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

Fifteenth Meeting
Montreal, 13-16 December 1994

PROJECT PROPOSALS: TURKEY

This document includes the following project proposals and the Fund Secretariat's Comments and Recommendations. The project proposals have been grouped by project sector. The agency responsible for the implementation of the project is also indicated. The project proposals are presented in the order indicated below. The Fund Secretariat's Comments and Recommendations are presented at the front of the document.

Foam

Refrigeration

PROJECT EVALUATION SHEET

COUNTRY OR REGION:	Turkey
PROJECT TITLE:	Conversion to CFC-free technology in the manufacture of rigid polyurethane foam insulation panels at Assan Demir ve Sac Sanayi A.S., Tuzla-Istanbul
BUDGET:	US $925,000
INCREMENTAL COST:	US $925,000
ODS PHASE-OUT:	180 ODP tonnes
COST EFFECTIVENESS:	US $5.1/kg
PROJECT DURATION:	One year
IMPLEMENTING AGENCY:	World Bank
NATIONAL COORDINATING AGENCY :	Technology Development Foundation of Turkey
TECHNICAL REVIEW COMPLETED:	YES _X_ NO _

SECRETARIAT'S COMMENTS

1. This project covers the conversion of an enterprise manufacturing rigid polyurethane-foam insulating panels. The project proposes to replace the CFC-11 used as a blowing agent mainly with pentane. A small portion of the production will be converted to HCFC-141b for a transitional period of about two years and to a water blown system thereafter.

2. The project proposal includes modification of existing equipment when possible, procurement and installation of safety equipment for the use of pentane, trial runs, testing, and a training programme. The existing foam machine will be used for manufacturing construction panels with less critical insulation requirements using HCFC-141b as a blowing agent.

3. The incremental operating savings associated with the lower price of the pentane than CFC-11 will be offset by higher costs for the need to use fire retardant polyols, higher operation and maintenance, higher density of the all water blown foam, and ongoing safety training.

4. Implementation of this project will result in the phase-out of 180 ODP tonnes of CFC-11.

5. The Secretariat reviewed the project proposal to assess the eligibility of the equipment requested in terms of the conversion to pentane foaming technology and the cost items required for the conversion.

6. The Secretariat recommends reducing costs allowed for the pentane equipment from US $240,000 to US $150,000. A quotation for comparable complete pentane equipment (pre-blending unit with enclosure and safety related components), at US $150,000 was attached to the project documentation, but was declined in favour of a more costly unit. If a more costly unit is preferred, the balance of the cost should be met by the enterprise.

SECRETARIAT'S RECOMMENDATIONS

7. The Secretariat recommends approval of the project at a reduced cost of US $815,000.

PROJECT EVALUATION SHEET

COUNTRY OR REGION:	Turkey	
PROJECT TITLE:	Engineering Assistance for the Elimination of Ozone Depleting Substances Used in the Production of: a) Freezers and Coolers at Klimasan Klima Sanayi ve Ticaret A.S. b) Household Refrigerators at PEG Profilo Elecktrikli Gerecler Sanayi, A.S. c) Household Refrigerators at Pekel Teknik Sanayi ve Ticaret, A.S.	
BUDGET:	Capital costs: Operating costs:	US $8,053,911 US $4,151,019
INCREMENTAL COST:	US $8,053,911	
ODS PHASE-OUT:	422 ODP tonnes	
COST EFFECTIVENESS:	US $19.1/kg	
PROJECT DURATION:	a) Klimasan b) PEG c) Pekel	20 months 18 months 6 months
IMPLEMENTING AGENCY:	World Bank	
NATIONAL COORDINATING AGENCY :	Technology Development Foundation of Turkey	
TECHNICAL REVIEW COMPLETED:	YES _X_ NO _	

SECRETARIAT'S COMMENTS

1. This project covers the conversion of three domestic refrigerator manufacturing plants. The projects propose to replace the CFC-11 used as a blowing agent in the production of insulation foam with cyclopentane, and the CFC-12 used as refrigerant with HFC-134a.

2. The conversion in the Klimasan Klima plant will be implemented in two phases. In phase I, the plant will be converted to HCFC-141b technology, and in phase II to cyclopentane technology.

3. The project proposals include modification of existing equipment when possible, procurement and installation of new equipment including safety devices for the use of cyclopentane, redesign of assembly lines and refrigerator and freezer doors and cabinets, testing and development of prototypes, and a training programme.

4. Each enterprise proposes the establishment for a network of recovery and recycling of both CFC-12 and HFC-134a. In total, 126 stations will be equipped. A project for recovery and reclamation of CFC-12 from household refrigerators was approved by the Executive Committee at its Seventh Meeting (US $400,000). Production of HFC-134a based refrigerators will start only by 1997.

5. Incremental operating costs have been estimated for each plant. However, funds to cover these costs are not included in the present request, but will be requested on an annual basis, after they have been incurred by the enterprises.

6. Implementation of this project will result in the phase-out of 422 ODP tonnes of controlled substances.

7. The three enterprises export part of the production to non-Article 5 countries, with the following export share:

a.	Klimasan	10 per cent exported to Bulgaria, Russia and Rumania (the latter an Article 5 country);
b.	Pekel	50 per cent exported to France, Italy, Holland and Portugal; and
c.	PEG	20 per cent to Canada, France, Spain and USA.

8. The Thirteenth Meeting of the Executive Committee extensively discussed the issue of the eligibility of export of products manufactured in Article 5 countries to developed countries, while considering the Embraco project (Brazil). The Committee then decided inter alia, "that no new projects could be presented to the Executive Committee until the policy issues raised by the Embraco project had been studied and decided upon by the Executive Committee".

9. Both PEG and Pekel enterprises buy their compressors from a number of manufacturers, including Embraco (Brazil). The Executive Committee decided at its Thirteenth Meeting, while approving the Embraco project, that "the assistance given by the Multilateral Fund to refrigerator manufacturers based in the Article 5 countries supplied with compressors from Embraco should take account of the subsidy given to Embraco" (UNEP/OzL.Pro/ExCom/13/47 para. 82).

10. Apart from policy on exports, the Fund Secretariat has been discussing with the World Bank several items related to eligibility and high costs. These issues are, inter alia:

a. The capital cost of some of the equipment being requested (e.g., the foam insulation system, two testing rooms, a computerized performance systems in the Pekel enterprise; vacuum pumps for the PEG enterprise);

b. Variation in the cost of similar items in the three project proposals;

c. The need for HFC-134a refrigerant recycling units at the enterprise level taking into consideration that production of HFC-134a based refrigerators will start only by 1997, and very few repairs are expected for the first years thereafter;

d. The need for sophisticated and expensive helium leak test apparatus and computerized performance testing systems being requested in each plant;

e. Whether the amount requested for testing provides capabilities for increased capacity of model development after the plant conversion;

11. It has not been possible to reach a conclusion on these matters in the time available, however, it is anticipated that most, if not all, will be settled before the meeting of the Project Review Sub-Committee. This will enable the meeting to consider the proposal at reduced cost.

SECRETARIAT'S RECOMMENDATION

12. Subject to resolution of policy concerning export to non-Article 5 countries, it is recommended that the Executive Committee consider approving the projects at the reduced cost to be advised to the Project Review Sub-Committee.

THE MONTREAL PROTOCOL ON SUBSTANCES THAT DEPLETE THE OZONE LAYER
PROJECT COVER SHEET

COUNTRY:	Turkey
SECTOR COVERED:	Foamed Plastics
ODS USE IN SECTOR:	3,628t ODS (3,599t ODP equivalent) in 1990 1,645t of CFC-11 in 1993 for Rigid Foams
PROJECT TITLE:	Conversion to CFC-Free Technology in the Manufacture of Rigid Polyurethane Foam Insulation Panels
PROJECT DURATION:	12 months
UNIT ABATEMENT COST (UAC):	US$ 0.84/kg/year
PROJECT IMPACT:	Eliminate the use of 180 tons/year of CFC-11 by 1996
TOTAL PROJECT COST:	US$ 925,000 (incremental capital costs incl. contingency)
PROPOSED MFMP GRANT:	US$ 925,000
IMPLEMENTING ENTERPRISE:	Assan Demir ve Sac Sanayi A. S., Tuzla-Istanbul
IMPLEMENTING AGENCY:	International Finance Corporation (IFC)/The World Bank
NATIONAL COORDINATING AGENCIES:	Undersecretariat of Treasury and Foreign Trade & Ministry of Environment

PROJECT SUMMARY

This project will facilitate the replacement of CFC-11 as the foam blowing agent in the manufacture of rigid polyurethane foam insulating panels at Assan Demir ve Sac Sanayi's plant near Istanbul. Assan is a leading Turkish manufacturer of aluminum and steel products for the construction and manufacturing industry and has several manufacturing plants. Aluminum and iron sheets are used at the Tuzla plant for the manufacture of metal coated insulation panels for walls and roofs of commercial/industrial buildings and for the cold storage industry.

The project will eliminate CFC use in all operations at Assan very cost-effectively and will result in the elimination of at least 180 tons of CFC-11 per year from 1996 (the first proposed year of CFC-free operations). CFC use as a blowing agent will be replaced mainly with pentane, with a small portion of production converted to water with transitional use of HCFC-141b for about 2 to years. This project involves modification of the existing foam machines to handle pentane and installation of appropriate safety measures.

TECHNICAL ASSESSMENT: This project has been reviewed and supported by the OORG technical reviewer, Dr. G. M. F. Jeffs. His comments are attached.

CONVERSION TO CFC-FREE TECHNOLOGY IN THE MANUFACTURE OF RIGID POLYURETHANE FOAM INSULATION PANELS AT ASSAN

1. PROJECT OBJECTIVE

The objective of this project is to eliminate the use of CFCs in the manufacturing of rigid insulation panels for walls, roofs, and cold-storage installations at Assan Demir ve Sac Sanayi located in Tuzla-Istanbul, Turkey.

2. SECTOR BACKGROUND

Turkey ratified the Montreal Protocol on 20 September 1991. Under Article 5 of the Protocol, Turkey qualifies for a 10 year delay in the phaseout of CFCs and for assistance from the Multilateral Fund for the Implementation of the Montreal Protocol (MFMP).

Turkey does not produce ODS, but there are numerous users of ODS in the country. The ODS are imported either directly by the factories that use them in their production or by authorized distributors of international ODS manufacturers. Most of the ODS are imported from Europe, but also from the USA, Brazil, and Taiwan.

The bulk of the ODS are used in the manufacturing of rigid and flexible polyurethane foams (PUF) and as refrigerants in compressors for domestic refrigerators, air conditioners, and commercial cold-storage. The rigid PUF is primarily for insulation in domestic refrigerators, commercial cold-storage facilities, and construction panels for walls and roofs of commercial/industrial buildings.

CFC-11 and CFC-12 have been the dominant ODS used in Turkey. The switch to hydrocarbons in aerosols has decreased the proportion of CFC-12 but growth in the compressors for refrigeration and air conditioning markets will keep it a significant factor (Country Program, Page 8). The CFC-11 is used as a blowing agent in the manufacturing of rigid insulation and flexible cushioning PUF. Since these are associated with items that improve the standard of living, they have experienced growth exceeding that of the population.

CFC-11 use in foams accounted for 40% of the 3,628 tons of CFCs used in 1990. It was expected to increase to 53% by 1993. Exceptional demand for insulation panels has exceeded that. In 1993 Assan supplied 20-25% of the insulation panels for commercial/industrial walls, roofs, and commercial cold storage facilities.

3. ENTERPRISE BACKGROUND[1]

The family owned Kibar Group was established in 1977. In addition to aluminum and steel finishing activities, the Group has interests in prefabricated construction elements, export and domestic trading of steel, construction materials, packaging, textiles, food, and the distributorship for Hyundai cars and commercial vehicles in Turkey. Group turnover in 1992 was US$ 337 million; consolidated accounts are not prepared.

[1] The information in this section is based on the back-to-office report by Mr. Douglas Fenton (an engineer with IFC's Technical and Environment Department) after his technical appraisal of Assan for IFC's evaluation of the loan for Assan's aluminum project. The discussion has been edited for emphasis on polyurethane insulation panels with additional information added where required.

Assan is the principal company in the Group and is a leading manufacturer of aluminum and steel products with the following plants:

- 12,000 tpy aluminum sheet at Tuzla,
- 1.8 million sq. m. aluminum/polyurethane sandwich panels at Tuzla,
- Laminate foil packaging at Bursa,
- 150,000 tpy galvanized steel plant at Kartal, and
- 80,000 tpy steel finishing plant at Tuzla.

Turnover in 1992 was US$ 150 million, of which about US$ 20 million was exported. The company's cash flow was estimated at US$ 7 million, and it had a net profit of US$ 2 million. The company employs 750 people of which 50 are involved in the insulating polyurethane sandwich panel activities. Assan is 100% Turkish-owned.

3.1 Polyurethane Sandwich Panels

Assan has four units for producing sandwich panels; two discontinuous, one semi-discontinuous, and one continuous machine. In the discontinuous and semi-discontinuous machines, aluminum panels with beam or channel spacers are placed in a press and the urethane chemicals blown between the panels and allowed to foam and cure for the appropriate time. In the continuous machine, coils of metal roll stock are fed through the foam pouring and curing press in a continuous manner until the laminated product is cut to size by a flying cut-off-saw at the end of the machine. The total capacity of the four units is 2.3 million square meters, with the continuous machine capable of producing 1.6 million square meters. Assan consumed 111 tons of CFC-11 in the production of 550,000 m^2 of panels during 1993. Conservative forecasts, based on current Turkey's economic condition, indicate that consumption in 1994 and 1995 will be restricted to about 135 tons in each year. Consumption in 1996, based on forecasts of panel production, is expected to increase to 180 tons. All estimates are based on the fact that the continuous line is currently using 50% CFC formulation techniques already, while all others are using 100% CFC for foam blowing.

3.2 Aluminum Operations: Casting and Rolling

Assan began its aluminum operations in 1989 and produces sheet by re-melting imported or domestically purchased ingots and passing the molten aluminum through a computer-controlled continuous casting line. The hot-rolled output is then cold-rolled and sold, either as a product to the construction or industrial sectors, or as a coil for further processing by another producer. The caster has a capacity of 9,200 tpy, and the cold-rolling mill, around 29,000 tpy depending on the mix of product, at a current width of 1.4 meters.

The main products are: sheets for roofing and ceilings, panels for automotive vehicles, cable insulation, and bodies for refrigerators, freezers and other white goods products. Last year, the company produced nearly 12,000 tons of sheet and coils, and estimates that it has a 28% share of the Turkish market and 68% share of the aluminum products exported from the country. To achieve the 1993 tonnage, the company made up its caster output by buying 6,000 tons of hot-rolled coil from domestic and foreign sources.

Assan is planning to expand its production capacity from 12,000 tons to 25,000 tons, build a new aluminum casting line, and add an aluminum foil mill and other auxiliary equipment at a total project cost of $39.5 million. Towards this end, an IFC loan for US$15.3 million was approved earlier this year.

3.3 Laminating and Converting Plant

In 1992, Assan acquired Ispak, a laminating and converting plant at Bursa. This company was established in 1976 to produce wallpaper and labels for yogurt and milk containers. In the 1980's, it started laminating flexible packaging and purchased a Rotogravure Printing machine with four color capability. In addition, it has a range of equipment capable of wet and dry laminating, extruding, slitting , and embossing. Currently, it produces to its maximum capacity of about 5,000 tpy, operating three shifts, seven days a week. It is restricted in producing more due to the lack of laminating capacity and four color printing (demand is increasing for up to six colors). Capital expenditure is necessary if this plant is to meet the growing demand for flexible packaging. Assan is aware of this and, outside of the proposed aluminum expansion, is considering a new laminator and multi-color press.

Ispak is a small unit, but the production management is competent and the market manager is highly respected in the industry. This unit provides vertical integration for the foil production operation and can absorb 25% of the proposed foil outputs.

