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22085

THE MONTREAL PROTOCOL ON SUBSTANCES THAT DEPLETE THE OZONE LAYER

PROJECT COVER SHEET

COUNTRY:	**ARGENTINA**
PROJECT NAME:	**Elimination of CFCs in the manufacturing plant of domestic refrigerators of FRARE S.A.**
SECTOR COVERED:	**Domestic refrigeration**
ODS CONSUMPTION IN AFFECTED SECTORS:	**762 tons (1992)**
PROJECT IMPACT:	**Phase out of annual consumption of 25.2 tons of CFC-11, 5 tons of CFC-12 30.2 tons ODP**
PROJECT DURATION:	**2 years**
PROJECT ECONOMIC LIFE:	**10 years**
TOTAL PROJECT COST:	**U$S 737.682**
PROPOSED GRANT:	**U$S 636.523**
COST EFFECTIVENESS:	**15.7 kg SAO/year (without safety related costs)**
IMPLEMENTING AGENCY	**UNIDO**
COORDINATING NAT. AGENCIES	**Ozone Program Office**
BENEFICIARY ENTERPRISE	**FRARE S.A.**

PROJECT SUMMARY

This project will eliminate the use of CFCs in the manufacturing of domestic refrigerators and freezers at FRARE S.A. plant, located in Buenos Aires, in the Republic of Argentina. The CFC-11 used as foaming agent in the production of insulating foams will be replaced with cyclopentane, and the CFC-12 used in refrigeration circuit will be replaced with HFC-134a. 26 tons of CFC-11 and 6 tons of CFC-12 will be eliminated per year (28 tons of ODS). The fund required will be used to retrofit the production lines, the start-up and tests of the new models, the training of personnel and the incremental operating costs resulting from the changeover for a period of 6 month.

Prepared by M.L.Gómez-INTI

PROJECT : ELIMINATION OF CFCs IN THE MANUFACTURING PLANTS OF DOMESTIC REFRIGERATORS OF FRARE S.A.

1. COUNTRY BACKGROUND

The Country Program of the Republic of Argentina for the protection of the ozone layer was presented and approved during the XIV meeting of the Executive Committee of the Multilateral Fund of the Montreal Protocol. This Country Program reflects the objectives of the Government and Industry to reduce the consumption of substances that deplete the ozone layer. The Program foresees the total elimination of ODS for the year 2006, before the date established by the Montreal Protocol and its amendments. The reasons for this policy are the environmental impact of this decision and the restrictions that the global agreement will impose on the industry product that contains ODS and its production. Argentina has consumed in 1992, the base year for the Country Program, 1338 tons of CFC-11 and 2408 tons of CFC-12. Due to the growth in the sectors, we estimate that consumption has increased 7% during 1993, and has increased an additional 6% during 1994. Both substances are produced domestically (660 tons of CFC-11 and 772 of CFC-12, and are also imported (1048 tons of CFC-11 and 1990 tons of CFC-12).

2. SECTOR BACKGROUND

In the refrigeration sector, during 1992 (year base of the Country Program), 1441 tons of CFC-12 and 333 tons of HCFC-22 were consumed in the refrigeration circuit. This is the sector of largest consumption of ODS.

In the refrigeration sector, 440 tons of CFC-12 were consumed in the domestic sector, of which 190 tons were used for new equipment and 250 tons for servicing operations. With regards to the commercial refrigeration sector, the consumption was 668 tons of CFC-12 (68 tons for new equipment and 600 tons for service operations) and 333 tons of HCFC-22. The refrigerated transport and the fleets consumed 333 tons of CFC-12.

With respect to the foams sector, the consumption in 1992 was equal to 1275 tons of CFC-11 and 209 tons of CFC-12 (second largest consumer), of which 322 tons of CFC-11 were consumed in the manufacturing of insulating foams for domestic refrigerators and 21 tons were consumed in commercial refrigerators.

The domestic sector produces refrigerators and freezers and little units for bottle coolers and foods display for small shops. It is basically composed today of about 20 enterprises, of which 7 share approximately 72% of the market. FRARE S.A. is one of the medium-small size companies. The principal industries have expressed the will to immediately replace the CFCs. A part of them already use the CFC-reduced foaming process and are introducing the HFC 134a.

The production of domestic refrigerators in 1992, year base of the Country Program, was equal to 761,000 units. **This number grew by 7% in 1993, and 6% in 1994. 1995 production figures were 871,00 units and production plans of the companies foresee for next years production of 1.000.000 units.**

Reasons for this growth are: a) increase of internal demand, b) Increase of exports under the MERCOSUR (Common market of the southern cone), mainly to Brazil, c) Unexpected demand of little units for beverage and food for little retail shops , being the domestic sector who fills it. Growth was not similar in all the companies, some of them maintain the 1992 production level, but some others has grown over the average. Following tables show the evolution and situation in the refrigeration and foam sector:

Table 1: CFC use in the refrigeration sectors (ton)

	Year 1992 (Country Program)		Year 1996 (estimated)	
CATEGORY	CFC 12	HCFC22	CFC 12	HCFC22
1. Domestic:				
• New installations	190		230	
• Service	250		305	

2. **Commercial and Industrial**				
• New installations	68	33	90	66
• Service	600	300	735	450
3. **Transport**	333		412	42
TOTAL	1441	333	1772	558

Table 2: CFC use per foam category (ton)

	Year 1992 (Country Program)		Year 1996 (estimated)	
CATEGORY	CFC 11	CFC 12	CFC 11	CFC 12
PUF foams:				
Rigid insulation -commercial & domestic refrigerators, panels, vehicles	617		727	
Flexible -slabstock , semirigid -moulded	566		694	
Others	42		60	
Extruded foams (XPS/PE foams)	50	209	96	382
TOTAL	1,275	209	1577	382

An unrestricted demand of CFCs in the domestic refrigeration sector would result in estimated consumption of 1170 tons by the year 2000. The strategy of the Argentinean government for the phase-out of ODS consumption is clearly set forth in the Country Program, which considers the domestic refrigeration sector to be a priority. The program for reduction and elimination of consumption in the domestic refrigeration sector establishes total elimination of consumption in the production of new equipment in the year 2000.

Strategy, projects already approved are resumed below:

a) Four projects of three leader companies were approved in XVI Executive Committee Meeting of the Multilateral Fund in December 1994:
Mac Lean S.A., Fribe S.A., and Helametal S.A. Execution of this projects is near to began

c) Six projects of medium companies were approved in the XVIII Ex. Com. in November 1995:
Briket S.A., Neba S.A. and Autosal S.A, Aurora S.A., Piragua S.A.C.I.I.F.C.A. and ADZEN S.A.

d) A project of one of the two largest producer and consumer FRIMETAL in the sector was approved in the XX Ex. Com. Meeting in 1996

e) Phase I of a project for recovery and recycling of CFCs for the whole refrigeration sector has been concluded through a bilateral cooperation with Australia, Phase II has been recently approved and will allow the servicing of old equipment, specially in the domestic and commercial sector.

f) A bilateral cooperation project, for technical assistance and capacity building for hydrocarbons technology transfer, was approved by the XIX Ex.Com., being the expected results) a national team which will assist to all the enterprises (which projects are presented to this and future meetings) for a safe implementation and also ii) Update of local regulations and development of the needed ones for the use of hydrocarbons as blowing agents and refrigerants.

g) This project, a medium size company, of similar characteristics of group c) before, which is submitted to this meeting on an individual base, jointly with Radiovictoria y Bambi.

h) The project submission to the M.F in the domestic sector will be closed in 1997, with four small remaining companies and one partially multinational one. Taking into account that the annual expected increase for the CFCs consumption for the next years would be around 6 to 7%, the whole re-conversion of the sector,

ending during 1999, would allow to the Argentine Government to comply with the 1999 freeze, remaining only in this sector the CFCs consumption for servicing purpose

The CFCs consumption in Argentina is increasing far from the economy growth. Reasons for this growth are :a) the commerce within the Mercosur, bringing up to a development of the refrigerated transport, and the refrigerated stores, and of the automotive industry with 4 new terminals b) new regulations of the health authorities requiring the transport of perishable foodstuffs in isothermic transport provided with refrigeration equipment and c) new applications for foams in several uses as packaging, shoes, automotive industry.

For this reason, to assure the 1999 freeze of ODS required by the M.P., the argentine government, as it was announced in the Country Program, will phase out the use of CFCs in new equipments in the refrigeration sector and in the foam sector by 1st January of the year 2.000. First projects already approved in this sectors will be finished by beginning of 1999, and the this project and the rest of projects submitted during 1997, finished before year 2.000, would contribute to mantain the freeze after 1999. Thus, the CFCs consumption in this sectors will be for servicing of installations.

3. PROJECT OBJECTIVE

The objective of the project is the complete elimination of the use of chlorofluorocarbonated compounds in the manufacture of domestic refrigerators in the plant of the company FRARE S.A. located in Buenos Aires, Argentina. The CFC-11 used as foaming agent in the production of polyurethane foams used in thermal insulation will be replaced by cyclopentane, and the CFC-12 used as a refrigerant will be replaced by HFC-134a in the refrigerating system in the domestic refrigerators. The project does not intend to increase installed capacity.

4. ENTERPRISE BACKGROUND

FRARE S.A. is a local medium-small size company, in expansion founded in 1969. The company is building a new plant, where they will move by the end of the year and there the equipment under this project will be installed. The company is specialized in the production of chest freezers, and it also produces single and two dors refrigerators for hipermarkets chains. Background figures for the year base 1996 are the following:

Annual ODS consumption: 32 tons: 6 tons of CFC-12 and 28 tons of CFC-11

Installed capacity: 26.400 units per year

Total production: 25.100 units per year

Product Market: Local, exports to Uruguay, Paraguay and Brazil

Source of the present technology: Developed by the company

Enterprise ownership: 100% national capitals

Table 3 - Production and CFCs consumption

Year	Production units
1994	23.594
1995	24.284
1996	25.090

Table 4 - Production structure - 1996

MODEL	Units per year	CFC 11 kgr/unit	CFC 12 gr/unit	TOTAL CFC11	TOTAL CFC 12
F80	2976	0.84	130	2500	386,88
F120 S	2514	0.98	160	2464	402,24
F120	862	0.98	160	845	137.92
F160	1562	1.12	190	1750	296.78
F 240 2/T	730	1.4	210	1022	153.3
Fc 80 P	21	0.84	130	18	2.73
Fc 120 P	507	0.98	170	497	86.19
Fc 120 T/F	4	0.98	170	4	0.68
Fc 160 P	74	1.12	200	83	14.8
Fc 160 A	285	1.12	200	319	57
Fc 240 A	250	1.54	380 (R502)	385	-
Fc 720 P	106	2.1	620 (R502)	223	-
EH 80	404	0.84	130	340	52.52
EH 120	1480	0.98	170	1450	251.6
EH 160	507	1.12	210	568	106.47
EH 120 v	5531	0.98	210	5420	1161.51
EH 160 v	6251	1.12	260	7001	1625.26
EH 200 v	885	1.26	310	1115	273.35
Ex 280	141	1.26	410 (R 502)	178	-
TOTAL				25.200	4999,23

Note : This figures already include CFC11 evaporated during manual mixing and CFC12 leakage.

