fire alarm system;
* High pressure metering system;
* Modification of the two LMP extruders;
* Silos, foams and ductwork for improved material transport and ventilation;
* Fire walls with emergency exits;
* Protection.

4.2 Training

Within the framework of this project, CELPACK's personnel will be trained in the following areas:

* Management and production control;
* Abatement of risks in operation with N-butane (risk prevention);
* Maintenance of the new machinery and equipment;
* Quality assurance in relation to conversion;
* Safety rules and safety equipment.

4.3 Project Implementation

The project will be coordinated by the Secretaria de Recursos Naturales del Ministerio de Medio Ambiente. The implementation will be carried out by UNIDO in close co-operation with CELPACK S.A.

For the implementation of major components of the project (gas tank, pumping system, fire safety, silos, fans, ducts, etc.) subcontracts will be concluded based on competitive bidding. The subcontracts will include the supply of equipment, installation, commissioning and on-the-job training of CELPACK's personnel. The terms of reference for the subcontracts will be elaborated after approval of the project.

The final equipment specification and workplan can only be elaborated after approval of the basic approach for the project implementation by the Ministerio del Medio Ambiente and CELPACK S.A.

UNIDO as Implementing Agency has the necessary experience and capabilities for a successful implementation of projects on enterprise level. Upon approval by the Multilateral Fund for the implementation of the Montreal Protocol (MFMP), the project's budget will be transferred to UNIDO. The respective project allotment document will then be issued by UNIDO's Finance Section. Any substantive or financial deviation is subject to approval by the Executive Committee of the Multilateral Fund for the implementation of the Montreal Protocol.

For the project implementation, milestones are set hereunder.

4.4 Milestones

	months												
Duration	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1. Sign project rec. funding	1		*										
2. Prep. of workplan	1		*										
3. Initial trg. of management	1		*										
4. Specification of equipment	1			*									
5. Bids	1				*								
6. Purchase of equipment	1						*						
7. Supply/instal. comm. equipment	6						*	*	*	*	*	*	*	*		
8. Training	2						*	*					
9. Start-up test	1												*	
10. Operation with N-Butane														*

5. PROJECT COSTS

5.1 Incremental investment costs

Investment costs will be used for modification of manufacturing facilities, new machinery, safety equipment (see Annex A: Equipment Specification and Cost Breakdown), training, installation and consultancy services for modifications (see Annex B: Project Budget for CELPACK).

5.2 Incremental operating costs

The incremental operating costs are based on the price difference between the ODS to be phased out and their replacements as well as several other factors incurred in the production costs which are higher because of the requirements of the installed new process.

CELPACK S.A. TABLE II 28.June.94

INCREMENTAL OPERATING COSTS

Year	One	Two	Three	Four
Tonnes of PSR	1500	1500	1500	1500
% of CFC	9	9	9	9
Tonnes of CFC	135	135	135	135
% of Butane	7	7	7	7
Tonnes of Butane	105	105	105	105
Price with CFC (US$/Kg.)	2.2	2.2	2.2	2.2
Cost per year US$	297000	297000	297000	297000
Price with Butane (US$/Kg.)	0.8	0.8	0.8	0.8
Cost per year US$	84000	84000	84000	84000
Savings with Butane	-213000	-213000	-213000	-213000
Insurance	20000	20000	20000	20000
Employment	0	0	0	0
Electricity	16000	16000	16000	16000
Maintenance	27812	27812	27812	27812
Training costs	30000	0	0	0
Packaging	35000	35000	35000	35000
Trial production	50000			
Extra produdct cost (B)	178812	98812	98812	98812
INCR. COST PER YEAR (A)+(B)	-34188	-114188	-114188	-114188
TOTAL INCREMENTAL COSTS	-376752			

ANNEX A: EQUIPMENT SPECIFICATION AND COST BREAKDOWN
FOR CELPACK S.A.