3.4 Management

The Kibar Group has demonstrated an ability to handle a diverse, multifaceted organization. Each operation has achieved exceptional goals with a lean, but capable engineering staff. With the assistance of equipment suppliers and technical consultants, the conversion to ODS free rigid polyurethane insulating panels should be accomplished with few difficulties.

4. PROJECT DESCRIPTION

The project will involve installation of a pentane bulk storage system to supply the Hennecke and Manni lines, modification of the existing Hennecke equipment to handle the transfer, mixing and metering of the pentane with polyol. Modification will include housings around the pentane containing components that are added. There will be detectors for flammable vapors installed at critical locations that will be part of an alarm system (audible and visual) that will also shut the machines down before a dangerous concentration is reached. The Manni press (semi-discontinuous) would be relocated and get a new Pentane machine and a hood for ventilation, with safety items like the Hennecke.

The two discontinuous presses would be converted to all water blown foam using the present high pressure Cannon machine. Construction panels with non-cold storage requirements would be produced on them and no extra ventilation would be needed.

Exhausts for the pump housings will need to be provided. Hoods at the pouring point on the Hennecke machine and around the Manni press will need to be added. Ventilation will be provided by local contractors on a lowest cost bid, based on hood designs provided by the machinery manufacturers under a signed agreement as Technology Partners.

5. TECHNOLOGY SELECTION: INSULATION FOAM

5.1 Background

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

- CFC-11 —› partial water/HCFC-141b —› water (?)
- CFC-11 —› partial water/ HCFC-22, 142b —› HFC-134a, 152a
- CFC-11 —› pentane

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

The first solution – the "liquid" solution – employs technology that is closely related to the existing one. The final step in this process is not yet decided. One potential solution is HFC-356, but full water blown foam with improved cell structure remains an option, especially in "lesser demanding" systems such as water heaters and construction panels, where dimensional changes are possible, but at increased cost.[2]

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

Pentane technology is being used commercially in Europe. Its flammable character requires safety considerations and limits its use to factories that can be adapted to meet those requirements. Due to the requirement for the best insulation properties in cold storage applications, cyclopentane would be the best choice for these applications. Because of price considerations, n-pentane is being used for construction panels. From a safety standpoint, factories will require ventilation improvement and replacement of some electrical equipment in the foaming areas. Training and annual retraining programs should be in place.

5.2 Selection

Assan has elected to convert directly to pentane blowing on the higher volume machines rather than go through intermediate choices. The engineering department is aware of the potential dangers of using a flammable liquid in a metals processing plant and will set up the appropriate safety measures and training procedures in conjunction with the pentane and machinery suppliers as Technology Partners.

The company has selected cyclopentane as the alternative blowing agent because 15% of their present production is for cold storage and market demand is predicted to increase that to 25%. Government irrigation programs are expected to increase demand for food preservation over the next 2 to 3 years.

Assan would keep the two discontinuous presses on the present foam machine and convert to HCFC-141b with the goal of moving to all water blown foams as soon as practical. It is estimated that this transition will occur in 2 to 3 years. By keeping the present machine and the lower volume, less critical panels on these two presses, it gives them the opportunity to begin working with all water blown systems while maintaining the high volume, more critical applications on pentanes on the other machines. The use of HCFC-141b will be very similar to present production using CFCs and present cost is approaching the CFC cost at DM 3.50 to 4.00/kg.

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[2] The OORG (Ozone Operations Resource Group) Working Group for Pre-Insulated Pipe at their May 1994 meeting concluded that the initial physical property problems with all water-blown rigids had been resolved and could be considered as a viable solution in district heating and related sectors.

5.3 Required Modifications

A bulk storage system meeting "petroleum style, double wall" tank regulations will be installed outside the building (in ground) with appropriate safety systems for unloading tank trucks and drums as well as transfer through piping to the dispensing machines in the building. The installation of the tank system will comply with the more strict regulation of Turkey or the EC. There are two possible locations for the pentane bulk storage tank:

1) East of the building, at the end of the Hennecke continuous panel line in an open area that is intended for other bulk storage tanks. Piping would be parallel to the machine and inside the Panel Manufacturing Department. The distance from the bulk tank to the pentane blender at the Hennecke would be 85 to 90 meters. To the Manni press, at its present location, would be an additional 96 meters (30 meters, when relocated to a consolidated foam area).

2) South of the building, in an area 15 meters wide, between the building and a paved access road that runs around the factory. The pipe path to the Hennecke continuous machine would be through a metal fabricating operation where steel and aluminum sheet coils are slit to width and cut to length. The distance from the bulk tank to the pentane blender at the Hennecke would be 37 to 40 meters. To the Manni Press, at its present location, would be an additional 96 meters (30 meters, when relocated to a consolidated foam area).

Because of the long pipe runs, it is not possible to pre-blend the pentane and polyol. Separation would occur and create both processing and safety problems. Assan has two LPG tank installations near the front of their property and the gas is piped to different areas in the factory. They are aware of the potential dangers of flammable gases and feel comfortable with the concept of pentane foam blowing.

The continuous panel machine will have a pentane blender installed in the polyol line and a vapor enclosure with exhaust to encase the portions containing the pentane. A hood with exhaust will be installed over the Pour Point area. Pentane sensors will be placed in the vapor enclosures/hood and will be connected to a control system that will have audible/visual alarms. As a minimum protection, the system will be set at 20% of the LEL to alarm and double the ventilation rate and at 40% of the LEL, to shut the foam machine off. The alarm system should be capable of being set to lower values if desired.

The Manni semi-discontinuous panel press will be relocated to the same factory area as the Hennecke continuous panel line. The Manni press is presently located to the west and one bay north of the Hennecke line. It is located next to an annealing oven used for annealing coils of metal sheet that is coming off a rolling mill in the same bay. Relocation will remove it from the proximity of potential ignition sources and will consolidate the pentane use to a single production area. That will simplify safety concerns, in that panel manufacturing and storage will be combined, making ventilation and vapor monitoring more effective. Also, exhausts from the factory will limited to a restricted area and the pentane pipe run from the Hennecke continuous line to the Manni press will be shortened to 30 meters (details are provided in Annex A).

The Manni semi-discontinuous panel press will be hooded to contain and exhaust pentane vapors, leaving access for the panel make-up tables and the injection of foam chemicals from the dispensing machine. Pentane sensors will be placed at critical locations and will function as described for the Hennecke continuous panel machine. The Manni press will be provided with a new dispensing unit designed for use with pentane and containing the appropriate safety/alarm systems all ready described.

The present dispensing machine will be used for HCFC-141b immediately and ultimately 100% water blown rigids with the two single presses for manufacturing construction panels with less critical insulation requirements.

6. PROJECT COSTS

6.1 Summary of Project Costs

The total project incremental cost of US$ 925,000 is based on the incremental capital costs at the Assan factory. No significant net incremental recurring costs or savings are expected.

6.2 Capital Costs

The following costs are expected to be incurred for the proposed project (all costs are in US$):

1.	Pentane bulk storage equipment	$ 120,000
2.	Pentane piping	$ 40,000
3.	Hood for Hennecke machine	$ 12,000
4.	Pentane equipment on Hennecke machine	$ 240,000
5.	Pentane machine on Manni press	$ 200,000
6.	Relocation of Manni press	$ 56,400
7.	Hood for Manni press	$ 95,000
8.	Production Trials, Chemical Losses	$ 15,000
9.	Technology Transfer/Safety Training	$ 25,000
10.	Hand-held flammable gas detector	$ 3,000
11.	Contingency and rounding	$ 118,600
	TOTAL INCREMENTAL CAPITAL COSTS	$ 925,000

Annex A provides details for selection of options and associated incremental capital costs.

6.3 Operating Costs

Cyclopentane is lower priced than CFC-11, resulting in lower material costs. These savings, however, are offset by the higher cost fire retardant polyol, costs of operation and maintenance, higher density of the all water blown foam, and annual safety training. These costs are difficult to calculate in advance as individual formulation changes and operating conditions tend to be site specific. However, expected annual savings on cyclopentane over 4 years will approximately match the extra operating and chemical costs. Therefore, no recurrent incremental costs will be considered on this project.

6.4 Unit Abatement Costs

CC	=	ODS reduction project capital costs	=	$925,000
CRF	=	Capital Recovery Factor (10 years @ 10%)	=	0.16275
OC	=	Incremental Operating Costs	=	$0
OS	=	Operating Savings or Revenue	=	$0
ODS	=	ODP-weighted ODS reduction in first year of full operation (1996)	=	180,000 kg
UAC	=	Unit Abatement Costs = $\frac{CC \times CRF + (OC - OS)}{ODS}$	=	**$0.84/kg/yr**

7. FINANCING PLAN

The company requests an MFMP grant, representing all eligible incremental costs in the amount of $925,000. The grant will be administered by IFC (under agreement with The World Bank).

8. PROJECT IMPLEMENTATION

8.1 Management

IFC (in arrangement with The World Bank) will be the executing agency for this project and will work with the recipient of grant funds, i.e., Assan, and coordinate with the Turkish Undersecretariat of Treasury and Foreign Trade and the Ministry of Environment.

8.2 Procurement

All procurement by Assan will follow competitive procurement guidelines consistent with MFMP requirements. However, to avoid machine compatibility and safety problems on the existing Hennecke continuous line, the bidding process for the Hennecke machine will be waived. The replacement machine for the Manni press will be subject to competitive procurement. All local works will be subject to normal local bidding procedures.

8.3 Implementation Schedule

Task	Time to Completion					
	Q1	Q2	Q3	Q4	Q5	Q6
1. Preparation						
MPEC Approval	●					
Procurement Preparation	● ●					
Select Vendor/Contractor		●				
2. Installation						
Arrival, Customs				●		
Machine Installation				●		
3. Start-Up						
Machine Start-up				●		
Trials, Training				●		
Certification					●	

9. REQUIRED REGULATORY ACTIONS

The emissions from the process will be small quantities of pentane and must comply with the Turkish Government's *Air Quality Protection Regulation* concerning hydrocarbons.[3] This regulation requires that total plant emissions of hydrocarbons not exceed stated Short Term Standard (STS) Limits. Annex 4 of the regulation ("Organic Vapors and Gases") lists n-Pentane and cyclohexane (cyclopentane is similar) as Class III hydrocarbons. The main implication for Assan is the likely requirement of a permit from local (rather than national) authorities certifying allowable levels of fugitive pentane emissions after conversion.

10. PROJECT IMPACT

Based on present production practices and estimates of panel production for 1996, it is estimated that 180 tons of ODS will be used in 1996. The proposed project employs commercially available and environmentally acceptable technology and will eliminate the use of at least 180 tons of CFC-11 in the first year of implementation at an estimated cost of $0.84/kg.

11. CHANGES IN PROJECT SCOPE AND COSTS DUES TO OORG COMMENTS

As noted in the OORG reviewer's comments, the letter from Hennecke indicating its commitment to be Assan's technical partner for pentane safety and training has been added to the documentation in Annex A. Selection of the technical options, the associated costs, and the documentation of the costs were found to be reasonable and all items were considered necessary. The project is supported by the reviewer and was "approved as proposed".

[3] Information presented here is based on the Turkish Government's *Air Quality Protection Regulation*, passed on November 2, 1986, and published in the Official Gazette # 19269. The regulation itself is based on Environment Law 2872 passed on August 9, 1983.

ATTACHMENT

Comments of OORG Reviewer, Dr. G. M. F. Jeffs

PROJECT - TURKEY - ASSAN DEMIR VE SAC SANAYI AS

TECHNOLOGY

The enterprise manufactures metal-faced foam-cored sandwich panels for cold stores and other applications. This is a demanding application for rigid polyurethane foam with emphasis on thermal insulation, structural strength and foam to metal adhesion through a variety of climatic regimes.

The choice of pentane and particularly cyclopentane for the majority of the production is fully supported. Of the zero ODP technologies available, pentane is the most cost effective and cyclopentane gives the best insulation value under most conditions. The equipment chosen would allow the use of different pentane blends to be used as these evolve.

In developed countries, pentane technology for this application has been thoroughly tested and is in use in some enterprises and is being applied in others. More widespread use has been precluded so far by conversion costs by high conversion costs.

The alternatives to pentane, such as the liquid HFCs will not be commercially available for several years and issues of cost effectiveness, toxicity and GWP will have to be resolved.

For the low production discontinuous lines the use of HCFC 141b is supported as an intermediate measure whilst CO_2 (water) technology is investigated. HCFC 141b is well proven in this application and conversion costs are very low.

ENVIRONMENTAL IMPACT

The application, using gas tight facers, has low emission rates to the atmosphere. The main alternative, pentane, has zero ODP and virtually zero GWP. HCFC 141b has a residual ODP and GWP but again actual emissions in these durable products will be extremely low.

Pentane is a volatile organic compound and compliance with existing regulations should be confirmed by the enterprise.

Safety of operating with pentane because of its flammability is a key issue and the reviewer is satisfied with the conversion steps proposed. He has been informed that the project consultants have received a letter from Hennecke, the main contractor, that they will pass onto the enterprise full guidance on the training and safe operation of the equipment. This letter should be added to the appendices. Hennecke are experienced in the conversion of polyurethane production lines to pentane.

PROJECT COSTS

The overall UAC is $ 0.84/kg/year. This project is cost effective. It is noted that operating costs are about neutral.

The total capital costs are $ 925,000 and all items are necessary. There is sufficient information in terms of quotations from reliable sources.

IMPLEMENTATION TIMEFRAME

This is clearly set out and is acceptable.

RECOMMENDATION

Approved as proposed.

GMFJ/kd/6/10/94

COUNTRY:	Republic of Turkey
PROJECT TITLE:	Engineering Assistance for the Elimination of Ozone Depleting Substances Used in the Production of Household Refrigerators at PEKEL Teknik Sanyi ve Ticaret A.S.
SECTOR COVERED:	Household Refrigerator
ODS USE IN SECTOR:	714 MT of CFC-12 in 1993[1] 1645 MT of CFC-11 in 1993[1] Total of 2359 MT (2359 ODP-weighted MT)
PROJECT IMPACT:	Eliminate annual consumption of 40 MT of CFC-12, 55 MT of CFC-11 Total of 95 ODP-weighted MT after production begins
PROJECT DURATION:	6 months
PROJECT ECONOMIC LIFE:	10 years
TOTAL PROJECT COST:	ODS Reduction Investment Cost: US$3,056,650 Incremental Operating Cost[2]: US$1,118,182 Incremental Operating Revenue: US$0 Total ODS Reduction Project Cost: US$4,174,832 Other Project Costs: US$0 Total Project Costs: US$4,174,832 Unit Abatement Costs: Capital Costs Only US$5.41 Capital Costs and Incremental Costs US$18.36
PROPOSED OTF FINANCING:	US$1,665,477 (including 15 percent contingency and 3 percent Financial Agency Fee). Incremental operating costs are not included in the present grant request, but will be requested after the costs have been incurred by the enterprises, in accordance with prevailing funding criteria.
IMPLEMENTING ENTERPRISE:	PEKEL Teknik Sanyi ve Ticaret A.S.
COORDINATING MINISTRY:	Technology Development Foundation of Turkey (TDF) Republic of Turkey
IMPLEMENTING AGENCY:	The World Bank

This proposal has been revised to reflect changes recommended by the OORG reviewers.

[1] Projection given in "Turkey Country Program for Phaseout of ODS", August 1992

[2] Net present value of first year of operating costs/savings. The incremental costs are not covered in the present grant request, but will be requested on an annual basis, after they have been incurred by the enterprise.

PROJECT SUMMARY

This project will phase out chlorofluorocarbons (CFCs) used in household refrigerators manufactured at PEKEL Teknik Sanyi ve Ticaret A.S. in Turkey. The project will comprise one phase and will convert the production lines to household refrigerators using HFC-134a and cyclopentane as the new refrigerant and foam blowing agent respectively. This project will provide for product development using CFC alternatives and will identify all equipment and process changes needed to implement the alternative technology. It will also implement refrigerant recovery and recycling practices for the refrigerators being serviced at PEKEL service centers. During the project, PEKEL will seek engineering assistance and training from various companies including its joint venture partner Merloni Elettrodomestici of Italy. PEKEL will start full production of non-CFC refrigerators in the beginning of 1995. The project will result in the elimination of 40 MT/year of CFC-12 (refrigerant) and 55 MT/year of CFC-11 (foam blowing agent) after the conversion is completed.