5. TECHNOLOGY SELECTION CRITERIA AND IMPACT

5.1 REPLACEMENTO OF CFC 11

5.1.1. Technology selection

Currently, there are three replacement technologies of CFC11 in insulation for domestic refrigerators : water/HCFC141b, water/blend of HCFC22 and 142b of HFC 134a and 152a, and cyclopentane. The first solution is an aqueous solution whose technology is similar to the one used currently, but it is a transitional solution due to the fact that HCFC 141b is a transitional substance, and as such will be controlled by the Montreal Protocol and the policy of the Government concerning this issues is to favor projects that provide definite solutions. The second solution uses a blend of foaming gases, requires totally new equipment, and its implementation is difficult.

The third solution, which is the one proposed in this project is cyclopentane, a technology that has successfully been introduced in various European Countries. Although the installations of cyclopentane require special considerations because of safety problems, including the flammability of this liquid, it is also true that there exists considerable experience in the country concerning the handling and storage of hydrocarbons, since Argentina has considerable production of gaseous hydrocarbons, used as fuel including in automobiles. The supplier will guarantee the correct transfer of cyclopentane technology to FRARE S.A. as well as global guarantee on the safety installation through the provision of specialists. Safety independent audit of the final installation will be conducted by INTI.

5.1.2. Impact on the production process

To replace the CFC-11 used as blowing agent of the polyurethane foams, FRARE S.A. has decided to eliminate the step with a transition substance and convert its installations and processes to use cyclopentane. Currently the manufacture processes are the following:

- forming, cutting and preparation of the metal sheets
- electrodeposition paint on the metal parts
- manual cabinets and doors preparation, manual placement in 6 molds
- automatic placement of the cabinet in one mold
- automatic opening and closing of molds,
- heating of the molds by water
- polyurethane foam injection, manual injection head movement
- cleaning of injection heads with methylene chloride

The replacement of CFC-11 by cyclopentane forces the changes enumerated here and that are part of this project:

- a tank for the bulk reception of cyclopentane, piping and pumps that complies with the safety requirements corresponding combustible liquids,
- a installation for detection of cyclopentane with sufficient sensors and located in storage areas as well as working areas,
- improvement of the fire extinguishing installation with sufficient sensors and located in storage areas as well as work areas,
- pre-mix equipment for cyclopentane with polyol adapted for the use of flammable and explosive substances,
- installation of a preheating oven heated by water
- change of the low pressure dispensing units for high pressure injections one, able to handle cyclopentane, which eliminates the use of methylene chloride. FRARE proposes to replace two injections machines for only one for cabinets and doors.
- Present mold system has to be retrofitted. FRARE proposes an injection system prepared for the masks, with one injection head with a nitrogen sweeping valve for cabinets foaming, contained inside a chamber with its own functioning and emergency ventilation chamber and the individual
- The current dispensing unit for doors would be eliminated, using the same dispensing unit for doors that for cabinets, for that reason, the individual molds system inadequate for cyclopentane would be replaced by a drum with 3 positions, with independent ventilation and extraction system
- all machinery and installations will be explosion proof and grounded,
- safety technicians will study the requirements for the installations before execution of the project and will audit the construction and the start-up of the plant,
- Training course will be performed for the involved personnel.

The adjudicating enterprises for the supply of the principal machinery will provide the adequate technology transfer and will be responsible for the global safety of the installation.

CFC-11	CYCLOPENTANE
STORAGE Containers of 500 kg. for isocyanate and polyol. Mixing tank of 200 l. and pneumatic pump to feed daily tanks.	Same containers for isoyanate and polyols. A cyclopentane tank, with the corresponding piping and pumps explosion proof, provided with sensors and safety systems Premixing station and feeding group Pressurization equipment with nitrogen for cyclopentane tank, premix unit and feeding group. Enclosed exhaust cabins with its respective

POLYURETHANE INJECTION : 1 Low pressure dispensing unit, ICR 80kg 1:1 origin Italy for cabinets foaming cabinets Capacity: 80 kg/min 1 Low pressure dispensing unit, CANNON VIKING for doors foaming,. Capacity 40 kg/min	1 High pressure dispensing unit for cabinets and door foaming. Capacity: 10- 20 kg/min. For doors 50 - 100 kg/min. for cabinets Two mixing heads, one for doors, one for cabinets Ventilation cabinets, normal and emergency, with corresponding alarm and sensor systems. Fire fighting equipment
MOLDS : 17 interchangeable molds for cabinets, heated by water and pneumatic moved. 2 molds heated by water, which are capable of allocate different models, pneumatic moved. Manual movement of the injection heads	Retrofitting of the present line including : A preheating oven provided by the company Reallocation of cabinets molds, in fix stations. Reallocation of the doors foaming line, close to the cabinets one, to be able to operate with only one dispensing unit. Heads transport cars Modification of jigs and molds. Installation of grounding Replacement of electrical panel Ventilation and extraction systems, sensors and safety, boxes for cabinets and doors foaming. Fire fighting equipment

The Argentine Government will be responsible for the destruction of the replaced equipment.

5.2 REPLACEMENT OF CFC 12

5.2.1. TECHNOLOGY SELECTION

For the replacement of refrigerant there are two possibilities : HFC 134a and hydrocarbons. HFC 134a is currently universally accepted gas, whose technology has been widely developed and introduced commercially in many developing countries. There are numerous suppliers of gas, oil and components for the circuit, and it appears to be the only solution in other sub-sectors, such as commercial refrigeration and the automobile industry. There are some doubts about its GWP and the limitation of its use in the future.

The option of using hydrocarbons as refrigerants has been developed in Germany. Hydrocarbons have thermodynamic properties similar to CFC 12. It can be incorporated into the refrigeration circuit without the need for important changes to the system. Since the production of hydrocarbons is not covered by patents, the local suppliers can provide it with domestic raw materials, reducing significantly its cost. It requires replacement of the charging equipment and the incorporation system for detection, ventilation and safety . Its application implies the redesign of refrigerators in terms of the safety of its use. The technology has began to spread commercially, and is has been implemented in some European countries with success.

Notwithstanding the advantages of hydrocarbons, and since high inversion on the refrigerant lines are required compared with the grant, and taking into account that FRARE is in the segment of small/medium enterprise, the company decided to reconvert to HFC 134a, and in a second stage, to hydrocarbons, once the leader companies would have introduced them in the market. This solution appeared to be for the company the only way to comply with the 2.000 phase out of CFCs established by the Government for this sector.

5.2.2. REPLACEMENT OF CFC12 WITH HFC 134A.

The current charging process of CFC-12 consists of the injection in liquid state of the pressured liquid (12 bar) after the machine sense the correct previous vacuum, according to the following sequence:

- entrance of the refrigerator in the pre vacuum sector, through a transporting band
- 3 vacuum pumps produce vacuum in the high and low pressure part of the refrigeration system, during approximately 30 minutes.
- the refrigerant is charged immediately, after the charging machine has sensed the previous vacuum.
- leak control
- testing and control of electrical parameters.

The process for charging HFC-134 a is similar, but the materials of the charging machine have to be resistant to HFC-134 a. At the time of disconnecting the charging machine, there has to be a way of eliminating the habitual gas purge of the residues in the hose. The injection unit for the project has to comply with this requirement. It is also common that defects will appear during the assembly process that will require the evacuation of the charged gas. A recovery system for HFC-134a will be installed for this function. Also, the leak detectors should be replaced because the current ones are sensitive to chlorine molecules. The vacuum pumps can be used after undergoing an adequate cleaning process. The refrigeration circuit should be optimized to use HFC-134a, through the test of new compressors, dehydrating filters, and new capillaries due to the lower flow of refrigerant at low temperature. The use of ester-type oil in the compressors require greater care in terms of humidity and cleanliness. All the refrigerator models should be tested for compliance with IRAM 2120 Parts 1 to 4, national standards that are in effect in Argentina. Raw materials for testing will be covered by FRARE

The actual and recommended equipment is summarized in the following comparative table

CFC-12	HFC-134a
VACUUM 3 pumps, "Pascal P 1000"	Repair of the present vacuum pumps
REFRIGERANT CHARGE: Charging station LEYBOLD AG, Model F/D ¼-4 Automatic charging station with digital panel, CEMA Model On Fill F2/1 and accessories for CFC-12 charging, including vacuum transfer pumps	Charging Machine for HFC-134a, including supply pump and accessories.
REFRIGERANT LEAKAGE DETECTION : 1 Chlorine detector, YOKOGAWA MOD H 25 C - Sensitivity 3,5 -	1 Halogen leak detector,

The Argentine Government will be responsible for the destruction of the replaced equipment.

6. PROJECT TOTAL COSTS

6.1 CAPITAL COSTS

The total investment necessary to cover the procurement of the new equipment, installations, development and training costs, detailed in Annex 1 is U$S 726.555. For the imported equipment, the prices detailed in annex I is the F.O.B. value according to the supplier's quotation. C.I.F. cost, including insurance, amounting to 5% of F.O.B. was added. Only 5% for contingencies of the above value was added. A project costs summary is included below:

EQUIPMENT	U$S
1. Foaming system	504.000
2. Refrigeration system	47.712
3. Technology transfer and technical assistance: Foaming Refrigeration	 20.000 18.500
5. Training: Foaming Refrigeration	4.500 6.000
6. Text and trials: Foaming Refrigeration	21.125 7.250
7. Contingencies (10% of equipment)	64.700
TOTAL COSTS	711.787

6.2 INCREMENTAL OPERATIONAL COSTS

The detailed calculations for the incremental operating costs re included in Annex II, and amount to U$S 25.895

6.3 PROJECT TOTAL COSTS

a. Capital Incremental Costs	U$S 711.787
b. Operational Incremental Costs	U$S 25.895

PROJECT TOTAL COST	**U$S 737.682**

6.4 COST EFECTIVENESS

Total costs of the project	U$S 737.682
Amount requested to the Fund	U$S 636.523
Factor for safety items	0.65
Investment to be considered	U$S 413.740

Cost effectiveness	**13,7 U$S/kg/year**

7. PROJECT FINANCING

FRARE S.A. requests the donation of U$S 636.523 of the project costs, reflecting the 100% local ownership

8. PROJECT EXECUTION

UNIDO jointly with the OPROZ will supervise the project implementation.