Item	Description	Total cost US$
1.	Gas Tank Storage System (25 tonnes capacity) complete with all discharge pipework, valves, fittings and filters to provide an adequate supply quantity at 5 Bar above vapour pressure at the inlet to the high pressure metering system. To include all the necessary equipment for safety and filling of the tank.	USD 130.000
2.	One set of Fire Safety Security Measures to include a Sprinkler System, Fire Extinguishers, Fire Hose Reels, Smoke Detectors, Gas Detectors, Fire Alarm System, to meet the necessary standards as outlined by and to include the services of a Specialist Industrial Fire Defence Supply Company or Consultant.	USD 134.000
3.	One Factory Survey by Heating & Ventilation Consulting Co. to establish the requirements to obtain the necessary number of air changes per hour in all areas.	USD 20.000
4.	Refurbishment of old High Pressure Metering System complete with two sets of anti static protections and extrusion system interlocks.	USD 31,500
5.	Fans & Ductwork for Improved Material Transport and Ventilation comprising:-	USD 12.750
	(a) Relocated Fluff Silo.	
	(b) Pipes and Fans from existing Thermoformers to new Silo location with pipe static bonding.	
	(c) Pipe and Fan from Fluff Silo to Reclaim Extruder Hopper complete with Cyclone discharge. Complete with static bonding on pipework.	
	(d) Set of Six Local Ventilation Fans and Ductwork extraction and two sets of panel pressurisation fans and pipework in key extrusion areas.	
	(e) Reclaim line vent extractor fan and ductwork.	

6.	Modification of existing building:		
	(a) Additional Emergency Personnel Exits		
	(b) External High Pressure Pump House with Ventilation Fans, Explosion Proof Lighting and Electrics.	USD	9.000
7.	Protections to Extruder Scrap Granulator comprising:	USD	11.000
	(a) Belt to Feed Unit.		
	(b) Explosion Hatch/Blast Tunnel.		
	(c) Interlocks to:		
	(i) Pressure - Extrusion Duct.		
	(ii) Fan Motor Running		
8.	One Training Package for;		
	(i) Management (2 people for 1 week)	USD	12,000
	(ii) Operator Training (6 people for 3 weeks each)	USD	45,000
9.	Project Technical Consultant	USD	29,000
10.	Pressure indication before injection point with interlock to shutdown extruder on LMP 1 and LMP 2 and signal to close emergency gas shut off valves.	USD	4,500
11.	Conversion package for two extruders (Lethy Eng.)	USD	347,500
12.	Static Blowers and Bars on Thermoformer Punch Press	USD	6,000
13.	Reel store artificial air extraction.	USD	37,500
	TOTAL	USD	829,750

All prices specified above include transportation, insurance, installation and commissioning (where appropriate).

CONVERSION PACKAGE from LETHY Eng. for extruders.

	Description	U.S. $
*	New twin screw cylinder prolongation (par 2) with connection flanges to the existing anterior cylinder part.	21.300
*	Complete new twin screws L/D approx 25.1, no single screw requested, heated by thermo oil.	35.850
*	One homogenizer, with two independent heating sections,heated by thermo oil internally and externally.	34.800
*	One pneumatic gas injector for butane gas.	2,250
*	One complete new Extrusion-Die with thermo-oil heating die-gap regulated during production. The extrusion-die is thermostated at 4 different zones.	36.500
*	One sheet-cooling and calibration apparatus with support in steel for one sheet width.	6.500
*	Two cylinder-sleeves to be mounted on extruded cylinder for the thermo-oil heating.	5.800
*	Five pieces of "collarettes" for the thermo-oil heating	12.500
	TOTAL	155.000
*	One complete new Extrusion-Die for redensified product with thermo-oil heating. Thermostated at four different zones (RD-19-E)	36.500

SUMMARY OF CONVERSION PACKAGE:

2 conversion sets (one for each extruder) @ 155.500	311.000
1 set for redensify product	36.500
TOTAL U.S.$	347.500

ANNEX B: PROJECT BUDGET FOR CELPACK S.A.

		m/m	USD
BL 11-01	Expert in ODS phase-out in foam sector	1.0	15,000
BL 11-51	Consultant in production layout for foamed PSR production	0.3	4,000
BL 11-52	Consultant in design of foamed PSR system	0.3	4,000
BL 11-53	Consultant in safety and security in C4 operation	0.4	6,000
BL 21-00	Subcontract for:		
	*provision of equipment for gas storage with all necessary equipment for safety and filling of tank. Incl. installation, commissioning and on-the-job-training of CELPACK staff. (1 specialist for 1 week)		130,000
	*provision of equipment for fire safety, i.e. sprinkler system, fire extinguishers, fire hoses, smoke detectors, gas detectors, fire alarm systems incl. services of a specialist from an industrial fire defence supply company		134,000
	* provision for refurbishment of existing high pressure metering system with two sets of antistatic protection and extension system interlocks.		31,500
	* provision of silos, fans and ductwork for improved material transport and ventilation, incl. a factory survey by a ventilation consulting company to establish the requirements to obtain the necessary number of air changes per hour in all areas.		32,750
	* modification of existing building incl. emergency personnel exits, external high pressure pump house with ventilation fans and ex-proof electric.		9,000
	* modification of extruder scrap granulator incl. belt to feed unit, explosion hatch/blast tunnel, and interlocks and two underpress granulators.		11,000
	* modification of LMP equipment		347,500