PROJECT OBJECTIVE

The objective of this project is to phase out CFC-12 and CFC-11 used in household refrigerators at PEKEL Teknik Sanyi ve Ticaret A.S. The project provides for the purchase of equipment, the transfer of technology, and the training necessary to facilitate an effective transition to HFC-134a for the refrigerant and to cyclopentane as the new blowing agent in polyurethane insulation foam.

SECTOR BACKGROUND

The consumption of chlorofluorocarbons (CFCs) in the refrigeration and foam industries has been estimated in 1993 at approximately 2359 MT representing 75 percent of the country's consumption of CFCs. Of the sector's total estimate use of CFCs, domestic and commercial refrigeration appliances accounted for 714 MT of CFC-12[3]. In addition, it is estimated that 1100 MT of CFC-11[4] were used in the production of polyurethane (PU) appliance insulation foam.

The production of household refrigerators and freezers in Turkey has increased significantly in the last past three years, from about 965,000 units in 1990 to approximately 1.25 million units in 1993. In 1993, 20% of the units produced were exported to a number of countries, including the US, Germany, Great Britain, Italy, and France. There are four major domestic refrigerator manufacturers in Turkey: Arcelik, PEG Profilo, Pekel Teknik and Simtel. Arcelik and PEG Profilo dominate the domestic market with about 95% of market share.

Commercial freezers and coolers are produced mainly by two companies: Klimasan and Ugur with a domestic market share of 90%. The rest is produced by numerous local shops and manufacturers throughout Turkey with very limited production capabilities. Because commercial freezers and coolers are principally used in the food and beverage industry, it is estimated that the market for such appliances will grow at a rate of 6.5% for the next coming years.

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[3] This number was taken from the 1992 Turkey country program. However, based on the actual production of 1.25 Million appliances produced in Turkey, the consumption of CFC-12 in new appliances can be approximated around 300 MT. In addition, it is estimated that between 250 and 300 MT of CFC-12 is used to service existing appliances in repair shops, bringing the total consumption of CFC-12 in 1993 to nearly 600 MT.

[4] This number was estimated from the 1992 Turkey country program. Nonetheless, given the actual 1993 production of 1.25 Million appliances and considering that most manufacturers have switched to 50% CFC-11 reduction foam formulation, the consumption of CFC-11 in the domestic and commercial refrigeration sector should be approximately 625 MT.

The average charge of CFC-12 in refrigerators, freezers and coolers manufactured in Turkey is around 0.2 kg. An additional 0.4 to 0.6 kg of CFC-11 is used in making the rigid polyurethane foam in the cabinet. Most of the refrigerator manufacturers in Turkey have already started using 50 percent CFC-11 reduced PU foams formulations. Most refrigerators, freezers and coolers produced for the domestic market are equipped with compressors manufactured in Turkey by TEE (Arcelik) except for PEG Profilo which manufactures most of its own compressors based on a design from AEG Germany. TEE produced over 1,000,000 compressors in 1993 and licenses its technology from Tecumseh U.S.A. A number of compressors are also imported from various manufacturers including Embraco, Danfos, Nicchi, Electrolux and Matsushita, mainly for appliances that are exported to Europe and the U.S.

ENTERPRISE BACKGROUND

PEKEL Teknik Sanyi ve Ticaret A.S. is located in Manisa at approximately 50 km north-east of Izmir, Turkey. Forty six percent of the company is Turkish owned while the rest is owned by Merloni Elettrodomestici of Italy. PEKEL employs 460 people in its household refrigerator factory and its revenues in 1993 were approximately US$35 million.

PEKEL was established in 1990 and produced its first domestic refrigerator the same year. PEKEL bought the technology and the production rights from Philco of Italy. In 1994, PEKEL will produce approximately 200,000 refrigerators comprising ten different models that can be categorized as follows: three single-door models, four double-doors models, and three table-top models. About 50 percent of PEKEL's refrigerator production is exported to several countries, including France, Italy, Holland and Portugal. The rest is sold domestically and represent a market share of about 12 percent. The Manisa plant has one production line with a total capacity of 300,000 sets a year. PEKEL expects to reach its maximum capacity by 1996.

PEKEL buys its compressors from a number of manufacturers including TEE, Embraco, Unitad Hermetica and Necchi. These companies have provided PEKEL with a number of trial units to test HFC-134a and are ready to supply larger quantities of compressors when PEKEL requests it.

PEKEL plans to eliminate the use of CFCs by the beginning of 1995. In 1993, the company consumed 40 MT of CFC-12 and 55 MT of CFC-11. The average CFC-12 charge size in refrigerators is 0.2 kg. PEKEL has been using 50 percent CFC-11 reduction formulation in its foam since 1992 and uses about 0.3 kg of CFC-11 per set.

PROJECT DESCRIPTION

In this project, PEKEL Teknik Sanyi ve Ticaret A.S. will eliminate the use of CFC-12 and CFC-11 in household refrigerators by converting its manufacturing facility to one that is compatible with HFC-134a and cyclopentane, the new refrigerant and foam blowing agent respectively.

The project will be realized in one phase and will provide for the acquisition of the new technology, the procurement and installation of the necessary machinery and equipment, engineering assistance and training. At the completion of the project, PEKEL will have totally converted its production lines to the alternative technology and will start full production of CFC-free refrigerators.

PEKEL started investigating the use of HFC-134a in its refrigerators in 1993. Through technical assistance from a number of companies including its joint venture partner Merloni Elettrodomestici of Italy, PEKEL was successful in developing a new line of refrigerators suitable for the alternative refrigerant. To develop reliable CFC-free refrigerators, and in order to minimize the risks associated with the conversion process, PEKEL received technical assistance for the following :

- Redesign of the different refrigerator models

- Construction, prototype manufacturing, short and long-term testing of the refrigerators

- Training on manufacturing, maintenance and quality control

PEKEL has already made a large investment in machinery and equipment as it plans to start full production of non-CFC refrigerators by early 1995. For instance, most of the foaming equipment has already been purchased and is being installed at the factory to be ready for production trials by the end of 1994.

Because of the relatively high consumption of CFC-12 during servicing, PEKEL plans to equip its main regional service centers with recovery equipment. In addition, PEKEL will provide training to the technicians in these service centers on service procedures.

PEKEL will install, during the project, all the necessary equipment for the use of cyclopentane. To ensure a safe and effective transfer to cyclopentane technology, PEKEL will seek technical assistance from Impianti OMS of Italy, a company which specializes in the design and installation of cyclopentane systems. As part of the agreement with PEKEL, Impianti OMS will do the following (a written statement by Impianti OMS can be found in Annex 5):

- Design the complete cyclopentane system including storage tank, piping, safety and alarm systems

- Supervise the installation of the entire cyclopentane system

- Provide extensive training on safety issues

The last stage of the project will consist of finalizing the transition to CFC-free technology for mass production. During this time, production trials of non-CFC refrigerators will be conducted to enable PEKEL's personnel to get more acquainted with the new equipment and to fine-tune the production lines, resulting in better quality products.

As part of the conversion process to non-CFC technology the following equipment needs to be replaced, purchased or modified:

1- Refrigeration System

- To protect the refrigeration system against chlorine contamination, one existing charging board will be replaced by one compatible with HFC-134.

- The existing leak detectors will be replaced by ones suitable for HFC-134a. .

- Thirty vacuum pumps will be purchased to replace old ones not suitable for HFC-134a systems. This replacement is necessary as the old pumps cannotbe retrofitted (to make them compatible with ester oil and to achieve deeper vacuum levels in the refrigeration circuit) at a competitive cost.

- A computerized performance line tester will be installed on the production lines to verify that the refrigerators are performing as required. This equipment will very accurately measure, record and store performance parameters such as temperatures and running times, and will automatically detect malfunctioning units. The acquisition of this equipment is needed to improve quality control on CFC-free refrigerators and to help bring the quality of HFC-134a units to a level similar to the one achieved with CFC-12 technology.

- Two environmental testing chambers with their data acquisition systems will be purchased and installed to conduct performance tests on samples of each refrigerator model (five samples for each model will be tested). These rooms are necessary to accurately test new refrigerators and to optimize the cooling system for the application of HFC-134a.

2- Foaming System

- A complete cabinet foaming plant that fulfills all the necessary safety requirements for cyclopentane will be acquired. This includes foaming fixtures, high pressure injection heads, a metering unit with its cooling system, preheating ovens, and an alarm and ventilation system.

- A door foaming plant suitable for cyclopentane will be purchased. The plant comprises a set of foaming fixtures, high pressure injection heads, a metering unit, an alarm and ventilation system.

- Because of the high flammability of cyclopentane, a complete safety system will be installed. This consists of double wall piping, gas sensors, alarms and a ventilation system in the foaming area.

- All the machinery and the equipment in the foaming area will be grounded to prevent potential fires.

- An underground storage tank for cyclopentane will be designed, built and installed according to standard safety measures.

3- Refrigeration Service

- A set of one recovery equipment for CFC-12, one leak detector for HFC-134a and one mobile evacuation and charging board for HFC-134a will be supplied to each of the 20 regional service outlets of PEKEL.

- A reclamation unit will be purchased and installed in a central location where the CFC-12 collected from the regional service centers will be cleaned and sent back.

Price quotations on some of the items listed in Annex 1 of the proposal can be found in Annex 5.

JUSTIFICATION FOR SELECTION OF ALTERNATIVE TECHNOLOGY

HFC-134a has been accepted worldwide as the best replacement to CFC-12 in household refrigerators because of its good thermodynamic properties (similar to CFC-12), zero ODP, and non-flammability. PEKEL currently purchases its compressors from Embraco, Unitad Hermetica, Necchi and TEE (Arcelik), a company located in Istanbul Turkey that licenses its technology from Tecumseh U.S.A. These companies have indicated that they can supply PEKEL with HFC-134a compressors by the end of 1994.

Many different alternative blowing agents to CFC-11 are being developed, such as HCFC-141b, HCFC-22, HCFC-22/HCFC-142b and HFC-134a. PEKEL has decided to use cyclopentane as its new blowing agent for the following reasons:

- Merloni Elettrodomestici of Italy, PEKEL's joint venture partner, is already using cyclopentane as the blowing agent in its domestic refrigerators.
- Cyclopentane has a suitable boiling point and thermal conductivity.
- Cyclopentane has a zero ODP and a negligible GWP.

- Cyclopentane is available at competitive prices.

PEKEL will rely on Impianti OMS of Italy for the design and installation of the complete cyclopentane system to ensure a safe and effective transfer of technology.

PROJECT COSTS[5]

Total Project Cost

As described below and presented in detail in the relevant annexes, the total project cost is US$4,174,832. Because there are no non-ODS investment costs associated with this project, the total project cost equals the ODS reduction portion of the overall project. This project will not provide PEKEL Teknik Sanyi ve Ticaret A.S. with any incremental revenues.

Investment Cost

As detailed in Annex 1, the total investment cost for this project is US$3,056,650. Major components of the costs include costs associated with CFC-free refrigerator product development, technical assistance, testing and training.

Operating Costs

If the project is implemented, the annual incremental operating cost will be $1,230,000. Given an equipment life time of 10 years and a discount rate of 10 percent, the net present value of the first year of incremental operating cost is US$1,118,182. A detailed breakdown of operating costs is provided in Annex 2.

Funds to cover the incremental costs of the proposed activities are not included in the present grant request, but will be requested on an annual basis, after they have been incurred by the enterprise.

Unit Abatement Cost (UAC)

As shown in Annex 3, the UAC for this project is US$ 5.41 per ODP-weighted kilogram of ODS phased out per year (capital costs only) or US$18.36 with estimated incremental costs included. This number is derived from annualized incremental capital costs of $513,728, estimated first-year incremental operating cost of $1,230,000, and savings of 95 MT (weighted) of ODS per year.

Proposed OTF Grant

The proposed OTF grant for PEKEL is US$1,616,968 and was calculated as follows: the total investment cost was multiplied by the percentage of Turkish ownership (46 percent). This figure was increased by a 15 percent contingency to yield the grant amount. The total investment cost and the estimated total project cost before contingency for this project are listed above. As noted above, incremental costs will be requested on an annual basis, after they have been incurred by the enterprise.

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[5] Unless otherwise noted, all costs in this section are economic, rather than financial costs. As such, OTF financing is not reflected.

The 15 percent contingency is needed to ensure that the implementing enterprise still receives adequate compensation in cases in which the actual cost of items listed in this proposal exceeds their projected cost. As contingency funds would only be used for this purpose, including them in the total CTF grant would not necessarily increase the actual cost of the project.

FINANCIAL AND ECONOMIC ANALYSIS

Economic Internal Rate of Return (ERR)

Because the project entails an initial investment followed by a net annual incremental operating cost, there will be a net outflow of cash each year for the project's entire economic life. The ERR for the project is thus undefined.

Financial Internal Rate of Return (FRR)

Because the project entails an initial investment followed by a net annual incremental operating cost, there will be a net outflow of cash each year for the project's entire economic life. The FRR for the project is thus undefined.

FINANCIAL STATUS OF ENTERPRISE

Based on a review of the company's annual reports, the financial status of this enterprise appears to be sound and satisfactory for the purposes of the proposed activities.

FINANCING PLAN

To be completed by the World Bank during the appraisal mission tentatively scheduled for early December 1994..

PROJECT IMPLEMENTATION

Management

TDF will oversee the successful implementation of this project. The project will be carried out at PEKEL Teknik Sanyi ve Ticaret A.S.

Schedule

TASK	1994	1995	1996
Model Development, Technical Assistance	xxxx		
Testing of Prototypes	xxxx		
Procurement and Installation of Refrigeration and Foaming Equipment	xxx		
Training	xx	x	
Production Trials	x		
Full Production of Non-CFC Refrigerators		x	

Note: x = one quarter of the year

Procurement

Pekel will be responsible for ensuring that procurement under the Projects follow the agreed guidelines. The enterprise will, with assistance from technical consultants provided for in the grant, arrange procurement (international and local) for the packages in the subproject. Bidding documents will be prepared based on model bidding documents acceptable to the World Bank (e.g. sample Bank bidding documents) . Draft Procurement Guidelines will be prepared. The TDF will review compliance with the agreed procedures.

Disbursement

a) Between the World Bank and TDF: The World Bank has already established a revolving fund with the TDF under Turkey's first ODS project. The minimum amount for replenishment of the revolving account is US$50,000, provided funds are approved by the Montreal Protocol Executive Committee and transferred to the OTF. Requests for replenishment for contracts with a value of to US$50,000 each are based on Statement of Expenditures (SOEs). Terms, conditions, and schedule for disbursement, consistent with those established under the first ODS project in Turkey, will be included in the subgrant agreement. The OTF funds would be disbursed against (a) 100% of cif cost of imported goods or ex-factory cost of domestically manufactured goods; and (b) 100% of the cost of technical assistance for training and consultancy services, including technology transfer.

b) Between TDF and the Subproject proponent: Up to US$50,000 per contract, the TDF will disburse to the subproject proponent for eligible expenses without prior review by the World Bank. Disbursement will follow the guidelines established in the Disbursement Handbook published by the World Bank in 1992. Details of the disbursement procedures will be included in a Disbursement Letter to be issued by the World Bank to the TDF.

c) Disbursement for operating costs: For large projects (Over US$ 0.5 million) with a large share (proposed minimum threshold: over 50%) of grant funding for operating costs (as opposed to investment costs), the TDF

should proposes a disbursement plan in two or more tranches. Release of the tranches would be based on receipt of progress reports satisfactory to the TDF.

Audits

TDF will have an annual audit report prepared by an independent auditor acceptable to the World Bank. The audit report, including a separate opinion on SOEs used as a basis for disbursement would be submitted to World Bank within four months of the end of the TDF's fiscal year.