9. PROJECT IMPACT

This project will eliminate the use of 30.2 tons of CFCs in the first year of implementation.

10. TIMETABLE

The project execution demands two years, see below a preliminary schedule:

TIMETABLE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Project description	x																							
Final project	xx																							
Mailing of the legal documents		xxx																						
Financial agreements		xx	xxx																					
Document signing				xxx	xxx																			
Disbursements						xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Execution of detailed workplan						xxx																		
FOAMS																								
Equipment Selection							xxx																	
Safety project								xxx																
Equipment procurement								xxx	xxx															
Equipment construction								xxx	xxx	xxx	xxx	xxx	xxx											
Cyclopentane system procurement									xxx	xxx														
Building of Cyclopentane installations											xxx	xxx	xxx	xxx										
Safety audit															xxx									
Initial trials																xxx	xxx							
Training of Personnel																xxx	xxx							
Start up																							xxx	xxx
REFRIGERANT																								
Models redesign							xxx	xxx	xxx															
Personnel training										xxx														
Equipment selection									xxx															
Equipment procurement										xxx	xxx													
Installation												xxx	xxx	xxx										
Prototyping and tests															xxx	xxx	xxx	xxx	xxx	xxx				
Start up																					xxx	xxx	xxx	xxx

ANNEX I

Description	Quantity	Unit Cost U$S	Total Cost (F.O.B.) U$S
FOAM SYSTEM A) EQUIPMENT			
1. Storage area. Conditioning, cyclopentane tank, gas detectors, ventilation and extraction system	1	30.000	30.000
2. Injection System for cabinets foaming cabinets including: * Re-conversion of masks * Transport car for the injection head * Electrical wiring and panel molds (The preheating oven will be provided by FRARE)	1		
3. Injection unit for cabinets and doors, two speeds	1		
4. Premixing unit	1		
5. Re-conversion of the Injections Systems for door foaming with 2 masks heated by water, including: * Hydraulic unit and connections * Electric hiring and panel * Injection car	1		
6. Two Injection Heads, one for cabinets and one for doors, electrical wiring and installation	1		
7. Ventilation and extraction system for cyclopentane, including: * gas detectors for molds * nitrogen sweeping system for molds * ventilation and extraction system for injection heads * gas detectors an monitoring system for injection zone * nitrogen sweeping system for injection machines * boxes for door and cabinets foaming * premising unit	1		
	Subtotal	450.000	450.000
8. Fire protection system improvement	1	30.000	30.000
9. Shipping and insurance (CIF costs) (5% of the F.O.B. value)			24.000
TOTAL			**504.000**
B) TECHNOLOGY TRANSFER AND TECHNICAL ASSISTANCE			
1. Technician for supervision of the system, installation and start up.	1	15.000	15.000

Description	Quantity	Unit Cost U$S	Total Cost (F.O.B.) U$S
External consultant: engineering, lay out, electrical areas codification, plant modifications, control and monitoring of re conversion	1	25.000	5.000 (1)
TOTAL			**20.000**
C) TEST AND TRIALS			
1. Foaming test in cabinets: 5 models x 15 units per model (raw materials) and sample shipping	75	145	10.875
2. Type Testing according to national standards in a national laboratories (INTI), 1 units per model	5	1450	7.250
3. Follow up of field test, 50 units	50	60	3.000
TOTAL			**21.125**
D) TRAINING			
1. Technicians, 1 week, supplier plant	1	3.500	3.500
2. Fire fighting course	1	1.000	1.000
TOTAL			**4.500**
REFRIGERATION SYSTEM			
A) EQUIPMENT			
1. Charging machine HFC-134a	1	29.700	29.700
2. HFC-134a dosing pump for charging machine	1	6.800	6.800
3. Retooling of the vacuum pumps	3	3.000	3.000
4. Leak detector system for HFC-134 a: Detector Sensor Filter for tests Maintenance Kit Filters Kit	1	5.940	5.940
5. Shipping and insurance costs (CIF costs, 5% of F.O.B. costs)			2.272
TOTAL			**47.712**
B) TECHNOLOGY TRANSFER AND TECHNICAL ASSISTANCE			
1. International expert review of concept		15.000	15.000
2. Technical assistance for charging system provided by supplier, one technician, one week		3.500	3.500
TOTAL			**18.500**
C) TEST AND TRIALS			

Description	Quantity	Unit Cost U$S	Total Cost (F.O.B.) U$S
1. Destructive evaluation and test of the refrigeration circuits, 2 units per model, 5 models	10	300	3.000
2. Type testing according to national standards in national laboratories (INTI), 1 units per model, 6 models	5	1450	7.250
3. Follow up of field test, 50 units	50	300	15.000
TOTAL			**25.250**
D) TRAINING			
1. Training of personnel during implementation and start-up			**6.000**
Contingencies (5% of the capital costs)			64.700
TOTAL			[illegible]

NOTES:
(1) Technical assistance for the supervision of safety systems through the Swiss Argentine Bilateral Cooperation Project

ANNEX II - OPERATIONAL INCREMENTAL COSTS

CFC 11 PHASE OUT							
Production using CFC				Production using Cyclopentane			
	%	Price U$S / kg	Cost	%	Price U$S / kg	Cost	
Polyol	37	2.1	0.777	38	2.1	0.798	
MDI	49	3.1	1.519	56	3.1	1.736	
ABA	14	2	0.28	6	2	0.12	
Total		$/kg	2.576		$/kg	2.654	
Difference per kilogram			$/kg				0.078
Yearly consumption							180.000
Annual incremental operating cost							U$S14.040
CFC 12 PHASE OUT							
			kg.	U$S/kg		Total	
Present charge CFC 12			5.000	3.25		16.250	
HFC 134 a charge			4.500	12		54.000	
Difference							U$S 37.750
Annual incremental operating cost							U$S 51.790
Six months incremental operating cost							U$S 25.895

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COUNTRY:	**ARGENTINA**
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SECTOR COVERED:	**Domestic refrigeration**
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PROJECT IMPACT:	**Phase out of annual consumption of 23 tons of CFC-11 and 6 tons of CFC-12 29 tons ODP**
PROJECT DURATION:	**2 years**
PROJECT ECONOMIC LIFE:	**10 years**
TOTAL PROJECT COST:	**U$S 829.100**
PROPOSED GRANT:	**U$S 611.230**
COST EFFECTIVENESS:	**15.7 kg SAO/year (without safety related costs)**
IMPLEMENTING AGENCY	**World Bank**
COORDINATING NAT. AGENCIES	**Ozone Program Office**
BENEFICIARY ENTERPRISE	**BAMBI S.A.**

PROJECT SUMMARY

This project will eliminate the use of CFCs in the manufacturing of domestic refrigerators at BAMBI S.A. plant, located in Rosario, Santa Fé in the Republic of Argentina. The CFC-11 used as foaming agent in the production of insulating foams will be replaced with cyclopentane, and the CFC-12 used in refrigeration circuit will be replaced with HFC-134a. 23 tons of CFC-11 and 6 tons of CFC-12 will be eliminated per year (28 tons of ODS). The fund required will be used to retrofit the production lines, the start-up and tests of the new models, the training of personnel and the incremental operating costs resulting from the changeover for a period of 6 month.

Prepared by M.L.Gómez-INTI

ELIMINATION OF CFCs IN THE MANUFACTURING PLANT OF DOMESTIC REFRIGERATORS OF BAMBI S.A.

1. COUNTRY BACKGROUND

The Country Program of the Republic of Argentina for the protection of the ozone layer was presented and approved during the XIV meeting of the Executive Committee of the Multilateral Fund of the Montreal Protocol. This Country Program reflects the objectives of the Government and Industry to reduce the consumption of substances that deplete the ozone layer. The Program foresees the total elimination of ODS for the year 2006, before the date established by the Montreal Protocol and its amendments. The reasons for this policy are the environmental impact of this decision and the restrictions that the global agreement will impose on the industry product that contains ODS and its production. Argentina has consumed in 1992, the base year for the Country Program, 1338 tons of CFC-11 and 2408 tons of CFC-12. Due to the growth in the sectors, we estimate that consumption has increased 7% during 1993, and has increased an additional 6% during 1994. Both substances are produced domestically (660 tons of CFC-11 and 772 of CFC-12, and are also imported (1048 tons of CFC-11 and 1990 tons of CFC-12).

2. SECTOR BACKGROUND

In the refrigeration sector, during 1992 (year base of the Country Program), 1441 tons of CFC-12 and 333 tons of HCFC-22 were consumed in the refrigeration circuit. This is the sector of largest consumption of ODS.

In the refrigeration sector, 440 tons of CFC-12 were consumed in the domestic sector, of which 190 tons were used for new equipment and 250 tons for servicing operations. With regards to the commercial refrigeration sector, the consumption was 668 tons of CFC-12 (68 tons for new equipment and 600 tons for service operations) and 333 tons of HCFC-22. The refrigerated transport and the fleets consumed 333 tons of CFC-12.

With respect to the foams sector, the consumption in 1992 was equal to 1275 tons of CFC-11 and 209 tons of CFC-12 (second largest consumer), of which 322 tons of CFC-11 were consumed in the manufacturing of insulating foams for domestic refrigerators and 21 tons were consumed in commercial refrigerators.

The domestic sector produces refrigerators and freezers and little units for bottle coolers and foods display for small shops. It is basically composed today of about 20 enterprises, of which 7 share approximately 72% of the market. Bambi S.A. is one of the medium size companies. The principal industries have expressed the will to immediately replace the CFCs. A part of them already use the CFC-reduced foaming process and are introducing the HFC 134a.