	* provision of equipment for reel store artificial air extraction and tool repitching	48,000
BL 32-01	Training of two technicians and six staffmembers in use of foaming machine facilities for technical inspection and on-the-job-training.	57,000
BL 51-00	Miscellaneous (15 % contingency fund)	124,462
	Subtotal I	954,212
	Incremental operating costs (negative)	(-376,752)
	Subtotal II	577,460
	13 % overhead cost	75,070
	TOTAL	652,570

PROJECT DOCUMENT

COUNTRY:	Argentina
PROJECT TITLE:	Investment Project for Phasing Out of ODS at BANDEX S.A.
SECTOR COVERED:	Expanded Polystyrene Foam
ODS USE BY SECTOR:	115 tons CFC 11 and 285 tons CFC 12 per year 1993
PROJECT IMPACT:	Phase out of annual consumption of 22 tons of CFC 11 and 192 tons of CFC 12 (total ODS = 214 tons/year)
PROJECT DURATION:	12 months
ECONOMIC LIFE OF PROJECT:	10 years
TOTAL PROJECT COSTS:	US$ 368,086
OVERHEADS OF IMPLEMENTING AGENCY:	US$ 47,851 - 13 %
PROPOSED FINANCING BY MULTILATERAL FUND:	US$ 415,937
COST EFFECTIVENESS:	1.94 US$/kg
COUNTERPART ENTERPRISE:	BANDEX S.A.
IMPLEMENTING AGENCY:	UNIDO
COORDINATING MINISTRY:	Ministerio del Medio Ambiente

PROJECT IMPACT

The project has been designed to phase out 100 per cent of CFC 11 and CFC 12 used when producing extruded polystyrene foam at BANDEX S.A., Buenos Aires, Republic of Argentina. The chosen alternative is N-butane as foam blowing agent. The project will be implemented through modification of existing production facilities and installation of supplementary safety equipment and instruments.

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1. BACKGROUND

1.1 Sector Background

*** Foam Sector**

Two manufacturers (BANDEX, CELPACK) are producing extruded polystyrene foams in Argentina using CFC 11 and CFC 12 as foaming agent.

*** Consumption of ODS**

According to the country programme of 1992 the consumption was estimated as follows:

	CFC 11	CFC 12	TOTAL (tons/year)
Extruded PSR	112	209	321
Extruded P.E.	10	-	10
Total Foams	122	209	331

The total consumption in the country in 1992 in all sectors was:

CFC 11	1338 tons
CFC 12	2408 tons
other CFC	167 tons
Total	3913 tons

*** Production of ODS in Argentina**

The production facilities for CFC's in Argentina were shut-down in the past. Presently, CFC's are imported crude from Brazil and distilled locally to get CFC 11 and CFC 12.

*** Conversion strategy**

The production facilities of the extruded polystyrene foams manufacturers will be converted in order to phase out the use of ODS. Preparatory assistance has been given to establish the needs of the companies during the complete conversion of the factories and the total elimination of CFC products from their operations.

A study of the available options for alternative blowing agents has been prepared and the effect on the operation and production process has been determined for the use of normal butane which is preferred.

* **Used technologies**

The company BANDEX is using both CFC's in foam operation. The existing equipment has been supplied by well known international suppliers (Gloenco, LMP) and is still, after so many years, producing goods of excellent quality meeting the demands of the Argentinean market. Some of the goods are being exported to neighbour countries.

1.2 BACKGROUND INFORMATION OF BANDEX S.A.

BANDEX is the largest producer of expanded polystyrene foams in Argentina. It is 100% owned by nationals, and the sales volume in 1993 was about US$ 12.000,000. The company employs 103 people, 12 of them are engineers and technicians. The company started its activities in early 1980.

BANDEX S.A. is the manufacturer of extruded and thermoformed polystyrene food packaging products based in the industrial zone of San Luis in Argentina. They currently operate two extrusion lines and two main thermoforming lines and consume a total of 192 tonnes of CFC 12 and 22 tonnes of CFC 11 to produce an annual extruded output of 2.376 tonnes of expanded polystyrene roll stock. The market output after thermoforming and conversion of expanded polystyrene roll stock is approximately 1.426 tones of finished goods. The balance of 950 tonnes is being recycled within the plant.