REQUIRED REGULATORY ACTIONS

No regulatory actions, other than routine permitting, are required to implement his project. Under existing agreement with the World Bank, equipment and machinery imported as part of this project will be exempt from import duties levied by the Turkish government.

RESULTS

Direct Project Impacts

This project will phase out 40 MT/year of CFC-12 and 55 MT/year of CFC-11 from PEKEL's manufacturing process after full-scale production of CFC-free refrigerators begins in 1995. In total, approximately 95 ODP-weighted MT of ODP per year will be eliminated.

Indirect Project Impacts

This project will have no impacts on the performance and product quality of PEKEL's refrigerators.

ENTERPRISE COMMITMENT:

TDF has confirmed with executives of PEKEL that the enterprise is committed to undertaking the project described above provided that funds are approved and available as scheduled.

ANNEX 1

BREAKDOWN OF INVESTMENT COSTS

Estimated Costs in US Dollars

A. Refrigeration system

1)	Refrigerant charging system including: - Storage tank (2) - Supply pump - Charging unit	$	35,000
2)	Vacuum pumps (30)	$	70,000
3)	Refrigerator computerized performance testing system including: - Data registration box - Data monitoring and storage system	$	400,000
4)	Industrial leak detector for HFC-134a (4)	$	100,000
4)	Environmental testing room (2) with data acquisition system	$	130,000
Sub-total		**$**	**735,000**

B. Foam Insulation System

1)	Cabinet foaming unit including: - Preheating ovens (2) - Foaming fixtures (8) - High pressure injection heads (8) - Metering unit - Cooling system for metering unit - Suction fan (9) - Alarms and control board (10) - Loading and unloading conveyor	$	920,000
2)	Door foaming unit including: - Foaming fixtures (6) - Loading/unloading bench - High pressure injection heads (2) - Metering unit - Cooling system for metering unit - Alarm and control board (2) - Suction fan (2)	$	900,000

3)	Centralized Polyol and Isocyanate System including:	$	260,000
	- Underground storage tank for cyclopentane - Mixing unit for polyol and cyclopentane - Intermediate tank (2) - Circulation pump (4) - Alarm and control boar		
Sub-total		**$**	**2,080,000**

C. Refrigeration Service

1)	Reclamation unit for CFC-12	$	36,600
2)	Mobile recovery unit for CFC-12 (20)	$	24,000
3)	Mobile evacuation and charging board for HFC-134a (20)	$	11,000
4)	Mobile leak detector for HFC-134a (20)	$	3,400
Sub-total		**$**	**75,000**

D. Prototyping and Testing

1)	Preparation of non-CFC refrigerator prototypes for testing (10 models, 5 sets per model=50 sets x $500/set)	$	25,000
Sub-total		**$**	**25,000**

E. Technical Assistance and Training

1)	Consultancy fee for refrigeration technology including R&D design and testing (1 expert 2 weeks on site)		
	Round trip tickets Izmir/Europe (1x $650/trip)	$	650
	Hotel accommodation (2x7 daysx $110/day)	$	1,540
	Expert/Training fee (2x7 daysx $550/day)	$	7,700
2)	Consultancy fee for foam technology including R& D design and testing (1 expert 2 weeks on site)		
	Round trip tickets Izmir/Europe (1x $650/trip)	$	650
	Hotel accommodation (2x7 daysx $110/day)	$	1,540

	Expert/Training fee (2x7 daysx $550/day)	$	7,700
3)	One training expert for one week at PEKEL to train 20 service technicians		
	Travel expense (1 tripx $650/trip)	$	650
	Hotel accommodation (7 daysx $110/day)	$	770
	Expert training fees (7 daysx $550/day)	$	3,850
	Accommodation, meals and travel expenses for 20 technicians (1x20x $80/day)	$	1,600
4)	Out of country travel for consulting and training for one project leader and two engineers		
	Travel expense (4 tripsx $650/trip)	$	2,600
	Hotel accommodation (4x10 daysx $110/day)	$	4,400
	Other expenses (conference fee etc...) (4x $1000/trip)	$	4,000
Sub-total		**$**	**37,650**
F. Personnel Requirements			
1)	one project leader	$	35,000
2)	Two project engineers (2x $18,000)	$	36,000
3)	Three technicians (3x $11,000)	$	33,000
Sub-total		**$**	**104,000**
TOTAL INVESTMENT COSTS		$	3,056,650

ANNEX 2

BREAKDOWN OF INCREMENTAL OPERATING COSTS/SAVINGS[6] (NOTE THAT THESE NOT INCLUDED IN GRANT REQUEST)

Estimated Costs in US Dollars

On average, the incremental cost per CFC-free refrigerators produced by PEKEL will be as follows:

1)	HFC-134a compressor	$	3.95
2)	Capillary tube modification	$	0.03
3)	Filter dryer	$	0.05
5)	HFC-134a refrigerant	$	0.30
6)	Cyclopentane polyurethane foam	$ 1.62	
7)	Nitrogen	$	0.20
TOTAL INCREMENTAL COSTS PER UNIT		**$**	**6.15**
TOTAL INCREMENTAL COSTS PER YEAR (based on 200,000 units produced)		**$**	**1,230,000**

[6] Recurrent costs will be evaluated on an annual basis, due to the rapid changes in foam technology and associated costs.

ANNEX 3

CALCULATION OF UNIT ABATEMENT COST

Estimated Costs in US Dollars

A. ODS SAVINGS:

Average use of CFC-11 per year	55 MT
ODP of CFC-11	1.0
Average use of CFC-12 per year	40 MT
ODP of CFC-12	1.0
ODP weighted savings	95 MT

B. ANNUALIZED CAPITAL COST:

Total from annex 1:	$3,156,650
Project life:	10 years
Discount rate:	10%
Annualized capital cost:	$513,728

C. ANNUAL INCREMENTAL OPERATING COST: $1,230,000

D. UNIT ABATEMENT COST:

	Cost per year	Unit Cost per kg ODP Saved
Annualized Capital Cost:	$513.728	$5.41
Annual Incremental Operating Cost	$1.230.000	$12.95
Unit Abatement Cost ($/kg)		$18.36

ANNEX 4

ENVIRONMENTAL ASSESSMENT

This project will not result in any additional emissions, effluents, or wastes being produced at PEKEL's plant. It is the best judgment of the project proposal team that the project will meet all applicable Turkish government environmental, health, and safety regulations and will not trigger the need for a revised certificate of compliance.

ANNEX 5

SUPPORTING DOCUMENTATION

concerns instalment of a regulation system in a climate room in order to specifically test new HFC-134a units. If this is the case, the amount claimed is considered acceptable; it should, however, be better described under "refrigeration system" in the proposal. It should also be so that the amount claimed for testing does not lead increased capacity of model development after the HFC-134a (and cyclopentane) conversion; otherwise a certain part of the investment should be considered (could be explicitly mentioned in the proposal).

Where it concerns the manufacture of HFC-134a units together with sophisticated HFC-134a leak detection, it is not clear why a helium leak test apparatus should be installed (this is normally the case in factories where leak testing for flammable refrigerants is done, lacking good other detection methods); it is proposed to take the helium leak testing out, or to very adequately describe why a specific extra leak testing stage is needed for a reliable HFC-134a product in this case.

The investments in CFC recovery units seem acceptable. More information on the amounts that can be recovered and reclaimed is needed to further consider the investment in a reclamation unit (it would concern logistics and infrastructure -other firms' workshops- information). HFC-134a equipment will be needed in the service workshops; it seems logical to postpone the instalment until there is a real need for HFC-134a servicing.

The costs claimed under technical assistance and training, also where it concerns training of service personnel, seem acceptable.

Operating costs
Incremental operating costs are acceptable, and are as observed in similar proposals.

Implementation timeframe
The implementation timeframe seems reasonable.

Recommendations
The HFC-134a conversion itself, as proposed in the project, can be recommended,
after that more explanation and/or some further changes in the investment costs have been made concerning:
- the need for the specific testing equipment with data acquisition system;
- the specific need for a helium leak testing system,

and that more information is provided on the amounts estimated for recovery (and reclaim).

The part of the production of the firm that is exported to Eastern Europe does not raise further questions.

Kuijpers, LJM
Eindhoven, 19 October 1994

Klimasan

Republic of Turkey

REVIEW OF A HFC-134a CONVERSION PROJECT

Manufacture of HFC-134a Appliances at Klimasan Klima Sanayi Ticaret A.S.

Proposal by The World Bank, October 1994

RTU-UNWB-LK-94535-lk

Scope

The project under review covers the conversion from CFC-12 to HFC-134a in circuits of refrigerators and the conversion from CFC-11 to (141b) cyclopentane. Only the HFC-134a part is reviewed here.

Technology

The HFC-134a technology selected is environmentally sound and safe. It is the most cost effective option that can be used at present. The proposal contains a phased approach for the introduction of HFC-134a, as given in OORG recommendations.

There is a technology assistance from the joint venture partner (Derby A/S) for the conversion from CFC-12 to HFC-134a; costs for technical assistance and training (USD 40,000) seem reasonable.

Compared to the production level (27,000 pieces), generally, the investment costs charging, leak testing, vacuum pumps etc. are reasonable. Where it concerns trial tests or reliability, the proposal mentions that Derby A/S will assist in short and long term testing prototypes; this cannot be found in the "breakdown of investment costs", however, if it is covered under technical assistance and training, it should be mentioned here. The procedure itself would be acceptable then.

An extra amount is claimed for reliability under pre-leak testing and testing equipment (these reliability aspects are dealt with below).

The proposal contains investments for reclamation, mobile recovery of CFC-12 and evacuation and charging of HFC-134a. The proposal mentions that high amounts of CFC-12 are used during servicing (10,000 kg of CFC-12/year); this does not automatically imply that these amounts can be recovered from units that need repairs (refrigerant leaked out, contaminated refrigerant). An estimate of the amount recoverable per workshop would give insight in the efficiency of a recovery unit and the "efficiency" of a central reclamation plant. If it would concern small amounts of refrigerant for reclaim, considerations should be given on infrastructure of service shops in Turkey and possible co-operation with other workshops owned by other companies.

The proposal also gives a 25,000 USD amount for HFC-134a leak testing and charging in the service shops. Since the repairs on HFC-134a units will take place after that HFC-134a appliances have been put on the market (1996-1997) and it will concern small amounts in the first years, it is proposed to consider the investments, however, not to invest in service equipment for HFC-134a until they are needed, i.e. after completion of the phase that involves full production.

Environmental impact

The HFC-134a refrigerant proposed has no ODP. Health and safety impacts are minimised.

Project costs

Most of the components seem necessary for the conversion, i.e. the instalment of charging stations, leak detection and vacuum pumps is required; it is appropriate to consider the retrofit of CFC-12 vacuum units to HFC-134a if they are new enough and provide sufficient vacuum.

An amount is claimed for "testing equipment and data acquisition system", that is described in the proposal by "a regulation system for temperature, humidity and voltage, in addition to a data acquisition system to test and optimise non-CFC units". It is not clear whether this

KLIMASEN - TURKEY

TECHNOLOGY

The technology phaseout schedule proposed by the enterprise is to replace CFC 11 by HCFC 141b for a short period whilst it gains experience before finally converting to cyclopentane. Both technologies are well proven in this application.

ENVIRONMENTAL IMPACT

The final blowing agent cyclopentane has a zero ODP and almost zero GWP. However, Annex 4 should be modified to reflect that it is a VOC and the enterprise should verify that it will meet any local regulations which pertain.

HCFC 141b is a transitional material with a residual ODP.

The main area for attention on the safety procedures associated with the flammability of cyclopentane. The reviewer is satisfied that the enterprise is proposing to purchase the necessary equipment and to carry out appropriate training. It has experienced partners in Derby and Polyfa trading. However, the reviewer requires to view the letter of assurance on safety matters from the latter.

PROJECT COSTS

This section is well laid out. The equipment proposed is necessary without excessive cost. It is noted that the high pressure dispensing machine to be purchased in phase 1 is pentane compatible and there are no items of equipment in phase 1 which will become redundant in phase 2. It is also noted that there are no incremental costs associated with phase 1 production based on HCFC 141b. However, the additional foam costs of $ 3.00/unit seems too high. This would equate to an increase of about 25% on foam cost - divided between a density increase (ca. 7-10%) and chemical cost. It is suggested that this item is deferred until the time of implementation.

TIMEFRAME

The timeframe proposed is acceptable.

RECOMMENDATION

Approved after modification as suggested and sharing letter of assurance with reviewer.

GMFJ/kd 18/10/94

Polyurethanes

TELEFAX

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18th October, 1994

PROJECTS IN TURKEY - OORG REVIEW

Please find following the review of the foam elements of these three projects.

I would like to add that these are three of the most clearly laid out projects that I have reviewed in the last two years. They are easy to read and to review.

My main comments refer to foam cost increases associated with cyclopentane-based foam. I think that they are excessive in two cases - however, they could be deferred and reexamined at the implementation stage.

Regards,

G. M. E. Jeffs
GMFJ/kd

ANNEX 5

SUPPORTING DOCUMENTATION

ANNEX 4

ENVIRONMENTAL ASSESSMENT

This project will not result in any additional emissions, effluents, or wastes being produced at Klimasan's plant. It is the best judgment of the project proposal team that the project will meet all applicable Turkish government environmental, health, and safety regulations and will not trigger the need for a revised certificate of compliance.

ANNEX 3

CALCULATION OF UNIT ABATEMENT COST

Estimated Costs in US Dollars

A. ODS SAVINGS:

Average use of CFC-11 per year	20.5 MT
ODP of CFC-11	1.0
Average use of CFC-12 per year	5.9 MT
Saving potential of CFC-12 per year due to proper servicing	10.0 MT
ODP of CFC-12	1.0
Average 1,1,1 Trichloroethane	5.0 MT
ODP of 1,1,1 Trichloroethane	0.1
ODP weighted savings	36.9 MT

B. ANNUALIZED CAPITAL COST:

Total from annex 1:	$1,028,943
Project life:	10 years
Discount rate:	10%
Annualized capital cost:	$167,455

C. ANNUAL INCREMENTAL OPERATING COST: $296,121

D. UNIT ABATEMENT COST:

	Cost per year	Unit Cost per kg ODP Saved
Annualized Capital Cost:	$167,455	$4.54
Annual Incremental Operating Cost	$296,121	$8.02
Unit Abatement Cost ($/kg)		$12.56

ANNEX 2

BREAKDOWN OF INCREMENTAL OPERATING COSTS/SAVINGS[7] (MAYBE REPLACE WITH ANNEX NOTING THESE WILL BE REQUESTED AT A LATER DATE)

Estimated Costs in US Dollars

On average, the incremental cost per CFC-free freezers and coolers produced by Klimasan will be as follows:

1)	HCF-134a compressor	$	5.35
2)	Capillary tube modification	$	0.14
3)	Evaporator modification	$	1.10
4)	Filter dryer	$	0.04
5)	HFC-134a refrigerant	$	1.25
6)	Cyclopentane polyurethane foam	$	3.00
TOTAL INCREMENTAL COSTS PER UNIT		**$**	**10.88**
TOTAL INCREMENTAL COSTS PER YEAR (based on 27,217 units produced)		**$**	**296,121**

[7] Recurrent costs will be evaluated on an annual basis, due to the rapid changes in foam technology and associated costs.