The production of domestic refrigerators in 1992, year base of the Country Program, was equal to 761,000 units. **This number grew by 7% in 1993, and 6% in 1994. 1995 production figures were 871,00 units and production plans of the companies foresee for next years production of 1.000.000 units.**

Reasons for this growth are: a) increase of internal demand, b) Increase of exports under the MERCOSUR (Common market of the southern cone), mainly to Brazil, c) Unexpected demand of little units for beverage and food for little retail shops , being the domestic sector who fills it. Growth was not similar in all the companies, some of them maintain the 1992 production level, but some others has grown over the average. Following tables show the evolution and situation in the refrigeration and foam sector:

Table 1: CFC use in the refrigeration sectors (ton)

	Year 1992 (Country Program)		Year 1996 (estimated)	
CATEGORY	CFC 12	HCFC22	CFC 12	HCFC22
1. Domestic:				
• New installations	190		230	
• Service	250		305	

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2. **Commercial and Industrial**				
• New installations	68	33	90	66
• Service	600	300	735	450
3. **Transport**	333		412	42
TOTAL	1441	333	1772	558

Table 2: CFC use per foam category (ton)

	Year 1992 (Country Program)		Year 1996 (estimated)	
CATEGORY	CFC 11	CFC 12	CFC 11	CFC 12
PUF foams:				
Rigid insulation -commercial & domestic refrigerators, panels, vehicles	617		727	
Flexible -slabstock , semirigid -moulded	566		694	
Others	42		60	
Extruded foams (XPS/PE foams)	50	209	96	382
TOTAL	1,275	209	1577	382

An unrestricted demand of CFCs in the domestic refrigeration sector would result in estimated consumption of 1170 tons by the year 2000. The strategy of the Argentinean government for the phase-out of ODS consumption is clearly set forth in the Country Program, which considers the domestic refrigeration sector to be a priority. The program for reduction and elimination of consumption in the domestic refrigeration sector establishes total elimination of consumption in the production of new equipment in the year 2000.

Strategy, projects already approved are resumed below:

a) Four projects of three leader companies were approved in XVI Executive Committee Meeting of the Multilateral Fund in December 1994:
Mac Lean S.A., Fribe S.A., and Helametal S.A. Execution of this projects is near to began

c) Six projects of medium companies were approved in the XVIII Ex. Com. in November 1995:
Briket S.A., Neba S.A. and Autosal S.A, Aurora S.A., Piragua S.A.C.I.I.F.C.A. and ADZEN S.A.

d) A project of one of the two largest producer and consumer FRIMETAL in the sector was approved in the XX Ex. Com. Meeting in 1996

e) Phase I of a project for recovery and recycling of CFCs for the whole refrigeration sector has been concluded through a bilateral cooperation with Australia, Phase II has been recently approved and will allow the servicing of old equipment, specially in the domestic and commercial sector.

f) A bilateral cooperation project, for technical assistance and capacity building for hydrocarbons technology transfer, was approved by the XIX Ex.Com., being the expected results) a national team which will assist to all the enterprises (which projects are presented to this and future meetings) for a safe implementation and also ii) Update of local regulations and development of the needed ones for the use of hydrocarbons as blowing agents and refrigerants.

g) This project, a medium size company, of similar characteristics of group c) before, which is submitted to this meeting on an individual base, jointly with Radiovictoria y Frare.

h) The project submission to the M.F in the domestic sector will be closed in 1997, with four small remaining companies and one partially multinational one. Taking into account that the annual expected increase for the CFCs consumption for the next years would be around 6 to 7%, the whole re-conversion of the sector,

ending during 1999, would allow to the Argentine Government to comply with the 1999 freeze, reamaining only in this sector the CFCs consumption for servicing purpose

The CFCs consumption in Argentina is increasing far from the economy growth. Reasons for this incredible growth are :a) the commerce within the Mercosur, bringing up to a development of the refrigerated transport, and the refrigerated stores, and of the automotive industry with 4 new terminals b) new regulations of the health authorities requiring the transport of perishable foodstuffs in isothermic transport provided with refrigeration equipment and c) new applications for foams in several uses as packaging, shoes, automotive industry.

For this reason, to assure the 1999 freeze of ODS required by the M.P., the argentine government, as it was announced in the Country Program, will phase out the use of CFCs in new equipments in the refrigeration sector and in the foam sector by 1st January of the year 2.000. First projects already approved in this sectors will be finished by beginning of 1999, and the this project and the group of project submitted during 1997, finished before year 2.000, would contribute to mantain the freeze after 1999. Thus, the CFCs consumption in this sectors will be only allowed for servicing of installations.

3. PROJECT OBJECTIVE

The objective of the project is the complete elimination of the use of chlorofluorocarbonated compounds in the manufacture of domestic refrigerators in the plant of the company BAMBI S.A. located in Rosario, Provincia de Santa Fé, Argentina. The CFC-11 used as foaming agent in the production of polyurethane foams used in thermal insulation will be replaced by cyclopentane, and the CFC-12 used as a refrigerant will be replaced by HFC-134a in the refrigerating system in the domestic refrigerators. The project does not intend to increase installed capacity.

4. ENTERPRISE BACKGROUND

BAMBI S.A. is a local medium size company, in expansion founded in 1955. Two years ago the company moved to the present plant of 14,000 m2. The plant is provided with the plastic forming area, the painting sector, two polyurethanes injection lines, two refrigerant lines, plant testing facilities and laboratories, including a chamber for the refrigerators testing. Background figures for the year base 1996 are the following:

Annual ODS consumption: 29 tons: 6 tons of CFC-12 and 23 tons of CFC-11

Installed capacity: 50.000 units per year

Total production: 31.000 units per year

Product Market: Local, with some exports to Uruguay, Paraguay and Brazil

Source of the present technology: Developed by the company

Enterprise ownership: 100% national capitals

Table 3 - Production and CFCs consumption

Year	Production units
1994	27,000
1995	25,000
1996	32.000

Table 4 - Production structure - 1996

MODEL	Units per year	CFC 11 kgr/unit	CFC 12 gr/unit	TOTAL CFC11	TOTAL CFC 12
C1100-2	4100	0.6	140	2460	574
C1300-2	3800	0.6	145	2280	551
C1600-2	1395	0.66	160	921	223,2
2F-1600	740	0.66	160	488	118.4
FH 2400	4600	0.7	168	3220	773
FH 3300	7750	0.75	200	5813	1550
FE 2400	550	0.7	168	385	92,4
FE 3300	640	0.75	200	480	128
EVE 4000	3250	0.8	230	2600	747,5
EBH2400	87	0.7	180	61	15.66
EVE 2800	835	0.7	200	585	167
2F 1400	1890	0.6	168	1134	317.52
EV 450	2360	0.8	230	1888	542,8
EV 520	20	0.8	230	16	4,6

Note: For the CFC 12 consumption, around 3% more was consumed for repairs and fails and around 3% also, for the CFC11, for evaporation during the mixing of the CFC 11 with polyol.

5. TECHNOLOGY SELECTION CRITERIA AND IMPACT

5.1 REPLACEMENTO OF CFC 11

5.1.1. Technology selection

Currently, there are three replacement technologies of CFC11 in insulation for domestic refrigerators : water/HCFC141b, water/blend of HCFC22 and 142b of HFC 134a and 152a, and cyclopentane. The first solution is an aqueous solution whose technology is similar to the one used currently, but it is a transitional solution due to the fact that HCFC 141b is a transitional substance, and as such will be controlled by the Montreal Protocol and the policy of the Government concerning this issues is to favor projects that provide definite solutions. The second solution uses a blend of foaming gases, requires totally new equipment, and its implementation is difficult.

The third solution, which is the one proposed in this project is cyclopentane, a technology that has successfully been introduced in various European Countries. Although the installations of cyclopentane require special considerations because of safety problems, including the flammability of this liquid, it is also true that there exists considerable experience in the country concerning the handling and storage of hydrocarbons, since Argentina has considerable production of gaseous hydrocarbons, used as fuel including in automobiles. The supplier will guarantee the correct transfer of cyclopentane technology to Bambi S.A. as well as global guarantee on the safety installation through the provision of specialists. Safety independent audit of the final installation will be conducted by INTI.

5.1.2. Impact on the production process

To replace the CFC-11 used as blowing agent of the polyurethane foams, Bambi S.A. has decided to eliminate the step with a transition substance and convert its installations and processes to use cyclopentane. Currently the manufacture processes are the following:

- forming, cutting and preparation of the metal sheets
- electrodeposition paint on the metal parts
- manual cabinets and doors preparation, manual placement in 6 molds

- automatic placement of the cabinet in one mold
- preheating of molds in a gas oven
- automatic opening and closing of molds,
- electrical heating of the moulds
- polyurethane foam injection, manual injection head movement
- cleaning of injection heads with methylene chloride

The replacement of CFC-11 by cyclopentane forces the changes enumerated here and that are part of this project:

- a tank for the bulk reception of cyclopentane, piping and pumps that complies with the safety requirements corresponding combustible liquids,
- a installation for detection of cyclopentane with sufficient sensors and located in storage areas as well as working areas,
- improvement of the fire extinguishing installation with sufficient sensors and located in storage areas as well as work areas,
- pre-mix equipment for cyclopentane with polyol adapted for the use of flammable and explosive substances,
- change of the low pressure dispensing units for high pressure injections one, able to handle cyclopentane, which eliminates the use of methylene chloride. Bambi proposes to replace two injections machines for only one for cabinets and doors.
- Present mold system and gas heated oven has to be retrofitted. Bambi proposes an injection system prepared for 7 masks, with one injection head with a nitrogen sweeping valve for cabinets foaming, contained inside a chamber with its own functioning and emergency ventilation chamber and the individual
- The current dispensing unit for doors would be eliminated, using the same dispensing unit for doors that for cabinets, for that reason, the individual molds system inadequate for cyclopentane would be replaced by a drum with 3 positions, with independent ventilation and extraction system
- all machinery and installations will be explosion proof and grounded,
- safety technicians will study the requirements for the installations before execution of the project and will audit the construction and the start-up of the plant,
- Training course will be performed for the involved personnel.

The adjudicating enterprises for the supply of the principal machinery will provide the adequate technology transfer and will be responsible for the global safety of the installation.

CFC-11	CYCLOPENTANE
STORAGE Containers of 1 ton for isocyanate and polyol. Mixing tank of 3 tons and pneumatic pump to feed daily tanks	Same containers for isocyanate and polyol. A cyclopentane tank, with the corresponding piping and pumps explosion proof, provided with sensors and safety systems Premixing station and feeding group Pressurization equipment with nitrogen for cyclopentane tank, premix unit and feeding group. Enclosed exhaust cabins with its respective ventilation systems.