2. PROJECT OBJECTIVE

The objective of this project is to eliminate the use of CFC 11 and CFC 12 in the production of expanded polystyrene foams at BANDEX S.A. through conversion of the production equipment so that N-butane can be used.

3. PROJECT DESCRIPTION

BANDEX S.A. is prepared to phase out ODS as soon as the new technology has been acquired, the necessary machinery and equipment installed, and the technical staff trained.

In the course of the preparatory assistance given by UNIDO an exhaustive analysis of the modifications to be introduced in the plant was made. A copy of the detailed report is included in Appendix A-1.

3.1 Project modifications

The main modifications to be introduced in the existing production facilities of BANDEX S.A. will lead to improvement and changes in the following areas:

- Storage and handling of N-butane
A new external storage tank in an open area at a specified distance from the factory and the factory boundaries is needed. New loading equipment will be required.

- Extrusion area
Specific protection and safety devises are needed.

- Storage area
Significantly improved natural ventilation as well as additional forced ventilation and a sprinkler system have to be installed.

- Thermoforming
A new sprinkler area has to be created as well as the ventilation and fire extinguisher systems have to be improved.

- Final goods storage
Improvement in safety is needed (ventilation and anti-fire system).

- Factory ventilation and extra safety equipment for the whole factory have to be included in the project.

A complete description of the project and the security and safety devices needed for the factory is included in Appendix A-1.

3.2 EVALUATION OF ALTERNATIVE BLOWING AGENTS

Table 1 sets out the possible alternative blowing agents commonly considered for this type of application for the production of low density polystyrene foams (70kg/m^3). These materials can be classified into:-

(a) HCFC.
(b) Hydrocarbons.
(c) Inert gases.

The only HCFC material commonly accepted and which is approved for use in contact with food is HCFC 22 and on technical grounds, it is fully acceptable; except it has an ODP of 0.055 (5% relative to CFC 11). This substance is under environmental pressure and, whilst significantly cheaper alternative non ozone depleting substances are available in the form of Hydrocarbons, it is not likely to be the permanent solution. It is, however, still widely used in developed countries by those companies preferring to offset the high incremental costs against the capital requirements of a plant equipped to a high fire and explosion standard. In some countries legislation is underway to bann HCFC consumption.

All four hydrocarbons listed are cheap, technically viable, non ozone depleting alternatives. Normal Pentane should be rejected, however, due to its high boiling point and low auto ignition temperature which give both process problems and a higher fire risk.

Iso-Butane is also viable, but due to its high vapour pressure tends to be less favoured for this application.

This leaves two viable hydrocarbons with similar properties and each would be fully acceptable as CFC replacements. These are:

(a) ISO Pentane.
(b) Normal Butane.

In colder climates ISO Pentane exists as a liquid (B.P. 23 C) and is often preferred because, in many countries, the liquid hydrocarbon storage regulations are less rigorous than those of L.P.G.

In Argentina, both ISO Pentane and Normal Butane will exist as gases for most of the time. Of the two blowing agents above, Normal Butane would be the preferred solution because it:

(a) gives some marginal improvement in product properties;
(b) is readily available and the storage technology is well established.

It is recommended that Normal Butane be used at Bandex S.A. in Argentina.

3.3 Conversion costs

With regard to the costs for conversion of the production facilities, BANDEX S.A. is eligible for financing from the Multilateral Fund as below:

I. **Incremental investment costs** used for replacement of capital goods including training, facility (re)construction, installation, start-up, etc.

II. **Incremental operating costs** for four years, to be used for labor, maintenance, insurance and feedstock.

III. **Contingency Fund**

TABLE 1

Alternatives to CFC Blowing Agents for Low Density Polystyrene Foams.

Type	Cost	ODP	Technical Suitability	Flammability
1. HCFC 22	High	0.05	OK	Nil
2. HCFC 142B	High	0.06	OK but food approval unclear	Some
3. HCFC 134A	V. High	Nil	Unproven and food approval unclear	Nil
4. HCFC 152B	V.V. High	Nil	Unproven and food approval unclear	Nil
5. Normal Pentane	Low	Nil	OK	High
6. ISO-Pentane	Low	Nil	OK	High
7. Normal Butane	Low	Nil	OK	High
8. ISO-Butane	Low	Nil	OK	High
9. CO_2	Low	Nil	Partially proven, but not as 100% replacement. Difficult technology.	Nil

Note

Blends of the above Blowing Agents are possible and sometimes used to some technical advantage.