Total investment costs in Phase I		**$**	**744,403**
Phase II			
G. Cyclopentane System			
1)	Ventilation and exhaust system	$	14,000
2)	Fire protection system revision	$	16,000
3)	Control panel for safety systems	$	19,000
4)	Foaming area enclosure	$	12,000
5)	Cleaning and anti-static floor coating	$	6,860
6)	Manual pneumatic/hydraulic transpalett (2)	$	7,000
7)	Maintenance tools & equipment ex-proof	$	1,200
8)	Rebuilding of foaming jigs (10)	$	30,000
9)	Foaming plugs (14)	$	106,400
10)	Cyclopentane storage tank	$	16,000
11)	Ex-proof cyclopentane transfer pumps and piping (3)	$	9,600
12)	Ex-proof barrel pump (2)	$	4,300
13)	Day tank (2)	$	2,400
14)	Local subcontract for foundation & erection of cyclopentane tank, installation of pumps and piping	$	9,200
15)	Local subcontract for erection and installation of utilities for machinery and equipment	$	5,000
16)	Local subcontract for rebuilt of foaming jigs and erection of day tanks and piping	$	6,000
Sub-total		**$**	**264,960**
H. Transportation and Insurance		**$**	**19,580**
Total investment costs in Phase II		**$**	**284,540**
TOTAL INVESTMENT COSTS		**$**	**1,028,943**

Round trip tickets Izmir/Europe (2x $650/trip)	$	1,300
Hotel accommodation (2x7 daysx $110/day)	$	1,540
Expert/Training fee (2x7 daysx $550/day)	$	7,700
Sub-total	$	40,540

E-2 Foam Insulation System

1) Two supervisors and one engineer from foam manufacturer for 4 weeks at two different periods on site

Travel expense (3x2x $650/trip)	$	3,900
Hotel accommodation (3x28 daysx $110/day)	$	9,240
Expert/training fees of two supervisors (2x28 daysx $550/day)	$	30,800
Expert/training fees of one engineer (1x28 daysx $750/day)	$	21,000
Sub-total	$	64,940

E-3 Refrigeration Service

1) One training expert for one week at Klimasan to train 30 service technicians

Travel expense (1 tripx $650/trip)	$	650
Hotel accommodation (7 daysx $110/day)	$	770
Expert training fees (7 daysx $550/day)	$	3,850
Accommodation, meals and travel expenses for 30 technicians (1x30x $80/day)	$	2,400
Sub-total	$	7,670
Sub-total	**$**	**113,150**

F. Personnel Requirements

1) Project leader	$	50,000
2) Staff support	$	2,000
Sub-total	**$**	**52,000**

ANNEX I

BREAKDOWN OF INVESTMENT COSTS

Estimated Costs in US Dollars

Phase I

A. Refrigeration system			
1)	Charging board for HFC-134a (2)	$	32,800
2)	Refrigerant supply pump	$	8,500
3)	Leak detector for HFC-134a (2)	$	18,700
4)	Mobile leak detector for HFC-134a	$	455
5)	Vacuum pump for HFC-134a (3)	$	13,650
6)	Vacuum pump renovation (2)	$	300
7)	Vacuum control system (5)	$	6,750
8)	Pre-foam leak testing with helium	$	80,640
9)	Testing equipment with data acquisition system	$	60,000
10)	Dry air unit for evaporator production	$	1,350
Sub-total		**$**	**223,145**
B. Foam Insulation System			
1)	High pressure injection machine with two heads	$	136,000
2)	Overhead transport system for injection heads	$	9,000
3)	Cooling system for polyol tank	$	7,000
4)	Mixing station	$	62,200
5)	Foam testing and quality control apparatus and equipment	$	1,500
6)	Revision of pre-heating system	$	2,400
7)	Roller conveyer for transfer of units	$	9,400
8)	Revision of factory layout	$	6,500
Sub-total		**$**	**234,000**
C. Refrigeration Service			
1)	Reclamation unit for CFC-12	$	36,600
2)	Mobile recovery unit for CFC-12 (30)	$	16,950
3)	Mobile evacuation and charging board for HFC-134a (30)	$	16,500
4)	Mobile leak detector for HFC-134a (30)	$	9,150
Sub-total		**$**	**79,200**
D. Transportation and Insurance		**$**	**42,908**
E. Technical Assistance and Training			
E-1 Refrigeration System			
1)	Consultancy fee for R&D and refrigeration system design	$	18,000
2)	Consultancy fee for production layout	$	12,000
3)	Two supervisors for 1 week on site		

b) Between TDF and the Subproject proponent: Up to US$50,000 per contract, the TDF will disburse to the subproject proponent for eligible expenses without prior review by the World Bank. Disbursement will follow the guidelines established in the Disbursement Handbook published by the World Bank in 1992. Details of the disbursement procedures will be included in a Disbursement Letter to be issued by the World Bank to the TDF.

c) Disbursement for operating costs: For large projects (Over US$ 0.5 million) with a large share (proposed minimum threshold: over 50%) of grant funding for operating costs (as opposed to investment costs), the TDF should proposes a disbursement plan in two or more tranches. Release of the tranches would be based on receipt of progress reports satisfactory to the TDF.

Audits

TDF will have an annual audit report prepared by an independent auditor acceptable to the World Bank. The audit report, including a separate opinion on SOEs used as a basis for disbursement, would be submitted to World Bank within four months of the end of the TDF's fiscal year.

REQUIRED REGULATORY ACTIONS

No regulatory actions, other than routine permitting, are required to implement his project. Under existing agreement with the World Bank, equipment and machinery imported as part of this project will be exempt from import duties levied by the Turkish government.

RESULTS

Direct Project Impacts

This project will phase out 5.9 MT/year of CFC-12, 20.5 MT/year of CFC-11 and 5.0 MT of 1,1,1, Trichloroethane from Klimasan's manufacturing process after full-scale production of CFC-free freezers and coolers begins in 1996. There is also a potential saving of 10 MT/year of CFC-12 used during servicing. In total, approximately 36.9 ODP-weighted MT of ODS per year will be eliminated.

Indirect Project Impacts

This project will have no impacts on the performance and product quality of Klimasan's refrigerators.

ENTERPRISE COMMITMENT:

TDF has confirmed with executives of Klimasan that the enterprise is committed to undertaking the project described above provided that funds are approved and available as scheduled.

Schedule

TASK	1994	1995	1996
Phase I: Model Development, Technical Assistance	xxxx		
Testing of Prototypes	xx	x	
Procurement and Installation of Refrigeration and Foaming Equipment	xx	x	
Training	xx	x	
Partial Production with HFC-134a and HCFC-141b		xxx	
Phase II: Installation of Cyclopentane Safety Equipment		xx	
Production Trials with Cyclopentane, Training		x	
Full Production of Non-CFC Refrigerators			x

Note: x = one quarter of the year

Procurement

Klimasan will be responsible for ensuring that procurement under the Projects follow the agreed guidelines. The enterprise will, with assistance from technical consultants provided for in the grant, arrange procurement (international and local) for the packages in the subproject. Bidding documents will be prepared based on model bidding documents acceptable to the World Bank (e.g. sample Bank bidding documents) . Draft Procurement Guidelines will be prepared. The TDF will review compliance with the agreed procedures.

Disbursement

a) Between the World Bank and TDF: The World Bank has already established a revolving fund with the TDF under Turkey's first ODS project. The minimum amount for replenishment of the revolving account is US$50,000, provided funds are approved by the Montreal Protocol Executive Committee and transferred to the OTF. Requests for replenishment for contracts with a value of to US$50,000 each are based on Statement of Expenditures (SOEs). Terms, conditions, and schedule for disbursement, consistent with those established under the first ODS project in Turkey, will be included in the subgrant agreement. The OTF funds would be disbursed against (a) 100% of cif cost of imported goods or ex-factory cost of domestically manufactured goods; and (b) 100% of the cost of technical assistance for training and consultancy services, including technology transfer.

contingency for this project are listed above. As noted above, incremental costs will be requested on an annual basis, after they have been incurred by the enterprise.

The 15 percent contingency is needed to ensure that the implementing enterprise still receives adequate compensation in cases in which the actual cost of items listed in this proposal exceeds their projected cost. As contingency funds would only be used for this purpose, including them in the total CTF grant would not necessarily increase the actual cost of the project.

FINANCIAL AND ECONOMIC ANALYSIS

Economic Internal Rate of Return (ERR)

Because the project entails an initial investment followed by a net annual incremental operating cost, there will be a net outflow of cash each year for the project's entire economic life. The ERR for the project is thus undefined.

Financial Internal Rate of Return (FRR)

Because the project entails an initial investment followed by a net annual incremental operating cost, there will be a net outflow of cash each year for the project's entire economic life. The FRR for the project is thus undefined.

FINANCIAL STATUS OF ENTERPRISE

Based on a review of the company's annual reports, the financial status of this enterprise appears to be sound and satisfactory for the purposes of the proposed activities.

FINANCING PLAN

The Financing Plan will be completed by TDF and the World Bank during the appraisal mission tentatively scheduled for early December 1994.

PROJECT IMPLEMENTATION

Management

TDF will oversee the successful implementation of this project. The project will be carried out at Klimasan Klima Sanayi ve Ticaret A.S..

- Derby S/A of Denmark, from which Klimasan licenses part of its technology, will be using cyclopentane as the blowing agent in its freezers and coolers.
- Cyclopentane has a suitable boiling point and thermal conductivity.
- Cyclopentane has a zero ODP and a negligible GWP.
- Cyclopentane is available at competitive prices.

Klimasan will rely on Polyfa Trading A/S of Denmark for the design and installation of the complete cyclopentane system to ensure a safe and effective transfer of technology.

PROJECT COSTS[6]

Total Project Cost

As described below and presented in detail in the relevant annexes, the total project cost is US$1,298,144. Because there are no non-ODS investment costs associated with this project, the total project cost equals the ODS reduction portion of the overall project. This project will not provide Klimasan Klima Sanayi ve Ticaret A.S. with any incremental revenues.

Investment Cost

As detailed in Annex 1, the total investment cost for this project is US$1,028,943. Major components of the costs include costs associated with CFC-free freezers and coolers product development, technical assistance, testing and training.

Operating Costs

If the project is implemented, the annual incremental operating cost is estimated to be $296,121. Given an equipment life time of 10 years and a discount rate of 10 percent, the net present value of the first year of incremental operating cost is US$269,201. A detailed breakdown of operating costs is provided in Annex 2.

Funds to cover the incremental costs of the proposed activities are not included in the present grant request, but will be requested on an annual basis, after they have been incurred by the enterprise.

Unit Abatement Cost (UAC)

As shown in Annex 3, the UAC for this project is US$ 4.54 per ODP-weighted kilogram of ODS phased out per year (capital costs only), or US$12.56 with estimated incremental operating costs included. This number is derived from annualized incremental capital costs of $167,455, the estimated first-year incremental operating cost of $296,121, and savings of 36.9 MT (weighted) of ODS per year.

Proposed OTF Grant

The proposed OTF grant for Klimasan is U.S.$926,048 and was calculated as follows: the total investment cost was multiplied by the percentage of Turkish ownership (75 percent). This figure was increased by a 15 percent contingency to yield the grant amount. The total investment cost and the estimated total project cost before

[6] Unless otherwise noted, all costs in this section are economic, rather than financial costs. As such, OTF financing is not reflected.

at various sections of the evaporator are leak free and will avoid the dismantling of the unit (and possibly its disposal) if a leak is detected after the refrigerant is charged in the system.

- The existing five vacuum pumps will be replaced by three new ones with comparable capacity. The two newly purchased vacuum pumps will be retrofitted for the utilization of HFC-134a.

- A testing room will be upgraded by purchasing a data acquisition system and a regulation system for temperature, humidity and voltage. This upgrade is necessary to accurately test and optimize HFC-134a units.

- An air drying unit will be acquired to reach necessary levels of dryness and cleanliness in the refrigeration system.

2- Foaming System

- To achieve a good quality in the rigid polyurethane foam and an acceptable insulation value, the two existing low pressure injection machines will be replaced by one high pressure machine with two injection heads.

- Since the polyol and cyclopentane cannot be delivered in premixed form in drums like CFC-11, it is necessary to acquire pre-mixing stations to feed the HP injection machine.

- Because of the high flammability of cyclopentane, a complete safety system will be installed. This will consist of gas sensors, alarms and a ventilation system in the foaming area.

- An underground storage tank for cyclopentane will be designed, built and installed according to standard safety measures.

- The foaming jigs will be rebuilt to be explosion-proof by eliminating the electrical heating system and replacing it with water heating system.

- The floor area in the foaming department and the neighboring areas will be coated with an anti-static material.

- All the machinery and the equipment in the foaming area will be grounded to prevent potential fires.

3- Refrigeration Service

- A set of one recovery equipment for CFC-12, one leak detector for HFC-134a and one mobile evacuation and charging board for HFC-134a will be supplied to each of the 30 regional service outlets of Klimasan.

- A reclamation unit will be purchased and installed in a central location where the CFC-12 collected from the regional service centers will be cleaned and sent back.

Price quotations on some of the items listed in Annex 1 of the proposal can be found in Annex 5.

JUSTIFICATION FOR SELECTION OF ALTERNATIVE TECHNOLOGY

HFC-134a has been accepted worldwide as the best replacement to CFC-12 in household refrigerators because of its good thermodynamic properties (similar to CFC-12), zero ODP, and non-flammability. Klimasan currently purchases its compressors from Danfos, Electrolux, Aspera and TEE (Arcelik), a company located in Istanbul Turkey that licenses its technology from Tecumseh U.S.A. These companies have indicated that they can supply Klimasan with HFC-134a compressors by the end of 1994.

Many different alternative blowing agents to CFC-11 are being developed, such as HCFC-141b, HCFC-22, HCFC-22/HCFC-142b and HFC-134a. Klimasan has decided to use cyclopentane as its new blowing agent for the following reasons:

the risks associated with the conversion process, Klimasan will request technical assistance during Phase I from its joint venture partner Derby A/S of Denmark. This technical assistance represents a continuation of existing arrangements between the two companies. Klimasan has used similar arrangements in the past to develop its existing line of freezers and coolers. The emphasis in Phase I is to provide Klimasan with the technology developed by the joint venture partner in Denmark, modifying it where necessary to account for differences in Turkish manufacturing conditions and refrigerator models. As part of the technical agreement, Derby S/A of Denmark will assist Klimasan in the following tasks:

- Redesign of the different freezers and coolers
- Construction, prototype manufacturing, short and long term testing of the different freezers and coolers
- Training on manufacturing, maintenance and quality control

During phase I, Klimasan plans to invest in a high pressure (HP) polyurethane foam injection machine, that for the most part, will be explosion-proof to allow the use of flammable and explosive foam blowing agents such as cyclopentane. Klimasan decided to go through a short transition period where HCFC-141b will be used as the foam blowing agent. This decision was made to enable Klimasan to train its personnel more extensively to reduce the potential problems that may arise during the commissioning of the new machinery and equipment. The HP injection machine will be selected and configured at the start such that there won't be any redundant parts at the changeover to cyclopentane. This period of transition will also allow the configuration of the production layout at the factory if need arises.

Because of the relatively high consumption of CFC-12 during servicing (estimated at 10 MT), Klimasan plans during phase I to equip its main regional service outlets with recovery equipment. In addition, Klimasan will provide training to the technicians in these service centers on service procedures.

The second phase of the project will consist of finalizing the transition to CFC-free technology for mass production. During this transition time, both CFC and non-CFC freezers and coolers will be produced. Klimasan will install, in phase II, all the necessary equipment for the use of cyclopentane. To ensure a safe and effective transfer to cyclopentane technology, Klimasan will seek technical assistance from Polyfa Trading A/S, a company which specializes in the design and installation of cyclopentane systems. As part of the agreement with Klimasan, Polyfa Trading A/S will do the following:

- Design the complete cyclopentane system including storage tank, piping, safety and alarm systems
- Supervise the installation of the entire cyclopentane system
- Provide extensive training on safety issues

As part of the conversion process to non-CFC technology the following equipment needs to be replaced, purchased or modified:

1- Refrigeration System

- To protect the refrigeration system against chlorine contamination, the existing two charging boards will be replaced by boards compatible with HFC-134a.

- The existing three leak detectors will be replaced by ones suitable for HFC-134a.

- A helium leak detection system will be acquired to check the refrigerator's evaporator for potential leaks prior to injecting the polyurethane foam. The use of helium gas charging and leak detection will ensure that the welding points

limited production capabilities. Because commercial freezers and coolers are principally used in the food and beverage industry, it is estimated that the market for such appliances will grow at a rate of 6.5% for the next coming years.