POLYURETHANE INJECTION :	
3 Preheating ovens, heated by gas	Conversion of the preheating oven to be heated by water.
1 Low pressure dispensing unit, OMS Model 80kg 1:1 origin Italy for cabinets foaming cabinets Capacity: 80 kg/min	1 High pressure dispensing unit for cabinets and door foaming. Capacity: 10- 20 kg/min. For doors 50 - 100 kg/min. for cabinets
1 Low pressure dispensing unit, CANNON VIKING for doors foaming,. Capacity 40 kg/min	Two mixing heads, one for doors, one for cabinets
	Ventilation cabinets, normal and emergency, with corresponding alarm and sensor systems.
	Fire fighting equipment
MOLDS :	
1 automatic mold, pneumatic moved 6 molds hydraulic moved, all heated by electrical resistance	Retrofitting of the present line including : -modification of water heating systems for the molds heated by electrical resistance. - Drum system, with 3 molds, for door injection and reallocation of the doors foaming line, close to the cabinets one, to be able to operate with only one dispensing unit. -modification of heads transport cars -modification of jigs and molds. -installation of grounding -replacement of electrical panel
	Ventilation and extraction systems, sensors and safety, boxes for cabinets and doors foaming.
	Fire fighting equipment

The Argentine Government will be responsible for the destruction of the replaced equipment.

5.2 REPLACEMENT OF CFC 12

5.2.1. TECHNOLOGY SELECTION

For the replacement of refrigerant there are two possibilities : HFC 134a and hydrocarbons. HFC 134a is currently universally accepted gas, whose technology has been widely developed and introduced commercially in many developing countries. There are numerous suppliers of gas, oil and components for the circuit, and it appears to be the only solution in other sub-sectors, such as commercial refrigeration and the automobile industry. There are some doubts about its GWP and the limitation of its use in the future.

The option of using hydrocarbons as refrigerants has been developed in Germany. Hydrocarbons have thermodynamic properties similar to CFC 12. It can be incorporated into the refrigeration circuit without the need for important changes to the system. Since the production of hydrocarbons is not covered by patents, the local suppliers can provide it with domestic raw materials, reducing significantly its cost. It requires replacement of the charging equipment and the incorporation system for detection, ventilation and safety . Its application implies the redesign of refrigerators in terms of the safety of its use. The technology has began to spread commercially, and is has been implemented in some European countries with success.

Notwithstanding the advantages of hydrocarbons, and since high inversion on the refrigerant lines are required compared with the grant, and taking into account that Bambi is in the segment of small/medium enterprise, the company decided to reconvert to HFC 134a, and in a second stage, to hydrocarbons, once the leader companies would have introduced them in the market. This solution appeared to be for the company the only way to comply with the 2.000 phase out of CFCs established by the Government for this sector.

5.2.2. REPLACEMENT OF CFC12 WITH HFC 134A.

The current charging process of CFC-12 consists of the injection in liquid state of the pressured liquid (12 bar) after the machine sense the correct previous vacuum, according to the following sequence:

- entrance of the refrigerator in the pre vacuum sector, through a transporting band
- 8 vacuum pumps produce vacuum in the high and low pressure part of the refrigeration system, during approximately 30 minutes.
- the refrigerant is charged immediately, after the charging machine has sensed the previous vacuum.
- leak control
- 100% testing according to IRAM standards.

The process for charging HFC-134 a is similar, but the materials of the charging machine have to be resistant to HFC-134 a. At the time of disconnecting the charging machine, there has to be a way of eliminating the habitual gas purge of the residues in the hose. The injection unit for the project has to comply with this requirement. It is also common that defects will appear during the assembly process that will require the evacuation of the charged gas. A recovery system for HFC-134a will be installed for this function. Also, the leak detectors should be replaced because the current ones are sensitive to chlorine molecules. The vacuum pumps can be used after undergoing an adequate cleaning process. The refrigeration circuit should be optimized to use HFC-134a, through the test of new compressors, dehydrating filters, and new capillaries due to the lower flow of refrigerant at low temperature. The use of ester-type oil in the compressors require greater care in terms of humidity and cleanliness. All the refrigerator models should be tested for compliance with IRAM 2120 Parts 1 to 4, national standards that are in effect in Argentina. Raw materials for testing will be covered by Bambi

The actual and recommended equipment is summarized in the following compartive table

CFC-12	HFC-134a
VACUUM 8 pumps, "VARIAN" with capacity 20 m3/hour	Repair of the present vacuum pumps
REFRIGERANT CHARGE: Automatic charging station with digital panel, CEMA Model On Fill and accessories for CFC-12 charging	Charging Machine for HFC-134a, including supply pump and accessories.
REFRIGERANT LEAKAGE DETECTION : 4 Chlorine detectors, YOKOGAWA MOD H 25 C - Sensitivity 3,5 -	4 Halogen leak detector,

The Argentine Government will be responsible for the destruction of the replaced equipment.

6. PROJECT TOTAL COSTS

6.1 CAPITAL COSTS

The total investment necessary to cover the procurement of the new equipment, installations, development and training costs, detailed in Annex 1 is U$S 726.555. For the imported equipment, the prices detailed in annex I is the F.O.B. value according to the supplier's quotation. C.I.F. cost, including insurance, amounting to 5% of

F.O.B. was added. Only 5% for contingencies of the above value was added. A project costs summary is included below:

EQUIPMENT	U$S
1. Foaming system	572.000
2. Refrigeration system	59.180
3. Technology transfer and technical assistance: Foaming Refrigeration	 20.000 18.500
5. Training: Foaming Refrigeration	4.500 6.000
6. Text and trials: Foaming Refrigeration	21.125 7.250
7. Contingencies (10% of equipment)	72.655
TOTAL COSTS	799.200

6.2 INCREMENTAL OPERATIONAL COSTS

The detailed calculations for the incremental operating costs re included in Annex II, and amount to U$S 29.904

6.3 PROJECT TOTAL COSTS

a. Capital Incremental Costs	U$S 799.200
b. Operational Incremental Costs	U$S 29.900

PROJECT TOTAL COST	**U$S 829.100**

6.4 COST EFECTIVENESS

Total costs of the project	U$S 829.100
Amount requested to the Fund	U$S 611.230
Factor for safety items	0.65
Investment to be considered	U$S 397.230

Cost effectiveness	**13,7 U$S/kg/year**

7. PROJECT FINANCING

Bambi S.A. requests the donation of U$S 611.230 of the project costs, reflecting the 100% local ownership

8. PROJECT EXECUTION

The World Bank jointly with the National Institute of Industrial Technology will supervise the project implementation.

9. PROJECT IMPACT

This project will eliminate the use of 29 tons of CFCs in the first year of implementation.

10. TIMETABLE

The project execution demands two years, see below a preliminary schedule:

TIMETABLE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Project description	x																							
Final project	xx																							
Mailing of the legal documents		xxx																						
Financial agreements		xx	xxx																					
Document signing				xxx	xxx																			
Disbursements						xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Execution of detailed workplan						xxx																		
FOAMS																								
Equipment Selection							xxx																	
Safety project								xxx																
Equipment procurement								xxx	xxx															
Equipment construction								xxx	xxx	xxx	xxx	xxx	xxx											
Cyclopentane system procurement									xxx	xxx														
Building of Cyclopentane installations											xxx	xxx	xxx	xxx										
Safety audit															xxx									
Initial trials																xxx	xxx							
Training of Personnel																xxx	xxx							
Start up																							xxx	xxx
REFRIGERANT																								
Models redesign							xxx	xxx	xxx															
Personnel training										xxx														
Equipment selection									xxx															
Equipment procurement										xxx	xxx													
Installation												xxx	xxx	xxx										
Prototyping and tests															xxx	xxx	xxx	xxx	xxx	xxx				
Start up																					xxx	xxx	xxx	xxx

ANNEX I

Description	Quantity	Unit Cost U$S	Total Cost (F.O.B.) U$S
FOAM SYSTEM A) EQUIPMENT			
1. Storage area. Conditioning, cyclopentane tank, gas detectors, ventilation and extraction system	1	30.000	30.000
2. Injection System for cabinets foaming cabinets including: * Re-conversion of Preheating oven * Re-conversion of masks * Transport car for the injection head * Electrical wiring and panel molds	1		
3. Injection unit for cabinets and doors, two speeds	1		
4. Premising unit	1		
5. Injections Systems for door foaming with 3 masks heated by water, including: * Hydraulic unit and connections * Electric hiring and panel * Injection car	1		
6. Two Injection Heads, one for cabinets and one for doors, electrical wiring and installation	1		
7. Ventilation and extraction system for cyclopentane, including: * gas detectors for molds * nitrogen sweeping system for molds * ventilation and extraction system for injection heads * gas detectors an monitoring system for injection zone * nitrogen sweeping system for injection machines * boxes for door and cabinets foaming * premising unit	1		
	Subtotal	485.000	485.000
8. Fire protection system improvement	1	30.000	30.000
9. Shipping and insurance (CIF costs) (5% of the F.O.B. value)			27.000
TOTAL			**572.000**
B) TECHNOLOGY TRANSFER AND TECHNICAL ASSISTANCE			
1. Technician for supervision of the system, installation and start up.	1	15.000	15.000

Description	Quantity	Unit Cost U$S	Total Cost (F.O.B.) U$S
External consultant: engineering, lay out, electrical areas codification, plant modifications, control and monitoring of re conversion	1	25.000	5.000 (1)
TOTAL			**20.000**
C) TEST AND TRIALS			
1. Foaming test in cabinets: 5 models x 15 units per model (raw materials) and sample shipping	75	145	10.875
2. Type Testing according to national standards in a national laboratories (INTI), 1 units per model	5	1450	7.250
3. Follow up of field test, 50 units	50	60	3.000
TOTAL			**21.125**
D) TRAINING			
1. Technicians, 1 week, supplier plant	1	3.500	3.500
2. Fire fighting course	1	1.000	1.000
TOTAL			**4.500**
REFRIGERATION SYSTEM			
A) EQUIPMENT			
1. Charging machine HFC-134a	1	29.700	29.700
2. HFC-134a dosing pump for charging machine	1	6.800	6.800
3. Retooling of the vacuum pumps	8	1.000	8.000
4. Leak detector system for HFC-134 a: Detector Sensor Filter for tests Maintenance Kit Filters Kit	2	5.940	11.880
5. Shipping and insurance costs (CIF costs, 5% of F.O.B. costs)			2800
TOTAL			**59.180**
B) TECHNOLOGY TRANSFER AND TECHNICAL ASSISTANCE			
1. International expert review of concept		15.000	15.000
2. Technical assistance for charging system provided by supplier, one technician, one week		3.500	3.500
TOTAL			**18.500**
C) TEST AND TRIALS			