4. OUTPUTS

4.1 Capital goods replacement

Foam system

The technology for production of expanded polystyrene foams using N-butane as blowing agent is well known and has been tested in many countries. The main equipment to be installed at the BANDEX S.A. factory is related to safety in handling and operating of raw materials and intermediate products in order to avoid any operational risks and hazards.

The items to be installed are related to:

* Gas tank storage system;
* Sprinkler system, fire extinguisher, smoke detectors, gas detectors, fire alarm system;
* High pressure metering system;
* Silos, foams and ductwork for improved material transport and ventilation;
* Fire walls with emergency exits;
* Protection.

4.2 Training

Within the framework of this project, BANDEX's personnel will be trained in the following areas:

* Management and production control;
* Abatement of risks in operation with N-butane (risk prevention);
* Maintenance of the new machinery and equipment;
* Quality assurance in relation to conversion;
* Safety rules and safety equipment.

4.3 Project Implementation

The project will be coordinated by the Secretaria de Recursos Naturales del Ministerio de Medio Ambiente. The implementation will be carried out by UNIDO in close co-operation with BANDEX S.A.

For the implementation of major components of the project (gas tank, pumping system, fire safety, silos, fans, ducts, etc.) subcontracts will be concluded based on competitive bidding. The subcontracts will include the supply of equipment, installation, commissioning and on-the-job training of BANDEX's personnel. The terms of reference for the subcontracts will be elaborated after approval of the project.

The final equipment specification and workplan can only be elaborated after approval of the basic approach for the project implementation by the Ministerio del Medio Ambiente and BANDEX S.A.

UNIDO as Implementing Agency has the necessary experience and capabilities for successful implementation of projects on the enterprise level. Upon approval by the Multilateral Fund for the implementation of the Montreal Protocol (MFMP), the project's budget will be transferred to UNIDO. The respective project allotment document will then be issued by UNIDO's Finance Section. Any substantive or financial deviation is subject to approval by the Executive Committee of the Multilateral Fund for the implementation of the Montreal Protocol.

For the project implementation, milestones are set hereunder.

4.4 Milestones

		months											
	Duration	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1. Sign project rec. funding	1			*										
2. Prep. of workplan	1			*										
3. Initial trg. of management	1			*										
4. Specification of equipment	1				*									
5. Bids	1					*								
6. Purchase of equipment	1							*						
7. Supply/instal. comm. equipment	6							*	*	*	*	*	*	*	*
8. Training	2							*	*					
9. Start-up test	1													*
10. Operation with N-Butane															*

5. PROJECT COSTS

5.1 Incremental investment costs

Investment costs will be used for modification of manufacturing facilities, new machinery, safety equipment (see Annex A: Equipment Specification and Cost Breakdown), training, installation and consultancy services for modifications (see Annex B: Project Budget for BANDEX).

5.2 Incremental operating costs

The incremental operating costs is based on the price difference between the ODS to be phased out and their replacements as well as several other factors incurred in the production costs which are higher because of the requirements of the new process installed.

BANDEX S.A. TABLE II 29.June.94
INCREMENTAL OPERATING COSTS

Year	One	Two	Three	Four
Tonnes of PSR	2376	2376	2376	2376
% of CFC	9	9	9	9
Tonnes of CFC	213.84	213.84	213.84	213.84
% of Butane	7	7	7	7
Tonnes of Butane	166.32	166.32	166.32	166.32
Price with CFC (US$/Kg.)	2.2	2.2	2.2	2.2
Cost per year US$	470448	470448	470448	470448
Price with Butane (US$/Kg.)	0.8	0.8	0.8	0.8
Cost per year US$	133056	133056	133056	133056
Savings with Butane (A)	-337392	-337392	-337392	-337392
Insurance	40000	40000	40000	40000
Employment	0	0	0	0
Electricity	26000	26000	30000	30000
Maintenance	36175	36175	36175	36175
Training costs	30000	0	0	0
Packaging	43776	43776	43776	43776
Trial production	50000			
Extra product. cost (B)	225951	145951	149951	149951
INCR. COST PER YEAR (A)+(B)	-111441	-191441	-187441	-187441
TOTAL INCREM. COST	-677764			

ANNEX A: EQUIPMENT SPECIFICATION AND COST BREAKDOWN
FOR BANDEX .