The average charge of CFC-12 in refrigerators, freezers and coolers manufactured in Turkey is around 0.2 kg. An additional 0.4 to 0.6 kg of CFC-11 is used in making the rigid polyurethane foam in the cabinet. Most of the refrigerator manufacturers in Turkey have already started using 50 percent CFC-11 reduced PU foams formulations. Most refrigerators, freezers and coolers produced for the domestic market are equipped with compressors manufactured in Turkey by TEE (Arcelik) except for PEG Profilo which manufactures most of its own compressors based on a design from AEG Germany. TEE produced over 1,000,000 compressors in 1993 and licenses its technology from Tecumseh U.S.A. A number of compressors are also imported from various manufacturers including Embraco, Danfos, Nicchi, Electrolux and Matsushita, mainly for appliances that are exported to Europe and the U.S.

ENTERPRISE BACKGROUND

Klimasan Klima Sanayi ve Ticaret A.S. is located in Izmir, Turkey. The company was founded in 1969 by Ismet and Sabahattin Senocak, an entrepreneur family in Izmir which had experience in refrigeration equipment since the 1920's. Seventy five percent of the company is Turkish owned while the rest is owned by Derby A/S (12.5 percent) and Industrialization Fund for Developing Countries (IFU, 12.5%) of Denmark. Klimasan employs 106 people in its freezers and coolers factory and its revenues in 1993 were approximately US$4.7 million.

Klimasan produced its first commercial refrigerator in 1969. It moved to its present facility in 1992, the same year it made a joint venture and technical assistance agreements with Derby A/S of Denmark. Klimasan produces some of its upright coolers and chest freezers under a licensing agreement from Derby A.S. From May 1993 to May 1994, Klimasan manufactured 27,217 coolers and freezers comprising eleven different models that can be categorized as follows: one model of water dispenser/cooler, four models of beverage and soft drink coolers, three models of display cabinets, two models of ice cream conservatories and two models of chest freezers. About 10% of Klimasan's production is exported mainly to East European countries including Romania, Bulgaria and Russia. The rest is sold domestically and represent a market share of about 40 percent. The plant has two production lines with a total capacity of 50,000 sets a year. Klimasan expects to reach its maximum capacity by 1997.

Klimasan buys its compressors from a number of manufacturers including TEE, Danfos, Electrolux and Aspera. These companies have provided Klimasan with a number of trial units to test HFC-134a and are ready to supply larger quantities of compressors when Klimasan requests it.

Klimasan plans to eliminate the use of CFCs by the beginning of 1996. In 1993, the company consumed 5.9 MT of CFC-12 and 20.5 MT of CFC-11. The average CFC-12 charge size in its freezers and coolers is 0.2 kg. Klimasan is still using full CFC-11 formulation for its foam and uses about 0.75 kg of CFC-11 per set.

PROJECT DESCRIPTION

In this project, Klimasan Klima Sanayi ve Ticaret A.S. will eliminate the use of CFC-12 and CFC-11 in freezers and coolers by converting its manufacturing facility to one that is compatible with HFC-134a, the new refrigerant and HCFC-141b and cyclopentane, the new foam blowing agents in the transition and final stages of the project respectively.

The project will be divided into two phases. The first phase will provide for the acquisition of the new technology, the procurement and installation of the necessary machinery and equipment, engineering assistance and training. The second phase will allow for the progressive elimination of CFC-12 and CFC-11 through actual production of CFC-free freezers and coolers.

The main objective of the project's first phase consists of developing reliable new CFC-free freezers and coolers at Klimasan. This task is particularly difficult to accomplish given the considerable engineering design modifications and the necessary testing that have to be done in a relatively short period of time. In order to minimize

PROJECT SUMMARY

This project will phase out chlorofluorocarbons (CFCs) used in the freezers and coolers manufactured at Klimasan Klima Sanayi ve Ticaret A.S. in Turkey. The project will comprise two phases. The first phase will convert the production line to freezers and coolers using HFC-134a and HCFC-141b as the new refrigerant and foam blowing agent respectively. This phase will provide for product development using CFC alternatives and will identify all equipment and process changes needed to implement the alternative technology. It will also implement refrigerant recovery and recycling practices for the freezers and coolers being serviced at Klimasan service outlets. During this phase, Klimasan A.S. will seek engineering assistance and training from its joint venture partner Derby A/S of Denmark. The second phase will replace the foam blowing agent HCFC-141b by cyclopentane. During this phase, Klimasan will purchase and install all the necessary safety equipment needed to handle cyclopentane and will extensively train its personnel on the use of flammable blowing agents. The project will result in the elimination of 5.9 MT/year of CFC-12 (refrigerant), 20.5 MT/year of CFC-11 (foam blowing agent) and 5.0 MT/year of Trichloroethane after the conversion is completed.

PROJECT OBJECTIVE

The objective of this project is to phase out the use of ozone depleting substances in the production of freezers and coolers at Klimasan Klima Sanayi ve Ticaret A.S. The project provides for the purchase of equipment, the transfer of technology, and the training necessary to facilitate an effective transition to HFC-134a for the refrigerant and to HCFC-141b as the new blowing agent in polyurethane insulation foam in the first transition stage and to cyclopentane in the second stage to replace HCFC-141b.

SECTOR BACKGROUND

The consumption of chlorofluorocarbons (CFCs) in the refrigeration and foam industries has been estimated in 1993 at approximately 2359 MT representing 75 percent of the country's consumption of CFCs. Of the sector's total estimate use of CFCs, domestic and commercial refrigeration appliances accounted for 714 MT of CFC-12[4]. In addition, it is estimated that 1100 MT of CFC-11[5] were used in the production of polyurethane (PU) appliance insulation foam.

The production of household refrigerators and freezers in Turkey has increased significantly in the last past three years, from about 965,000 units in 1990 to approximately 1.25 million units in 1993. In 1993, 20% of the units produced were exported to a number of countries, including the US, Germany, Great Britain, Italy, and France. There are four major domestic refrigerator manufacturers in Turkey: Arcelik, PEG Profilo, Pekel Teknik and Simtel. Arcelik and PEG Profilo dominate the domestic market with about 95% of market share.

Commercial freezers and coolers are produced mainly by two companies: Klimasan and Ugur with a domestic market share of 90%. The rest is produced by numerous local shops and manufacturers throughout Turkey with very

[4] This number was estimated from the 1992 Turkey country program. Nonetheless, given the actual 1993 production of 1.25 Million appliances and considering that most manufacturers have switched to 50% CFC-11 reduction foam formulation, the consumption of CFC-11 in the domestic and commercial refrigeration sector should be approximately 625 MT.

[5] This number was estimated from the 1992 Turkey country program. Nonetheless, given the actual 1993 production of 1.25 Million appliances and considering that most manufacturers have switched to 50% CFC-11 reduction foam formulation, the consumption of CFC-11 in the domestic and commercial refrigeration sector should be approximately 625 MT.

COUNTRY:	Republic of Turkey
PROJECT TITLE:	Engineering Assistance for the Elimination of Ozone Depleting Substances Used in the Production of Freezers and Coolers at Klimasan Klima Sanayi ve Ticaret A.S.
SECTOR COVERED:	Domestic and Commercial Refrigeration
ODS USE IN SECTOR:	714 MT of CFC-12 in 1993[1] 1645 MT of CFC-11 in 1993[1] Total of 2359 MT (2359 ODP-weighted MT)
PROJECT IMPACT:	Eliminate annual consumption of 5.9 MT of CFC-12, 20.5 MT of CFC-11, 5.0 MT of Trichlorethane Saving potential of 10.0 MT of CFC-12 per year (estimated consumption by company's service network) Total of 36.9 ODP-weighted MT after production begins
PROJECT DURATION:	Phase I: 8 months Phase II: 12 months
PROJECT ECONOMIC LIFE:	10 years
TOTAL PROJECT COST:	ODS Reduction Investment Cost: US$1.028,943 Incremental Operating Cost[2]: US$269,201 Incremental Operating Revenue: US$0 Total ODS Reduction Project Cost: US$1.298,144 Other Project Costs: US$0 Total Project Costs: US$1.298,144 Unit Abatement Costs: Capital Costs Only US$4.54 Capital Costs and Incremental Costs US$12.56
PROPOSED OTF FINANCING:	US$953.829 (including 15 percent contingency and 3 percent Financial Agency Fee). Incremental operating costs are not included in the present grant request, but will be requested after the costs have been incurred by the enterprises, in accordance with prevailing funding criteria.
IMPLEMENTING ENTERPRISE:	Klimasan Klima Sanayi ve Ticaret A.S.
COORDINATING MINISTRY:	Technology Development Foundation of Turkey (TDF) Republic of Turkey
IMPLEMENTING AGENCY:	The World Bank

This proposal has been revised to reflect changes recommended by the OORG reviewers.

[1] Projection given in "Turkey Country Program for Phaseout of ODS", August 1992

[2] Net present value of first year of operating costs/savings. Incremental costs are not included in the present grant request, but will be requested later, on an annual basis after they have been incurred by the enterprise.

PE6

Republic of Turkey

REVIEW OF A HFC-134a CONVERSION PROJECT

Manufacture of HFC-134a Appliances and Compressors at PEG Profilo Elektrikli Gerecler Sanayii A.S.

Proposal by The World Bank, October 1994

RTU-UNWB-LK-94536-lk

Scope

The project under review covers the conversion from CFC-12 to HFC-134a in circuits of refrigerators and the conversion from CFC-11 to cyclopentane. Only the HFC-134a part is reviewed here.

Technology

The HFC-134a technology selected is environmentally sound and safe. It is the most cost effective option that can be used at present. The proposal contains a phased approach for the introduction of HFC-134a, as given in OORG recommendations.

There is no licensing agreement (with AEG Germany) for the HFC-134a conversion, however, technical assistance is guaranteed from the joint venture partner (AEG Germany) and other companies (which ?) for the conversion from CFC-12 to HFC-134a. The costs for technical assistance and training (USD 120,000) are not low, however, it also consists of a part "installation of charging units" and "service technician training"; if these are not considered the costs for technical assistance and training for the conversion is about USD 73,000 which seems acceptable (however, it should also be taken into account that an extra USD 158,000 is claimed for a project team for the conversion).

Compared to the production level (400,000 pieces), generally, the investment costs need further consideration (see below); it is not clear whether all is specifically needed for the HFC-134a conversion and does not add to manufacturing capacity and quality in general.

Where it concerns trial tests or reliability, the proposal mentions that PEG has received technical assistance for the short and long term testing of prototypes; this cannot be found in the "breakdown of investment costs", however, if it is covered under technical assistance and training, it should be mentioned there. The procedure itself would be acceptable then.

The proposal mentions the conversion of the compressor (original license from AEG, that no longer produces) from CFC-12 to HFC-134a; the proposal does not mention whether the firm has received or will receive technical support for this conversion. Adding more information as to this aspect and some more insight in the reliability testing of the compressors would be desirable, if not required.

The proposal contains investments for reclamation, mobile recovery of CFC-12 and evacuation and charging of HFC-134a. The proposal mentions that high amounts of CFC-12 are used during servicing (no specific amount); this does not automatically imply that these amounts can be recovered from units that need repairs (refrigerant leaked out, contaminated refrigerant). An estimate of the amount recoverable per workshop would give insight in the efficiency of a recovery unit and the "efficiency" of a central reclamation plant. If it would concern small amounts of refrigerant for reclaim, considerations should be given on infrastructure of service shops in Turkey and possible co-operation with other workshops owned by other companies.

The proposal also gives a 53,000 USD amount for HFC-134a leak testing and charging in the service shops.

Since the repairs on HFC-134a units will take place after that HFC-134a appliances have been put on the market (1996-1997) and it will concern small amounts in the first years, it is proposed to consider the investments, however, not to invest in service equipment for HFC-134a until they are needed, i.e. after completion of the phase that involves full production.

PEG PROFILO TURKEY

TECHNOLOGY

The choice of cyclopentane-based technology for this application is now well proven.

ENVIRONMENTAL IMPACT

Cyclopentane has a zero ODP and an almost zero GWP and hence constitutes a long term solution. However, Annex 4 should be modified to reflect that it is a VOC and the enterprise should verify that it will meet any relevant local regulations.

The main area for attention are the safety procedures associated with the flammability of cyclopentane. The reviewer is satisfied that the enterprise is proposing to purchase the necessary equipment and to carry out appropriate training. It has experienced partners in AEG of Germany and AEG Impianti. However, the reviewer requires to view the letter of assurance on safety matters (Annex 5).

PROJECT COSTS

The equipment proposed is necessary and without excessive cost. The additional foam costs of $4.11/unit seems to be too high. This would equate to an increase of about 30% on foam cost. It is suggested that this item is deferred until the time of implementation and then re-examined.

TIMEFRAME

The project timeframe is acceptable.

RECOMMENDATION

Approved subject to acting on the comments above.

GMFJ/kd/18/10/94

ANNEX 5

SUPPORTING DOCUMENTATION

ANNEX 4

ENVIRONMENTAL ASSESSMENT

This project will not result in any additional emissions, effluents, or wastes being produced at PEG's plant. It is the best judgment of the project proposal team that the project will meet all applicable Turkish government environmental, health, and safety regulations and will not trigger the need for a revised certificate of compliance.

ANNEX 3

CALCULATION OF UNIT ABATEMENT COST

Estimated Costs in US Dollars

A. ODS SAVINGS:

Average use of CFC-11 per year	200 MT
ODP of CFC-11	1.0
Average use of CFC-12 per year	90 MT
ODP of CFC-12	1.0
ODP weighted savings	290 MT

B. ANNUALIZED CAPITAL COST:

Total from annex 1:	$4,039,496
Project life:	10 years
Discount rate:	10%
Annualized capital cost:	$657,406

C. ANNUAL INCREMENTAL OPERATING COST: $3,040,000

D. UNIT ABATEMENT COST:

	Cost per year	Unit Cost per kg ODP Saved
Annualized Capital Cost:	$657,406	$2.27
Annual Incremental Operating Cost	$3,040,000	$10.48
Unit Abatement Cost ($/kg)		$12.75

ANNEX 2[6]

BREAKDOWN OF INCREMENTAL OPERATING COSTS/SAVINGS (NOTE THAT THESE ARE NOT INCLUDED IN GRANT REQUEST)

Estimated Costs in US Dollars

On average, the incremental cost per CFC-free refrigerators produced by PEG will be as follows:

1)	HCF-134a compressor	$	2.70
2)	Filter dryer	$	0.10
3)	HFC-134a refrigerant	$	0.69
4)	Cyclopentane polyurethane foam	$	4.11
TOTAL INCREMENTAL COSTS PER UNIT		**$**	**7.60**
TOTAL INCREMENTAL COSTS PER YEAR (based on 400,000 units produced)		**$**	**3,040,000**

[6] Recurrent costs will be evaluated on an annual basis, due to the rapid changes in foam technology and associated costs.