Description	Quantity	Unit Cost U$S	Total Cost (F.O.B.) U$S
1. Destructive evaluation and test of the refrigeration circuits, 2 units per model, 5 models	10	300	3.000
2. Type testing according to national standards in national laboratories (INTI), 1 units per model, 6 models	5	1450	7.250
3. Follow up of field test, 50 units	50	300	15.000
TOTAL			**25.250**
D) TRAINING			
1. Training of personnel during implementation and start-up			**6.000**
Contingencies (10% of the capital costs)			72.655
TOTAL			[illegible]

NOTES:
(1) Technical assistance for the supervision of safety systems through the Swiss Argentine Bilteral Cooperatrion Project

ANNEX II - OPERATIONAL INCREMENTAL COSTS

CFC 11 PHASE OUT							
Production using CFC				Production using Cyclopentane			
	%	Price U$S / kg	Cost	%	Price U$S / kg	Cost	
Polyol	37	2.1	0.777	38	2.1	0.798	
MDI	49	3.1	1.519	56	3.1	1.736	
ABA	14	2	0.28	6	2	0.12	
Total		$/kg	2.576		$/kg	2.654	
Difference per kilogram			$/kg				0.078
Yearly consumption							186.000
Annual incremental operating cost							U$S14.508

CFC 12 PHASE OUT				
	kg.	U$S/kg	Total	
Present charge CFC 12	6.000	3.25	19.500	
HFC 134 a charge	5.400	12	64.800	
Difference				U$S 45.300
Annual incremental operating cost				U$S 59.808
Six months incremental operating cost				U$S 29.900

MONTREAL PROTOCOL

PROJECT COVER SHEET

COUNTRY:	ARGENTINA
PROJECT TITLE:	Elimination of CFCs in the manufacturing plants of domestic refrigerators of RADIO VICTORIA CATAMARCA S.A. , in Catamarca, Argentina
SECTOR:	Domestic refrigeration
ODS CONSUMPTION IN SECTOR:	762 tons (1993)
PROJECT IMPACT:	33.6 tons (6.6 tons CFC-12 and 27 tons CFC-11)
PROJECT ECONOMIC LIFE:	10 years
PROJECT TOTAL COST:	US$ 878,626 (Hay un error en este valor que influye en este valor.)
PROPOSED GRANT:	US$ 700,000
COST EFFECTIVENESS:	13,54 US$/kg SAO/year (excluding safety costs)
BENEFICIARY:	RADIOVICTORIA CATAMARCA S.A
NATIONAL COORDINATING AGENCY:	Ozone Program Office
IMPLEMENTING AGENCY:	ONUDI
APPRAISAL DATE:	November 1996

PROJECT SUMMARY

This program will eliminate the use of CFCs in the manufacturing of domestic refrigerators at RADIO VICTORIA CATAMARCA S.A. factory, located in CATAMARCA. The CFC-11 used as a foaming agent in the production of insulating foams will be replaced with cyclopentane, and the CFC-12 used in the refrigeration circuit will be replaced with R 600 (isobutane). It is estimated that 6.6 tons of CFC-12 and 27 tons of CFC-11 (33.6 tons of SAO) will be eliminated per year. The funds required will be used to retrofit the production lines, start up and the test of new models, personnel training, resulting from the conversion.

Prepared by: Ing. María Lucía Gómez

GOVERNMENT OF ARGENTINA COUNTRY PROGRAM ELIMINATION OF CFCs IN THE MANUFACTURING PLANTS OF DOMESTIC REFRIGERATORS OF RADIO VICTORIA CATAMARCA S.A. S.A.

1. COUNTRY BACKGROUND

The Country Program of the Republic of Argentina for the protection of the ozone layer was presented and approved during the XIII meeting of the Executive Committee of the Multilateral Fund of the Montreal Protocol. The Country Program reflects the objectives of the Government and industry to reduce the consumption of substances that deplete the ozone layer.

This Program estimates the total elimination of ODSs for the year 2006, before it is established by the Montreal Protocol and its amendments. The reasons for this policy are the environmental impact of this decision and the restrictions that the global partnership will impose upon the industrial products that contain ODS in their production.

Argentina has consumed during 1992, the base year for the Country Program, 1338 tons of CFC-11 and 2408 tons of CFC-12. Due to the growth in the sectors that use SAO, this consumption has increased by 7% in the year 1993, and by 6% in 1994. Both substances are produced domestically (660 tons of CFC-11 and 772 tons of CFC-12) and are imported (1048 tons of CFC-11 and 1990 of CFC-12) (base year 1992).

2. SECTOR BACKGROUND

In the refrigeration sector, during 1992 (year base of the Country Program), 1441 tons of CFC-12 and 333 tons of HCFC-22 were consumed in the refrigeration circuit. This is the sector of largest consumption of ODS.

In the refrigeration sector, 440 tons of CFC-12 were consumed in the domestic sector, of which 190 tons were used for new equipment and 250 tons for servicing operations. With regards to the commercial refrigeration sector, the consumption was 668 tons of CFC-12 (68 tons for new equipment and 600 tons for service operations) and 333 tons of HCFC-22. The refrigerated transport and the fleets consumed 333 tons of CFC-12.

With respect to the foams sector, the consumption in 1992 was equal to 1275 tons of CFC-11 and 209 tons of CFC-12 (second largest consumer), of which 322 tons of CFC-11 were consumed in the manufacturing of insulating foams for domestic refrigerators and 21 tons were consumed in commercial refrigerators.

The domestic sector produces refrigerators and freezers and little units for bottle coolers and foods display for small shops. It is basically composed today of about 20 enterprises, of which 7 share approximately 72% of the market. Radio Victoria Catamarca S.A. is one of the medium size companies. The principal industries have expressed the will to immediately replace the CFCs. A part of them already use the CFC-reduced foaming process and are introducing the HFC 134a.

The production of domestic refrigerators in 1992, year base of the Country Program, was equal to 761,000 units. **This number grew by 7% in 1993, and 6% in 1994. 1995 production figures were 871,00 units and production plans of the companies foresee for next years production of 1.000.000 units.**

Reasons for this growth are: a) increase of internal demand, b) Increase of exports under the MERCOSUR (Common market of the southern cone), mainly to Brazil, c) Unexpected demand of little units for beverage and food for little retail shops , being the domestic sector who fills it. Growth was not similar in all the companies, some of them maintain the 1992 production level, but some others has grown over the average. Following tables show the evolution and situation in the refrigeration and foam sector:

Table 1: CFC use in the refrigeration sectors (ton)

	Year 1992 (Country Program)		Year 1995	
CATEGORY	CFC 12	HCFC22	CFC 12	HCFC22
1. Domestic:				
• New installations	190		216	
• Service	250		285	
2. **Commercial and Industrial**				
• New installations	68	33	79	47
• Service	600	300	690	410
3. **Transport**	333		375	38
TOTAL	1441	333	1645	495

Table 2: CFC use per foam category (ton)

	Year 1992 (Country Program)		Year 1995	
CATEGORY	CFC 11	CFC 12	CFC 11	CFC 12
PUF foams:				
Rigid insulation -commercial & domestic refrigerators, panels, vehicles	617		693	
Flexible -slabstock , semirigid -molded	566		661	
Others	42		42	
Extruded foams (XPS/PE foams)	50	209	90	360
TOTAL	1,275	209	1485	360

An unrestricted demand of CFCs in the domestic refrigeration sector would result in estimated consumption of 1170 tons by the year 2000. The strategy of the Argentinean government for the phase-out of ODS consumption is clearly set forth in the Country Program, which considers the domestic refrigeration sector to be a priority. The program for reduction and elimination of consumption in the domestic refrigeration sector establishes total elimination of consumption in the production of new equipment in the year 2000.

Strategy, projects already approved are resumed below:

a) Four projects of three leader companies were approved in XVI Executive Committee Meeting of the Multilateral Fund (Ex, Com.) in December 1994:
Mac Lean S.A., Fribe S.A., and Helametal S.A. Execution of this projects is near to began

c) Six projects of medium companies were approved in the XVIII Ex. Com. in November 1995:
Briket S.A., Neba S.A. and Autosal S.A, Aurora S.A., Piragua S.A.C.I.I.F.C.A. and ADZEN S.A.

d) A project of one of the two largest producer and consumer FRIMETAL in the sector was approved in the XX Ex. Com. Meeting in 1996

e) Phase I of a project for recovery and recycling of CFCs for the whole refrigeration sector has been concluded through a bilateral cooperation with Australia, Phase II is being submitted to next meeting and will allow the servicing of old equipment, specially in the commercial sector.

f) A bilateral cooperation project, for technical assistance and capacity building for hydrocarbons technology transfer, was approved by the XIX Ex.Com., being the expected results) a national team which will assist to all the enterprises (which projects are presented to this and future meetings) for a safe implementation and also ii) Update of local regulations and development of the needed ones for the use of hydrocarbons as blowing agents and refrigerants.

g) This project, of Radio Victoria Catamarca, a medium size company, of similar characteristics of group c) before, which is submitted to this meeting on an individual base, given its machinery and products.

h) The reaminder small companies, will be included in one global projects to close the domestic sector. This projects would be submitted in at the end of 1997.

3. PROJECT OBJECTIVES

The objective of the project is the complete elimination of the use of chlorofluorocarbonated substances in the manufacturing of domestic refrigerators in the plant of the enterprise RADIO VICTORIA CATAMARCA S.A., located in CATAMARCA, Republic of Argentina. The CFC-11 used as foaming agent will be replaced by ciclopentane in the polyurethane foams and the CFC-12 used as refrigerant by isobutane.

4. ENTERPRISE BACKGROUND

RADIO VICTORIA CATAMARCA S.A.. is a medium-sized enterprise of argentine capitals, which produces refrigerators. The company was founded in 1967 and produced domestic refrigerators in a 3,500 m2 plant. The company also produces electronic appliances in other plant located in the southest area of the country. Initially the company considered to reconvert to cyclopentane and HFC

134a, but it has finally decided to apply for isobutane technology, based mainly on technical and environmental reasons.

Following figures show the company activity:

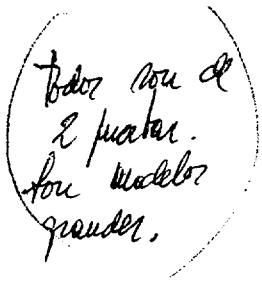
Annual ODS consumption:	33.6 tons: 6.6 t of CFC-12 and 27 t of CFC-11 (1995, see table 3)
Installed capacity:	5.000 units/month/shift
Total production:	32.000 units (1996, see table 3)
Participation in sector:	3 - 3.5 %
Market of the product:	Local and surrounding countries: Brazil
Origin of technology:	Part of the technology has been developed locally
Enterprise ownership:	100% argentine

Table 3 - Production and CFCs consumption - RADIO VICTORIA CATAMARCA S.A.