Item	Description		Total cost US$
1.	Gas Tank Storage System (25 tonnes capacity) complete with all discharge pipework, valves, fittings and filters to provide an adequate supply quantity at 5 Bar above vapour pressure at the inlet to the high pressure metering system. To include all the necessary equipment for safety and filling of the tank.	USD	130.000
2.	One set of Fire Safety Security Measures to include a Sprinkler System, Fire Extinguishers, Fire Hose Reels, Smoke Detectors, Gas Detectors, Fire Alarm System, to meet the necessary standards as outlined by and to include the services of a Specialist Industrial Fire Defence Supply Company or Consultant.	USD	134.000
3.	One Factory Survey by Heating & Ventilation Consulting Co. to establish the requirements to obtain the necessary number of air changes per hour in all areas.	USD	20.000
4.	New High Pressure Metering System and Refurbishment of Old System complete with two sets of anti static protections and extrusion system interlocks.	USD	100.000
5.	Silos, Fans & Ductwork for Improved Material Transport and Ventilation comprising:-		
	(a) Two Fluff Silos 2mØ x 5m high with Screw Extraction on base and Cyclone effect on Top.		
	(b) Pipes from existing Thermoformers to new Silos with static bonding.		
	(c) Pipe and Fan from Extrusion Scrap Granulator to new Silos with static bonding.		
	(d) Pipes and Fan from Fluff Silos to Reclaim Extruder Hopper complete with Cyclone discharge, complete with static bonding on pipework.		
	(e) Set of Five Local Ventilation Fans and Ductwork extraction and panel pressurisation in key extrusion areas.		
	(f) Forced ventilation in the reel store area.	USD	127.500

6.	Modification of existing building;		
	(a) Fire walls with 3 Emergency Fire Roller Shutter Doors (110m Total Length).		
	(b) Additional Emergency Personnel Exits.		
	(c) External High Pressure Pump House with Ventilation Fans, Explosion Proof Lighting and Electrics.	USD	108.000
7.	Protections to Extruder Scrap Granulator comprising;		
	(a) Belt to Feed Unit.		
	(b) Explosion Hatch/Blast Tunnel.		
	(c) Interlocks to:-		
	(i) Pressure - Extrusion Duct.		
	(ii) Fan Motor Running	USD	24,000
8.	One Training Package for;		
	(i) Management (2 people for 1 week)	USD	12,000
	(ii) Operator Training (6 people for 3 weeks each)	USD	45,000
9.	Project Technical Consultant	USD	29,000
10.	Refurbishment of LMP equipment	USD	172,500
	TOTAL	USD	902,000

All prices specified above include transportation, insurance, installation and commissioning (where appropriate).

ANNEX B: PROJECT BUDGET FOR BANDEX S.A.

		m/m	USD
BL 11-01	Expert in ODS phase-out in foam sector	1.0	15,000
BL 11-51	Consultant in production layout for foamed PSR production	0.3	4,000
BL 11-52	Consultant in design of foamed PSR system	0.3	4,000
BL 11-53	Consultant in safety and security in C4 operation	0.4	6,000
BL 21-00	Subcontract for:		
	* provision of equipment for gas storage with all necessary equipment for safety and filling of tank. Incl. installation, commissioning and on-the-job-training of BANDEX staff. (1 specialist for 1 week)		130,000
	* provision of equipment for fire safety, i.e. sprinkler system, fire extinguishers, fire hoses, smoke detectors, gas detectors, fire alarm systems incl. services of a specialist from an industrial fire defence supply company.		134,000
	* provision of a new high pressure metering system with two sets of antistatic protection and extension system interlocks.		100,000
	* provision of silos, fans and ductwork for improved material transport and ventilation, incl. a factory survey by a ventilation consulting company to establish the requirements to obtain the necessary number of air changes per hour in all areas.		147,500
	* modification of existing building incl. fire walls, emergency roller shutter doors, emergency personnel exits, external high pressure pump house with ventilation fans and ex-proof electric.		108,000
	* modification of extruder scrap granulator incl. belt to feed unit, explosion hatch/blast tunnel, and interlocks.		24,000

BANGKOK

	* modification of LMP equipment	172,500
BL 32-01	Training of two technicians and six staffmembers in use of foaming machine facilities for technical inspection and on-the-job-training.	57,000
BL 51-00	Miscellaneous (15 % contingency fund)	143,850
	Subtotal I	1,045,850
	Incremental operating costs (negative)	(-677,764)
	Subtotal II	368,086
	13 % overhead cost	47,851
	TOTAL	415,937