Total investment costs in Phase I	**$**	**3,967,896**

Phase II

There are no investment costs in phase II

TOTAL INVESTMENT COSTS	**$**	**3,967,896**

	(1x $650/trip)		
	Hotel accommodation	$	1,540
	(2x7 daysx $110/day)		
	Expert/Training fee	$	7,700
	(2x7 daysx $550/day)		
5)	Consultancy fee for materials chemistry, measurement and software		
	(1 expert 1 week on site at three different times)		
	Round trip tickets Istanbul/Europe	$	1,950
	(3x $650/trip)		
	Hotel accommodation	$	2,310
	(3x7 daysx $110/day)		
	Expert/Training fee	$	11,550
	(3x7 daysx $550/day)		
6)	One training expert for one week at PEG to train 76 service technicians		
	Travel expense	$	650
	(1 tripx $650/trip)		
	Hotel accommodation	$	770
	(7 daysx $110/day)		
	Expert training fees	$	3,850
	(7 daysx $550/day)		
	Accommodation, meals and travel expenses for 76 technicians	$	6,080
	(1x76x $80/day)		
7)	Out of country travel for consulting and training for one project leader and five engineers		
	Travel expense	$	5,200
	(8 tripsx $650/trip)		
	Hotel accommodation	$	8,800
	(8x10 daysx $110/day)		
	Other expenses (conference fee etc...)	$	8,000
	(8x $1000/trip)		
Sub-total		$	**120,230**

H. Personnel Requirements

1)	one project leader	$	35,000
2)	Five project engineers	$	90,000
	(5x $18,000)		
3)	Three technicians	$	33,000
	(3x $11,000)		
Sub-total		$	**158,000**

E. Refrigeration Service

1)	Reclamation unit for CFC-12	$	36,600
2)	Mobile recovery unit for CFC-12 (76)	$	93,170
3)	Mobile evacuation and charging board for HFC-134a (76)	$	40,070
4)	Mobile leak detector for HFC-134a (76)	$	13,000
Sub-total		**$**	**182,840**

F. Prototyping and Testing

1)	Preparation of non-CFC refrigerator prototypes for testing (23 models, 5 sets per model=115 sets x $500/set)	$	57,500
Sub-total		**$**	**57,500**

G. Technical Assistance and Training

1)	Installation of refrigerant charging units and training 2 engineers for 8 days, 1 engineer for 10 days	$	41,400
2)	Consultancy fee for refrigeration technology including R&D design and testing (1 expert 2 weeks on site)		
	Round trip tickets Istanbul/Europe (1x $650/trip)	$	650
	Hotel accommodation (2x7 daysx $110/day)	$	1,540
	Expert/Training fee (2x7 daysx $550/day)	$	7,700
3)	Consultancy fee for compressor technology including R&D design and testing (1 expert 2 weeks on site)		
	Round trip tickets Istanbul/Europe (1x $650/trip)	$	650
	Hotel accommodation (2x7 daysx $110/day)	$	1,540
	Expert/Training fee (2x7 daysx $550/day)	$	7,700
4)	Consultancy fee for foam technology (1 expert 2 weeks on site)		
	Round trip tickets Istanbul/Europe	$	650

5) Dosing unit suitable for cyclopentane including:

- Dosing group of 100 gr/min
- Tanks (2)
- Mixheads (2)
- Cooling system
- Control panel

6) Door foaming plant including:

- Heated mould-carrier (6)
- Handling/rotating frame
- Control panel
- Hydraulic pack
- Mixing head carriage

7) Fixtures (2)

Sub-total	$	523,165
Sub-total	**$**	**927,200**

C. Safety Equipment for Cyclopentane

Production lines

1) Stoking plant, electrical equipment, ground setting
2) Storage tank
3) Automatic safety system
4) Gas detection plant
5) Ventilation

Sub-total	$	269,166
Testing station		
1) Safety equipment	$	7,564
Sub-total	**$**	**276,730**

D. Compressor System

1) Compressor piston die	$	48.046
2) Length measuring instrument	$	18,578
3) Gauges to check compressor components	$	60,858
4) Oil charging and drying unit	$	77,447
5) Compressor calorimeter equipment	$	8,065
Sub-total	**$**	**212,994**

ANNEX I

BREAKDOWN OF INVESTMENT COSTS

Estimated Costs in US Dollars

Phase I

A. Refrigeration system

1)	Charging and evacuating station for HFC-134a (5)	$	179,736
2)	Refrigerant supply pump	$	9,800
3)	Industrial leak detector for HFC-134a (3)	$	86,460
4)	Recycling unit for CFC-12	$	11,280
5)	Vacuum pumps (9)	$	63,590
6)	Helium leak detection systems including charging and recovery stations (6)	$	465,572
7)	Refrigerator computerized performance testing system (3)	$	1,112,850
8)	Electrical safety tester (3)	$	34,660
9)	Testing room	$	62,814
10)	Recycling unit for HFC-134a	$	5,640
Sub-total		$	**2,032,402**

B. Foam Insulation System

1) Retrofit of cabinet foaming unit including:

- Multi-Easyfroth system
- Polyol jacketed 330 liters blend tank
- Polyol blend metering system

2) Retrofit of door foaming unit including:

- Multi-Easyfroth system
- Polyol jacketed 330 liters blend tank
- Polyol blend metering system

Sub-total	$	330,918

3) Retrofit of injection foaming machine for testing cyclopentane including:

- Mixing heads
- Hydraulic unit
- Control panel

4) Rebuilding of foaming jig

Sub-total	$	73,117

This project will phase out 90 MT/year of CFC-12 and 200 MT/year of CFC-11 from PEG's manufacturing process after full-scale production of CFC-free refrigerators begins in 1996. In total, approximately 290 ODP-weighted MT of ODP per year will be eliminated.

Indirect Project Impacts

This project will have no impacts on the performance and product quality of PEG's refrigerators.

ENTERPRISE COMMITMENT:

TDF has confirmed with executives of PEG that the enterprise is committed to undertaking the project described above provided that funds are approved and available as scheduled.

Procurement

PEG will be responsible for ensuring that procurement under the Projects follow the agreed guidelines. The enterprise will, with assistance from technical consultants provided for in the grant, arrange procurement (international and local) for the packages in the subproject. Bidding documents will be prepared based on model bidding documents acceptable to the World Bank (e.g. sample Bank bidding documents). Draft Procurement Guidelines will be prepared. The TDF will review compliance with the agreed procedures.

Disbursement

a) Between the World Bank and TDF: The World Bank has already established a revolving fund with the TDF under Turkey's first ODS project. The minimum amount for replenishment of the revolving account is US$50,000, provided funds are approved by the Montreal Protocol Executive Committee and transferred to the OTF. Requests for replenishment for contracts with a value of to US$50,000 each are based on Statement of Expenditures (SOEs). Terms, conditions, and schedule for disbursement, consistent with those established under the first ODS project in Turkey, will be included in the subgrant agreement. The OTF funds would be disbursed against (a) 100% of cif cost of imported goods or ex-factory cost of domestically manufactured goods; and (b) 100% of the cost of technical assistance for training and consultancy services, including technology transfer.

b) Between TDF and the Subproject proponent: Up to US$50,000 per contract, the TDF will disburse to the subproject proponent for eligible expenses without prior review by the World Bank. Disbursement will follow the guidelines established in the Disbursement Handbook published by the World Bank in 1992. Details of the disbursement procedures will be included in a Disbursement Letter to be issued by the World Bank to the TDF.

c) Disbursement for operating costs: For large projects (Over US$ 0.5 million) with a large share (proposed minimum threshold: over 50%) of grant funding for operating costs (as opposed to investment costs), the TDF should proposes a disbursement plan in two or more tranches. Release of the tranches would be based on receipt of progress reports satisfactory to the TDF.

Audits

TDF will have an annual audit report prepared by an independent auditor acceptable to the World Bank. The audit report, including a separate opinion on SOEs used as a basis for disbursement, would be submitted to World Bank within four months of the end of the TDF's fiscal year.

REQUIRED REGULATORY ACTIONS

No regulatory actions, other than routine permitting, are required to implement his project. Under existing agreement with the World Bank, equipment and machinery imported as part of this project will be exempt from import duties levied by the Turkish government.

RESULTS

Direct Project Impacts

Because the project entails an initial investment followed by a net annual incremental operating cost, there will be a net outflow of cash each year for the project's entire economic life. The FRR for the project is thus undefined.

FINANCIAL STATUS OF ENTERPRISE

Based on a review of the company's annual reports, the financial status of this enterprise appears to be sound and satisfactory for the purposes of the proposed activities.

FINANCING PLAN

To be completed by the World Bank during appraisal mission tentatively scheduled for early December 1994..

PROJECT IMPLEMENTATION

Management

TDF will oversee the successful implementation of this project. The project will be carried out at PEG Profilo Elektrikli Gerecler Sanayii A.S.

Schedule

TASK	1994	1995	1996
Phase I: Model Development, Technical Assistance	xxxx		
Testing of Prototypes	xxxx		
Procurement and Installation of Refrigeration and Foaming Equipment	xxx		
Training	xx	x	
Production Trials	x		
Phase II: Mix Production of CFC and Non-CFC Refrigerators		xxxx	
Full Production of Non-CFC Refrigerators			x

Note: x = one quarter of the year

Total Project Cost

As described below and presented in detail in the relevant annexes, the total project cost is U.S.$6,731,532. Because there are no non-ODS investment costs associated with this project, the total project cost equals the ODS reduction portion of the overall project. This project will not provide PEG Profilo Elektrikli Gerecler Sanayii A.S. with any incremental revenues.

Investment Cost

As detailed in Annex 1, the total investment cost for this project is US$3,96[illegible].896. Major components of the costs include costs associated with CFC-free refrigerator product development, technical assistance, testing and training.

Operating Costs

If the project is implemented, the annual incremental operating cost will be $3.040.000. Given an equipment life time of 10 years and a discount rate of 10 percent, the net present value of the first year of incremental operating cost is US$2,763,636. A detailed breakdown of operating costs is provided in Annex 2.

Funds to cover the incremental costs of the proposed activities are not included in the present grant request, but will be requested on an annual basis, after they have been incurred by the enterprise.

Unit Abatement Cost (UAC)

As shown in Annex 3, the UAC for this project is US$ 2.27 per ODP-weighted kilogram of ODS phased out per year (capital costs only), or U.S.$12.75 with estimated incremental costs included. This number is derived from annualized incremental capital costs of $657,406, a first-year incremental operating cost of $3,040,000, and savings of 290 MT (weighted) of ODS per year.

Proposed OTF Grant

The proposed OTF grant for PEG is US$3,650,464 and was calculated as follows: the total investment cost was multiplied by the percentage of Turkish ownership (80 percent). This figure was increased by a 15 percent contingency to yield the grant amount. The total investment cost, the present value of the incremental operating cost, and the estimated total project cost before contingency for this project are listed above. As noted above, funds to cover the incremental costs of the proposed activities are not included in the present grant request but will be requested on an annual basis, after they have been incurred by the enterprise The 15 percent contingency is needed to ensure that the implementing enterprise still receives adequate compensation in cases in which the actual cost of items listed in this proposal exceeds their projected cost. As contingency funds would only be used for this purpose, including them in the total OTF grant would not necessarily increase the actual cost of the project.

FINANCIAL AND ECONOMIC ANALYSIS

Economic Internal Rate of Return (ERR)

Because the project entails an initial investment followed by a net annual incremental operating cost, there will be a net outflow of cash each year for the project's entire economic life. The ERR for the project is thus undefined.

Financial Internal Rate of Return (FRR)

- New gauges and length measuring instruments used to check compressor components will be purchased as the existing ones can not be used anymore.

- An oil charging unit with a dryer will be installed, as the old unit is not suitable for ester oil.

4- Refrigeration Service

- A set of one recovery equipment for CFC-12, one leak detector for HFC-134a and one mobile evacuation and charging board for HFC-134a will be supplied to each of the 76 regional service outlets of PEG.

- A reclamation unit will be purchased and installed in a central location where the CFC-12 collected from the regional service centers will be cleaned and sent back.

Price quotations on some of the items listed in Annex 1 of the proposal can be found in Annex 5.

JUSTIFICATION FOR SELECTION OF ALTERNATIVE TECHNOLOGY

HFC-134a has been accepted worldwide as the best replacement to CFC-12 in household refrigerators because of its good thermodynamic properties (similar to CFC-12), zero ODP, and non-flammability. PEG produces the majority of its compressors based on a design from AEG of Germany. PEG also imports a number of compressors mainly for its export market. PEG has designed a new compressor model suitable for HFC-134a and is currently conducting extensive testing. PEG has indicated that it will start mass producing the new compressor models by the end of 1994.

Many different alternative blowing agents to CFC-11 are being developed such as HCFC-141b, HCFC-22, HCFC-22/HCFC-142b and HFC-134a. PEG has decided to use cyclopentane as its new blowing agent for the following reasons:

- AEG Hausgerate AG of Germany, PEG's joint venture partner, is already using cyclopentane as the blowing agent in its domestic refrigerators.
- Cyclopentane has a suitable boiling point and thermal conductivity.
- Cyclopentane has a zero ODP and a negligible GWP.
- Cyclopentane is available at competitive prices.

PEG will rely on AEG Impianti of Italy for the design and installation of the complete cyclopentane system to ensure a safe and effective transfer of technology.

PROJECT COSTS[5]

[5] Unless otherwise noted, all costs in this section are economic, rather than financial costs. As such, OTF financing is not reflected.

- The existing leak detectors will be replaced by ones suitable for HFC-134a.

- Three helium leak detection systems, including charging and recovery stations, will be acquired to check HFC-134a refrigerators for potential leaks prior to evacuation. Because helium has a small molecular size, its use is particularly helpful in detecting very small leaks which are likely to occur in the new refrigeration circuit due to the tendency of HFC-134a to leak more easily through smaller openings than CFC-12.

- Nine vacuum pumps will be purchased to replace old ones not suitable for HFC-134a systems. This replacement is necessary as the old pumps cannot be retrofitted (to make them compatible with ester oil and to achieve deeper vacuum levels in the refrigeration circuit) at a competitive cost.

- Three computerized performance line testers will be installed on three production lines to verify that the refrigerators are performing as required. This equipment will very accurately measure, record and store performance parameters such as temperatures and running times, and will automatically detect malfunctioning units. The acquisition of this equipment is needed to improve quality control on CFC-free refrigerators and to help bring the quality of HFC-134a units to a level similar to the one achieved with CFC-12 technology.

- A testing room will be purchased and installed to conduct performance tests on HFC-134a refrigerators. This testing room, in addition to three others already installed, will be used to test 115 samples (five samples for each model). These testing chambers are necessary to accurately analyze the new refrigerators and optimize the cooling system for the application of HFC-134a.

- Two recovery and recycling units, one for HFC-134a and one for CFC-12, will be purchased and installed in the factory to service refrigerators that need repairs on site.

2- Foaming System

- The actual cabinet foaming unit has been retrofitted to fulfill all the necessary safety requirements for cyclopentane. This includes a Multi-EasyFroth system and a pre-mixing station with a metering unit.

- A door foaming unit was purchased and an existing one was retrofitted (as described above) for cyclopentane.

- To conduct tests with the new blowing agent, an old high pressure injection machine and its accessories was modified to handle cyclopentane.

- A cabinet foaming jig used to test cyclopentane was rebuilt to be explosion-proof by eliminating the electrical heating system and replacing it with a water heating system.

- Because of the high flammability of cyclopentane, a complete safety system was installed. This consisted of gas sensors, alarms and a ventilation system in the foaming area.

- All the machinery and the equipment in the foaming area were grounded to prevent potential fires.

- An underground storage tank for cyclopentane will be designed, built and installed according to standard safety measures.

3- Compressor System

- Because of the differences in thermodynamic properties between HFC-134a and CFC-12, the new compressors need sightly larger pistons to compensate for the loss in capacity.

and training. The second phase will allow for the progressive elimination of CFC-12 and CFC-11 through actual production of CFC-free refrigerators.

PEG started investigating the use of HFC-134a in its refrigerators in 1992. Through technical assistance from a number of companies including its joint venture partner AEG of Germany, PEG was successful in developing a new line of refrigerators and compressors suitable for the alternative refrigerant. To develop reliable CFC-free refrigerators and compressors, and in order to minimize the risks associated with the conversion process, PEG received technical assistance for the following :

- Redesign of the different refrigerator and compressor models
- Construction, prototype manufacturing, short and long-term testing of the refrigerators and compressors
- Training on manufacturing, maintenance and quality control

PEG has already made a large investment in machinery and equipment as it plans to start the production of non-CFC refrigerators by early 1995. For instance, most of the foaming equipment has already been purchased and is being installed at the factory to be ready for production trials by the end of 1994. Similarly, the compressor facility is being retooled to accommodate the design changes made in HFC-134a compressors and new piston dies have already been manufactured.

Because of the relatively high consumption of CFC-12 during servicing, PEG plans during phase I to equip its main regional service centers with recovery equipment. In addition, PEG will provide training to the technicians in these service centers on service procedures.