Year	Production units
1993	15.019
1994	21.627
1995	31.000
1996	32.000

Table 4 - Production structure - 1996

MODEL	Units per year	CFC 11 gr/unit	CFC 12 gr/unit	TOTAL CFC11	TOTAL CFC 12
RK 362	19,500	880	215	17.2	4.2
RK 282	6,000	782	160	4.7	1
RK 216	6,500	782	195	5.1	1.2



Note: For the CFC 12 consumption, around 3% was added for repairs and fails.

5. TECHNOLOGY SELECTION CRITERIA AND IMPACT

5.1 Replacement of CFC 11

5.1.1. Technology selection

Currently, there are three replacement technologies of CFC-11 in insulation for domestic refrigerators: water/HCFC-141b, water/blend of HCFC-22 and -142b or HFC-134a and -152a, and cyclopentane. The first solution is an aqueous solution whose technology is similar to the one used currently, but it is a transitional solution due to the fact that HCFC-141b is a transitional substance, and as such will be controlled by the Montreal Protocol, and the policy of the Government concerning

this issue is to favor the projects that provide definitive solutions. The second solution uses a blend of foaming gases, requires totally new equipment, and its implementation is difficult.

The third solution, which is the one proposed in this project, is cyclopentane, a technology that has successfully been introduced in various European countries. Although the installations of cyclopentane require special considerations because of safety problems, including the flammability of this gas, it is also true that there exists considerable experience in the country concerning the handling and storage of hydrocarbons, since Argentina has a considerable production of gaseous hydrocarbons, used as fuel, including in automobiles. The supplier will guarantee the correct transfer of cyclopentane technology to RADIO VICTORIA CATAMARCA S.A. as well as a global guarantee on the safety of installation through the provision of specialists. Safety independent audit of the final installation will be conducted by INTI.

5.1.2 Impact on the production process

To replace the blowing agent of the polyurethane foam, RADIO VICTORIA CATAMARCA S.A. S.A. has decided to eliminate the transitional substance step and transform its installations and processes to use cyclopentane. Currently, the manufacturing processes are the following:

- forming, cutting and preparation of the metal sheets
- manual pre-assembly of cabinets and/or doors
- manual location of cabinet and/or door inside the molds
- two preheating ovens
- one authomatic mold and three manual closing and opening molds
- three cabinets molds heated by electrical resistance and one by hot water
- three doors molds heated by electrical resistance and one by hot water
- injection of polyurethane foams with manual head movement
- self cleaning of the heads
- containers of polyol and isocianate and CFC 11 (cylinders of 600 kg), mixed in 3 ton tanks and pneumatic pump for the daily tanks of the machine.

The replacement of CFC-11 with cyclopentane forces the changes enumerated here and that are a part of this project:

- it will be necessary to have a tank for for the reception of cyclopentane that complies with the safety requirements corresponding to flammable liquids
- it will be necessary to have an installation for detection of cyclopentane with enough sensors and located in the storage and in the working areas
- it will be necessary to have pre-mix equipment for cyclopentane with polyol adapted for the use of flammable and explosive substances, with its corresponding cabin and system for gas extraction, for the dispensing unit.
- it will be necessary to provide the safety mechanism to the high pressure dispensing units, so that it can also work with cyclopentane.
- it will be necessary to provide the injection heads with a nitrogen-sweeping valve, and the whole will be contained inside a cabin with its own functioning and emergency ventilation
- all the machinery and installations must be explosion-proof and grounded

- safety technicians will study the requirements for the installations before the execution of the project, and will audit the construction and the start-up
- training courses will be performed for the involved personnel

The adjudicating enterprise for the supply of the principal machinery will provide the adequate technology transfer and will be responsible for the global safety of the installation.

The actual and recommended equipment is summarized in the following comparative table:

R-11	CYCLOPENTANE
STORAGE: Containers 1 ton for isocyanate and polyol. A mixing tank of 3 tons and a pneumatic pump to feed daily tanks.	Same storage tank or drums for isocyanate and polyol. A cyclopentane tank, with its corresponding piping and pumps explosion proof, provided with sensors and safety systems Premixing station and feeding group. Pressurization equipment with nitrogen for cyclopentane tank, pre mix unit and feeding group. Closing and extraction cabins with its respective ventilation systems
POLYURETHANE INJECTION: • 2 preheating ovens, heated by electrical resistance • 1 high pressure dispensing unit CANNON model A 100, capacity 90 kg/min., provided with two heads, one for the Cannon molds and the other for the rest of the molds	• Reconversion of the preheating oven , to be heated by water • Reconversion of the high pressure unit to work with cyclopentane • Ventilation cabinets, normal and emergency, with corresponding alarm and sensor systems

MOLDS:
 	
• Containment mold for cabinets:
  • three molds heated by electrical resistance, manual opening and closing
  • one Cannon mold heateb by water, authomatic opening and closing
• Containment molds for doors:
  • three molds with injection head with manual movement, heated electrically
  • one Cannon mold heated by water, with authomatica opening and closing
	Retrofitting of the present lines including:
	• water heating systems for the molds heated by electrical resistance
	• heads transport cars
	• jigs and molds
	• grounding
	• electrical panel
	Ventilation and extraction systems, sensors and safety, boxes for cabinets and doors foaming.

5.2 Replacement of CFC 12

5.2.1. Technology selection:

For the replacement of refrigerant, there are two possibilities: HFC-134a and hydrocarbons. HFC-134a is currently a universally accepted gas, whose technology has been widely developed and introduced commercially in many developing countries. There are numerous suppliers of gas, oil, and components for the circuit, and it appears to be the only solution in other subsectors, such as commercial refrigeration and the automobile industry. There are some doubts about its GWP and the limitation of its use in the future.

The option of using hydrocarbons as refrigerants has been developed by Germany. Hydrocarbons have thermodynamic properties similar to CFC-12. It can be incorporated into the refrigeration circuit without the need for important changes to the system. Since the production of hydrocarbons is not covered by patents, the local suppliers can provide it with domestic raw materials, reducing significantly its cost. It requires replacement of the charging equipment and the incorporation systems for detection, ventilation, and security. Its application implies the redesign of refrigerators in terms of the safety of its use. The technology has begin to spread commercially, and it has been implemented in some European countries with success.

RADIO VICTORIA CATAMARCA S.A. has introduced in a pilot phase the use of HFC 134a for a model of display & bottles cooler, requested by a customer, but increase penetration of hydrocarbons technologies, problems related to charging operations for HFC 134a and the increasing demand of the markets of non HFCs solutions have lead to the company to analyze hydrocarbon solution. Since a) charging operations are easier, safety provided, b) compressors and lubricants used today are totally compatible with hydrocarbons c) the similar cost of isobutane would have in Argentina compared with HFC-134a, this technology appeared to be for the company the most competitive solution and therefor it has changed its primary decision of using HFC 134a.

Through the bilateral cooperation project between Swiss and Argentine Governments, engineering procedures will be the available for the reconversion of the refrigeration circuit in all the issues related with safety and the regulations applied to this type of appliance based on present regulations in European countries, where these technologies are commercially available.
All models will be tested to assure compliance with safety related regulations to be developed.

5.2.2 Replacement of CFC-12 with hydrocarbons

The charging process for CFC-12 consists of the injection in liquid state of the pressurized fluid (12 bar) after the machine sensed the correct previous vacuum, according to the following sequence of operations:

- entrance of refrigerator into pre-vacuum sector through a transporting band
- simultaneously, through the vacuum pumps, a prevacuum is performed during 15 minutes in the low- and high- pressure parts of the circuit with Leybold pumps and a final vaccumm is made with Galileo Vacumtec, 18 m3

- the refrigerant is charged immediately, after the charging machine has sensed the previous vacuum.

The process for charging hydrocarbons is similar, but it is essential to perform a sweeping of the circuit with nitrogen, which at the same time serves to control that there are no losses in the circuit. Also, the leak detectors should be replaced since the ones in use are sensitive to chlorine molecules. Because this is an explosive refrigerant, a stricter framework of leak controls is required, for which the incorporation of a helium leak detector is necessary as a previous step to the charging of the units. The charging area should be provided with a ventilation system with a regime for normal working conditions and under emergencies, and the corresponding monitoring system.

RADIO VICTORIA CATAMARCA S.A. presently has 3 basic models in production, with different accesories, providing different options to the customers. Some of them are produced with the evaporator foamed (outside the cabinets). To improve the energy consumption, this fomed evaporators models are being redesigned to inside cabinet evaporators. The company has evaluated the three possibilities: a) evaporator foamed, b) light and thermostat explosion proof, or c) thermostat and light outside of the cabinets one or another chosen depending on the model applications.

As a condition to start production, all the refrigerator models should be tested by a national laboratory (INTI) to assure compliance with safety standards applied in Europe. INTI would decide which of them would be applied in a short term. Also national standards Iram 2120 Parts 1 to 4 would be applied.

As noted above, INTI will assist and provide the necessary support from the safety side to the company for the redesign process and the plant conversion. The enterprise selected as supplier of the charging station will provide the technical assistance necessary for guaranteeing the safety related with all the charging operations. SICOM and EMBRACO, the present compressor suppliers will technically assist the company in the process.

The actual and recommended equipment is summarized in the following comparative table:

CFC-12	R 600
VACUUM 2 pumps, Leybold TRIVAC DG5/BCS16 m3 3 pumps, GALILEO V2AG, Vacum Tec D18, 20 m3/h, authomatic	Idem.

REFRIGERANT CHARGE 1 automatic charging unit, GALILEO DIGIFILL A 150	One charging machine , cycle time 30 sec. for 60 gram charge. Sweeping system with nitrogen and helium for control of leaks in connections, cycle time 40 sec. Bulk measure Helium/nitrogen with electronic volume meter Boxes for charging machines, sensors and ventilation system.
REFRIGERANT LEAK CONTROL 4 halogen detectors: 2 INFICON HLD 3000, and 2 INFICON HLD 4000.	1 Helium leak detector 4 hydrocarbon leak detectors.

6. PROJECT COSTS

6.1 Capital costs

The total investment necessary to cover the procurement of the new equipment, installations, development and training costs are detailed in Annex 1. For the imported equipment, three different figures are detailed: F.O.B. value source port, adding an item for insurance and freight.

The following table shows a summary total capital cost and amount requested to the Multilateral Fund:

CONCEPT	US$
1. Foaming equipment	508,200 ✓
2. Refrigeration equipment	214,826 ✓
3. Technology transfer, training and technical assistance	30,500 ✓
5. Tests and trials	7,100 ✓
6. Contingencies	76,000
TOTAL COSTS	836,626

6.2 Incremental operating costs:

The detailed calculations for the incremental operating costs are included in Annex II:

Elimination costs of CFC-11:	U$S 73,890
Elimination costs of CFC-12:	U$S 10,230
Total Operational Costs per year:	U$S 84,120
Six month IOCs:	U$S 42,000

6.3	Total costs of the project:	U$S 878,626
	Amount requested to the Fund:	U$S 700,000

6.4 Cost effectiveness

A) Grant amount U$S 700.000

B) Safety costs ICS1: US$ 342,000
ICS2: US$ 212,000
ICS1 + ICS2: US$ 554,0000

As safety costs are higher than 35% total costs, 35% discount is taken for the grant:
B= 0,35 x 700,000= U$S 245,000

C) ODS Reduction 33.600 kg

Cost-benefit analysis for projects = (A - B)/C = 13,54 US$/kg/year

7. PROJECT FINANCING

The enterprise requires financing through the Multilateral Fund of the Montreal Protocol for project costs:

US$ 700.000

8. PROJECT EXECUTION

The Implementing Agency together with OPROZ and INTI will supervise the implementation of the project.

9. PROJECT IMPACT

This project will eliminate the use of 33.6 tons of CFCs in the first year of implementation. The incorporation of hydrocarbons as refrigerant and the cyclopentane system as insulation are radical technological innovations, and very important, that do not have precedents or previous experiences in our country. The hydrocarbons used are imported, although the goal of the project is that the supply by the local industry is achieved.

5.1 TIMETABLE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Description of the project	xx																
Final draft	xx																
Delivery of legal document		xx															
Financial negotiations		xx	xx														
Document signing				xx	xx												
Disbursements						xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
Preparation of detailed work plan						xx											
FOAMS																	
Equipment selection							xx										
Safety project								xx									
Equipment procurement								xx	xx								
Equipment construction									xx	xx	xx	xx	xx				
Installations													xx	xx	xx	xx	xx
Safety audit																	
Initial tests																	
Personnel training																	
Cyclopentane production start																	
REFRIGERANT																	
Month	1 a 7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Model redesign	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx					
Personnel training																	
Equipment selection						xx	xx										
Equipment procurement							xx	xx	xx	xx	xx						
Installation												xx	xx	xx	xx		
Prototypes and trials							xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
Start of production with new technologies																	

ANNEX 1 - CAPITAL COSTS - RADIO VICTORIA CATAMARCA S.A. PROJECT

DESCRIPTION	Quantity	Unit Cost US$	Total Cost US$	ICS1 (direct) US$	ICS2 (indirect) US$
POLYURETHANE INJECTION SYSTEM A) EQUIPMENT					
1. Tank for bulk storage of cyclopentane, piping and pumps explosion proof, ventilation, sensors, and monitoring system	1	25,000	25,000	25,000 (1)	
2. Feeding and pre-mix group for raw materials: Easy-froth unit Deposit for pure polyol with heat exchanger Discharge pump Nitrogen pressurizing group for cyclopentane tanks Closing cabin, ventilators, tubing for unit Cannon A 100	1	64,000	64,000		64,000 (2)
3. Retrofitting for use with cyclopentane for: • Dispensing unit Cannon model A100, for cabinets and doors, including storage tank, pressurized with nitrogen, mixer, valves, and explosion-proof presostats Injection group, with explosion proof pump and engine, with safety cables and presostats	1	80,000	80,000	80,000 (3)	
4. Retrofitting of the injection systems for cabinets and planks to use cyclopentane including: *preheating oven * water heating system for molds heated electrically *Transport cars * Molds, jigs/masks *Grounding *Electrical panel	1	106,000	106,000		53,000 (4)
5. Retrofitting of the injection system for doors to use cyclopentante including: * Water heating system * Transport car * Molds jigs/masks for doors. * Grounding * Electrical panel * Installation	1	30.000	30,000		15,000 (4)

DESCRIPTION	Quantity	Unit Cost US$	Total Cost US$	ICS1 (direct) US$	ICS2 (indirect) US$
6. Ventilation and extraction system including fans, piping, systems, grounding, electrical commands and connection for: • cabinets foaming • dispensing unit and premixing station • door foaming	1	35.000	35,000	35,000 (5)	
7. Box for: • cabinets foaming • door foaming	1	50,000	50,000	50,000 (6)	
8. Sensors and alarm systems for installations of cabinet and door foaming	1	79,000	79,000	79,000 (9)	
11. Improving of the fire protection system for the plant including refrigerant charging area	1	15,000	15,000	15,000	
12. Delivery, freight and insurance (5% of equipment)			24.200		
TOTAL AMOUNT			508,200	284,000	132,000
B) TECHNOLOGY TRANSFER AND TECHNICAL ASSISTANCE					
1. Assistance for installation and start-up of foaming system provided by equipment supplier.	1	15,000	10,000 (10)		
2. Supervision of safety engineering study, lay-out, classification of electric areas, modifications to plant, control. Certification by National body	1	15,000	5,000 (rest not requested, see (10))	5,000 (10)	
TOTAL AMOUNT			15,000	5,000	
C) TESTS AND TRIALS					
1. Trial of prototype for each model: 2 models x 10 units per model (raw materials)	20	100	2000		
2. INTI trial, 1 per model	2	1,450	2.900		
TOTAL AMOUNT			~~3.100~~ (15)	5900	
D) TRAINING					
1. Technicians, one week, supplier plant	1	3,500	3,500		
2. Training for working with explosive materials for plant workers	1	1,000	1,000	1,000	
TOTAL AMOUNT			4,500	1,000	
REFRIGERATION SYSTEM A) EQUIPMENT					

DESCRIPTION	Quantity	Unit Cost US$	Total Cost US$	ICS1 (direct) US$	ICS2 (indirect) US$
1. Automatic equipment for recovery and charge of hydrocarbons, model PRODIGIT H020	1	107,900	107,900 Sacado de oferta ya probado otras veces.		70,000 (11)
Accessories: interface for printer, remote control panel, complete system of gas sensors, sensor calibration	1	23,000	23,000		
2. Dosifying pump for HCs	1	6,500	6,500		
3. Charging accessories: hose connectors, reducers	1	1,450	1,450		
4. Leak detectors for HCs, including: Detector Sensors Filter for testing Maintenance kit Filter connections	4	4,694	18,776		
5. Helium leak detector	2	17,000	17,000	17,000 (12)	
6. Cabin for gas extraction, sensors, safety system for charging area	1	30,000	30,000	30000 (13)	
7. Delivery, freight, insurance			10,200	47,000	70,000
TOTAL AMOUNT			214,826	✓ ✓	
B) TECHNOLOGY TRANSFER AND TECHNICAL ASSISTANCE					
1. Technical assistance from international expert for conversion to HCs, safety measures, and models redesign (Technology transfer agreement.)		15,000 (10)	5,000 (rest not requested see (10)		5,000
2. Technician from supplier for assistance and training for charging system, one week		5,000	5,000		5,000
TOTAL AMOUNT			(*) 10,000		10,000
C) TESTS AND TRIALS					
1. Trials and evaluation of refrigeration system, 2 units per model, 14 models	2	300	600	600	
2. Trials in INTI laboratories for appliance qualification, 1 unit per model, 11 models	2	1,700	3,400	3,400 (14)	
TOTAL AMOUNT			4,000	4,000	
D) TRAINING					
1. Training of personnel during implementation and start-up Training for work with flammable liquids in charging zone	1	1,000	1,000		
TOTAL AMOUNT			(*) 1,000	1,000	
CONTINGENCIES			76,000		
TOTAL			**836.626**	**342,000**	**212,000**

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NOTES:

(1) Special storage tank, piping, pumps explosion proof, sensor and monitoring systems for cyclopentane

(2) Corresponds to approximately US $15,000 per feeding and pre-mix group and is related with the nitrogen pressurization system, installation and electrical connections under standard IP55, enclosure boxes, the ventilators, and the tubing.

(3) Corresponds to the modification of the current dispensing unit so that it can operate with cyclopentane, the components that involves are the storage tank, pressurized with nitrogen, mix, valves and explosion proof presostats, cables, according to standards IP55, for the present high pressure machine

(4) Correspond to the retrofitting of the present cabinets and doors foaming system for their use with cyclopentane

(5), (6), (7), (8), (9), (12 and (13) Safety systems exclusively necessary for the use of cyclopentane and/or isobutane

(10) Engineering, supervision, and control of installation, testing of refrigerators by the company; technical assistance for reconversion of models, supervision of safety systems through Swiss Argentine Bilateral Cooperation Project.

(11) Difference between the conventional machine for HFC-134a and the necessary for HCs. Related costs because it is necessary that engines, connections, and electrical material be explosion-proof

(14) Test to comply with safety standards requires to appliances with hydrocarbon as refrigerants

(15) The company will assume U$S 10,000 on cost of test and trials for the foam.

(10) Existe un convenio con Suiza para formación de personal argentino. por eso NL ha puesto solamente 5,000 US$. Para evitar el double counting.

ANNEX II - OPERATIONAL INCREMENTAL COSTS

Incremental Operational cost are given only for information. THE COMPANY DOES NOT REQUIRE INCREMENTAL OPERATIONAL COST

1. CFC 11 phase out

Assumptions	CFC 11	Cyclopentane
Polyol percentage	0,38	0,39
Polyol price	3,050	3,66
Multiplication	1,159	1,4274
MDI Percentage	0,50	0,56
MDI price	3,05	3,05
Multiplication	1,525	1,708
Blowing agent percentage	0,12	0,05
Blowing agent price	2,4	3,3
Multiplication	0,288	0,1650
For 1 kg foam	2,972	3,3
Yearly consumption (kg)	225.000	225.000
Multiplication	668,700	742,590
Annual incremental operating cost		**73,890**

2. CFC12 phase out:

Present annual charge: 6,600 kg x 3,25 U$S/kg = U$S 21.450
R 600 estimated charge: 2,640 x 12 U$S /kg. = U$S 31,680
Difference : U$S 10,230

Total annual incremental costs: (73,890+ 10,230) = **U$S 84,120**

Six month IOCs: U$S 42,000