PEG will install, in phase I, all the necessary equipment for the use of cyclopentane. To ensure a safe and effective transfer to cyclopentane technology, PEG will seek technical assistance from AEG Impianti of Italy, a company which specializes in the design and installation of cyclopentane systems. As part of the agreement with PEG, AEG Impianti will do the following (a description of the equipment supplied by AEG Impianti can be found in Annex 5):

- Design the complete cyclopentane system including storage tank, piping, safety and alarm systems
- Supervise the installation of the entire cyclopentane system
- Provide extensive training on safety issues

The second phase of the project will consist of finalizing the transition to CFC-free technology for mass production. During this transition time, both CFC and non-CFC refrigerators will be produced. Phase II will enable PEG's personnel to get more acquainted with the new equipment and will fine-tune the production lines, resulting in better quality products.

As part of the conversion process to non-CFC technology the following equipment needs to be replaced, purchased or modified:

1- Refrigeration System

- To protect the refrigeration system against chlorine contamination, five existing evacuation and charging boards will be replaced by boards compatible with HFC-134a.

Commercial freezers and coolers are produced mainly by two companies: Klimasan and Ugur with a domestic market share of 90%. The rest is produced by numerous local shops and manufacturers throughout Turkey with very limited production capabilities. Because commercial freezers and coolers are principally used in the food and beverage industry, it is estimated that the market for such appliances will grow at a rate of 6.5% for the next coming years.

The average charge of CFC-12 in refrigerators, freezers and coolers manufactured in Turkey is around 0.2 kg. An additional 0.4 to 0.6 kg of CFC-11 is used in making the rigid polyurethane foam in the cabinet. Most of the refrigerator manufacturers in Turkey have already started using 50 percent CFC-11 reduced PU foams formulations. Most refrigerators, freezers and coolers produced for the domestic market are equipped with compressors manufactured in Turkey by TEE (Arcelik) except for PEG Profilo which manufactures most of its own compressors based on a design from AEG Germany. TEE produced over 1,000,000 compressors in 1993 and licenses its technology from Tecumseh U.S.A. A number of compressors are also imported from various manufacturers including Embraco, Danfos, Nicchi, Electrolux and Matsushita, mainly for appliances that are exported to Europe and the U.S.

ENTERPRISE BACKGROUND

PEG Profilo Elektrikli Gerecler Sanayii A.S. is located in Cerkezkoy at approximately 100 km west of Istanbul, Turkey. Eighty percent of the company is Turkish owned while the rest is owned by AEG Hausgerate AG of Germany. PEG employs 830 people in its household refrigerator factory and its revenues in 1993 were approximately US$323 million.

PEG was established in 1953. It produced its first domestic refrigerator in 1961 and moved to its current location in 1975. PEG licenses part of its technology from AEG Hausgerate AG of Germany. However, this licensing agreement will not be renewed for the new CFC-free refrigerator models. In 1993, PEG produced approximately 400,000 refrigerators comprising twenty three different models that can be categorized as follows: twelve single-door models, five two-doors models, five no-frost models and one deep freezer model. About 20 percent of PEG's refrigerator production is exported to several countries, including Canada, Spain, France and the U.S. The rest is sold domestically and represent a market share of about 40 percent. The Cerkezkoy plant has five production lines with a total capacity of 750,000 sets a year. PEG expects to reach its maximum capacity by 1996.

PEG produces its own compressors based on a design from AEG of Germany. In 1993 the production reached 400,000 units comprising three different size models: 1/8, 1/6 and 1/5 horsepower. During the same year PEG imported about 80,000 compressors from a number of manufacturers including Necchi, Sumsung and Embraco. The majority of these compressors were mounted on refrigerators intended for the export market.

PEG plans to eliminate the use of CFCs by the beginning of 1996. In 1993, the company consumed 90 MT of CFC-12 and 200 MT of CFC-11. The average CFC-12 charge size in refrigerators is 0.2 kg. PEG has been using 50 percent CFC-11 reduction formulation in its foam since 1992 and uses about 0.5 kg of CFC-11 per set.

PROJECT DESCRIPTION

This project has two main parts. In the first part, PEG Profilo Elektrikli Gerecler Sanayii A.S. will eliminate the use of CFC-12 and CFC-11 in household refrigerators by converting its manufacturing facility to one that is compatible with HFC-134a and cyclopentane, the new refrigerant and foam blowing agent respectively. In the second part of the project, PEG will modify its compressor production facility to account for the differences in the design of the new HCF-134a compressors.

The project will be realized in two phases. The first phase of the project will provide for the acquisition of the new technology, the procurement and installation of the necessary machinery and equipment, engineering assistance

PROJECT SUMMARY

This project will phase out chlorofluorocarbons (CFCs) used in household refrigerators manufactured at PEG Profilo Elektrikli Gerecler Sanayii A.S. in Turkey. The project will comprise two phases and will convert the production lines to household refrigerators using HFC-134a and cyclopentane as the new refrigerant and foam blowing agent respectively. In addition, the project will also transform the compressor production facility so that HFC-134a compressors could be manufactured. This first phase will provide for product development using CFC alternatives and will identify all equipment and process changes needed to implement the alternative technology. It will also implement refrigerant recovery and recycling practices for the refrigerators being serviced at PEG service centers. During this phase of the project, PEG will seek engineering assistance and training from various companies including its joint venture partner AEG Hausgerate AG of Germany. In phase II, PEG will gradually eliminate CFCs by producing non-CFC refrigerators. The project will result in the elimination of 90 MT/year of CFC-12 refrigerant) and 200 MT/year of CFC-11 (foam blowing agent) after the conversion is completed.

PROJECT OBJECTIVE

This project has two main objectives:

a) to phase out the use of ozone depleting substances in the production of household refrigerators at PEG Profilo Elektrikli Gerecler Sanayii A.S. This part of the project provides for the purchase of equipment, the transfer of technology, and the training necessary to facilitate an effective transition to HFC-134a and cyclopentane as the new refrigerant and blowing agent in polyurethane insulation foam respectively.

b) to modify the compressor production facility so that HFC-134a compressors could be manufactured.

SECTOR BACKGROUND

The consumption of chlorofluorocarbons (CFCs) in the refrigeration and foam industries has been estimated in 1993 at approximately 2359 MT representing 75 percent of the country's consumption of CFCs. Of the sector's total estimate use of CFCs, domestic and commercial refrigeration appliances accounted for 714 MT of CFC-12[3]. In addition, it is estimated that 1100 MT of CFC-11[4] were used in the production of polyurethane (PU) appliance insulation foam.

The production of household refrigerators and freezers in Turkey has increased significantly in the last past three years, from about 965,000 units in 1990 to approximately 1.25 million units in 1993. In 1993, 20% of the units produced were exported to a number of countries, including the US, Germany, Great Britain, Italy, and France. There are four major domestic refrigerator manufacturers in Turkey: Arcelik, PEG Profilo, Pekel Teknik and Simtel. Arcelik and PEG Profilo dominate the domestic market with about 95% of market share.

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[3] This number was taken from the 1992 Turkey country program. However, based on the actual production of 1.25 Million appliances produced in Turkey, the consumption of CFC-12 in new appliances can be approximated around 300 MT. In addition, it is estimated that between 250 and 300 MT of CFC-12 is used to service existing appliances in repair shops, bringing the total consumption of CFC-12 in 1993 to nearly 600 MT.

[4] This number was estimated from the 1992 Turkey country program. Nonetheless, given the actual 1993 production of 1.25 Million appliances and considering that most manufacturers have switched to 50% CFC-11 reduction foam formulation, the consumption of CFC-11 in the domestic and commercial refrigeration sector should be approximately 625 MT.

COUNTRY:	Republic of Turkey
PROJECT TITLE:	Engineering Assistance for the Elimination of Ozone Depleting Substances Used in the Production of Household Refrigerators at PEG Profilo Elektrikli Gerecler Sanayii A.S.
SECTOR COVERED:	Household Refrigerators
ODS USE IN SECTOR:	714 MT of CFC-12 in 1993[1] 1645 MT of CFC-11 in 1993[1] Total of 2359 MT (2359 ODP-weighted MT)
PROJECT IMPACT:	Eliminate annual consumption of 90 MT of CFC-12, 200 MT of CFC-11 Total of 290 ODP-weighted MT after production begins
PROJECT DURATION:	Phase I: 6 months Phase II: 12 months
PROJECT ECONOMIC LIFE:	10 years
TOTAL PROJECT COST:	ODS Reduction Investment Cost: US$3,967,896 Incremental Operating Cost[2]: US$2,763,636 Incremental Operating Revenue: US$0 Total ODS Reduction Project Cost: US$6,731,532 Other Project Costs: US$0 Total Project Costs: US$6,731,532 Unit Abatement Costs: Capital Costs Only US$2.27 Capital Costs and Incremental Costs US$12.75
PROPOSED OTF FINANCING:	**US$3,759,978** (including 15 percent contingency and 3 percent Financial Agency Fee). Incremental operating costs are not included in the present grant request, but will be requested after the costs have been incurred by the enterprises, in accordance with prevailing funding criteria.
IMPLEMENTING ENTERPRISE:	PEG Profilo Elektrikli Gerecler Sanayii A.S.
COORDINATING MINISTRY:	Technology Development Foundation of Turkey (TDF) Republic of Turkey
IMPLEMENTING AGENCY:	The World Bank

This proposal has been revised to reflect changes recommended by the OORG reviewers.

[1] Projection given in "Turkey Country Program for Phaseout of ODS", August 1992

[2] Net present value of first year of operating costs/savings. Incremental costs

PEKEL - TURKEY

TECHNOLOGY

The choice of cyclopentane-based technology for this application is now well proven.

ENVIRONMENTAL IMPACT

Cyclopentane has a zero ODP and an almost zero GWP and hence constitutes a long term solution. However, Annex 4 should be modified to reflect that it is a VOC and the enterprise should verify that it will meet any relevant local regulations.

The main area for attention are the safety procedures associated with the flammability of cyclopentane. The reviewer is satisfied that the enterprise is proposing to purchase the necessary equipment and to carry out appropriate training. It has experienced partners in Merloni and OMS Impianti. However, the reviewer requires to view the letter of assurance on safety matters (Annex 5).

PROJECT COSTS

The equipment proposal is necessary and without excessive cost. The additional foam costs of $1.62/unit equate to 10-15% on foam cost. As cyclopentane technology develops - densities are already falling - then this should decrease. Hence, it is recommended that this item is deferred until the time of implementation and is then reexamined.

PROJECT TIMEFRAME

This is acceptable.

RECOMMENDATION

Approved subject to the comments above.

GMFJ/kd/18/10/94

An amount is claimed for two testing rooms ad USD 230,000. It is not clear why two testing rooms are needed. If climate rooms are installed in order to specifically test new HFC-134a units, the issue itself is adequate; it should, however, be better described under "refrigeration system" in the proposal. The amount claimed for testing rooms is considered to be -too- high. It should also be so that the amount claimed for the testing rooms does not lead to increased capacity of model development after the HFC-134a (and cyclopentane) conversion; otherwise only a certain part of the investment should be considered (could be explicitly mentioned in the proposal). Prototype testing is claimed to be USD 25,000; some explanation regarding the number of tests on models is required, which would also give more insight into the need for testing rooms (and their capacity). An amount between USD 90 and 130,000 seems more adequate.

The amount claimed for vacuum pumps is in principle acceptable and comparable per unit to similar proposals; however, it should be considered into more detail in how far replacement of the existing vacuum pumps (1990 vintage) is needed and whether no retrofits are possible (as stated above).
The proposal mentions the instalment of a computerised performance testing system, including leak detection ad USD 0,5 million. In a first instance, the costs claimed for the HFC-134a leak detection units should be put as a separate item. Furthermore, the proposal lacks information why the computerised system is specifically needed for the HFC-134a conversion. It will at least contribute to better manufacturing logistics and it may also involve increased capacity (which part is incremental ?); substantially better information is needed.

The investments in CFC recovery units seem acceptable. More information on the amounts that can be recovered and reclaimed is needed to further consider the investment in a reclamation unit (it would concern logistics and infrastructure -other firms' workshops- information). HFC-134a equipment will be needed in the service workshops; it seems logical to postpone the instalment until there is a real need for HFC-134a servicing.

The costs claimed under technical assistance and training, also where it concerns training of service personnel are acceptable.

Operating costs
Incremental operating costs are acceptable, and are as observed in similar proposals.

Implementation timeframe
The implementation timeframe seems reasonable.

Recommendations
In principle, the HFC-134a conversion itself, as proposed in the project, can be recommended, after that more explanation and/or further changes in the investment costs have been made concerning:
- the need for the investment in vacuum pumps (no retrofits);
- the need for two testing rooms (also taking into account the acceptable amount of testing);
- the need for a computerised performance testing system (which is believed to add to capacity); after that costs for leak detection have been put as a separate issue;
- the set-up of the testing program,

and that more information is provided on the amounts estimated for recovery (and reclaim).

50% of the production of the firm is exported to -mostly- "Western" countries; as to the knowledge of the reviewer, so far no specific provisions for this need to be taken in the proposal.

Kuijpers, LJM
Eindhoven, 19 October 1994

Pekel

Republic of Turkey

REVIEW OF A HFC-134a CONVERSION PROJECT

Manufacture of HFC-134a Appliances at PEKEL Teknik Sanyi Ticaret A.S.

Proposal by The World Bank, October 1994

RTU-UNWB-LK-94537-1k

Scope

The project under review covers the conversion from CFC-12 to HFC-134a in circuits of refrigerators and the conversion from CFC-11 to cyclopentane. Only the HFC-134a part is reviewed here.

Technology

The HFC-134a technology selected is environmentally sound and safe. It is the most cost effective option that can be used at present. The proposal contains a phased approach for the introduction of HFC-134a, as given in OORG recommendations.

There is no direct licensing agreement (with Merloni El. Italy) for the HFC-134a conversion, however, technical assistance is guaranteed from the joint venture partner (Merloni Italy) and other companies (which ?) for the conversion from CFC-12 to HFC-134a. The costs for technical assistance and training (USD 37,000) are acceptable, taking into account that it also involves training of service personnel (however, it should also be taken into account that USD 104,000 is claimed for a project team for the conversion).

Compared to the production level (200,000 pieces), generally, the investment costs need further consideration (see below); it is not clear whether all is specifically needed for the HFC-134a conversion and does not add to manufacturing capacity and quality in general.

Where it concerns trial tests or reliability, the proposal mentions that PEG has received technical assistance for the short and long term testing of prototypes; this cannot be found in the "breakdown of investment costs", however, if it is covered under technical assistance and training, it should be mentioned here. The procedure itself would be acceptable then.

The proposal contains investments for reclamation, mobile recovery of CFC-12 and evacuation and charging of HFC-134a. The proposal mentions that high amounts of CFC-12 are used during servicing (no specific amount); this does not automatically imply that these amounts can be recovered from units that need repairs (refrigerant leaked out, contaminated refrigerant). An estimate of the amount recoverable per workshop would give insight in the efficiency of a recovery unit and the "efficiency" of a central reclamation plant. If it would concern small amounts of refrigerant for reclaim, considerations should be given on infrastructure of service shops in Turkey and possible co-operation with other workshops owned by other companies (as e.g. the companies considered in other proposals, PEG and Klimasan).

The proposal also gives a 53,000 USD amount for HFC-134a leak testing and charging in the service shops. Since the repairs on HFC-134a units will take place after that HFC-134a appliances have been put on the market (1996-1997) and it will concern small amounts in the first years, it is proposed to consider the investments, however, not to invest in service equipment for HFC-134a until they are needed, i.e. after completion of the phase that involves full production.

Environmental impact

The HFC-134a refrigerant proposed has no ODP. Health and safety impacts are minimised.

Project costs

Most of the components seem necessary for the conversion, i.e. the instalment of a charging station, leak detection and vacuum pumps is required; it would, however, be appropriate to consider the retrofit of CFC-12 vacuum units to HFC-134a if they are new enough (the PEKEL plant is less than 5 years old). The amount claimed for the charging system is acceptable.