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

Thirteenth Meeting
Montreal, 25-27 July 1994

PROJECT PROPOSAL: VENEZUELA

PROJECT EVALUATION SHEET

COUNTRY OR REGION:	Venezuela
PROJECT TITLE:	AAISA, Mobile air conditioner (MAC) factory conversion for fabrication of HFC-134a heat exchangers
BUDGET:	US $4,800,000
INCREMENTAL COSTS:	US $4,230,000
ODS PHASE-OUT:	11.3 tonnes CFC-12 (directly) 90.0 tonnes CFC-12 (indirectly)
COST EFFECTIVENESS:	US $7.09/Kg. (Unit abatement cost)
PROJECT DURATION:	2 years
IMPLEMENTING AGENCY:	World Bank
NATIONAL COORDINATING AGENCY :	FONDOIN
TECHNICAL REVIEW COMPLETED:	YES _X_ NO _

SECRETARIAT'S COMMENTS

1. Aire Acondicionado Integral, Sociedad Anónima, AAISA, is a domestic manufacturer of MAC evaporators and condensers, and assemblers of compressors. Total annual production is 40,000 compressors and 35,000 heat exchangers. AAISA produces both complete MAC units (with compressor) and heat exchangers which are marketed separately.

2. AAISA is planning to install new lines for the production of heat exchangers and evaporators compatible with HFC-134a refrigerant for use in MAC units, before scrapping the existing lines. The project consists of retooling of the fabrication line and the related training and technical assistance. Consumption of CFC-12 in AAISA will be reduced from 11.3 tonnes to 0.3 tonnes when new condenser/evaporator lines are installed.

3. A project on the conversion of AAISA's compressor manufacturing line costing US $620,000, was approved at the Eleventh Meeting of the Executive Committee.

4. The Government of Venezuela submitted the project proposal to the Fund Secretariat and the World Bank. The World Bank evaluated the proposal in terms of the technology used and the costs associated. A technical review prepared by the World Bank was provided.

5. The Secretariat engaged a sector expert to assess cost items required for the conversion. The expert's report indicated that since the CFC-12 evaporator can be used with HFC-134a refrigerant, the existing equipment and tools in AAISA could be used to produce evaporators for HFC-134a MAC units. Evaporator changes that have been introduced are technological advances, applicable to either refrigerant. Thus, equipment, tools and training costs related to the production of evaporators should not be considered incremental.

6. The World Bank's consultant, however, considers that all the changes for both the condenser and evaporator, as included in the project proposal, are incremental due to switching from CFC-12 to HFC-134a refrigerant.

7. The report of the expert engaged by the Secretariat and the response from the World Bank are attached to the project document.

8. The variance in the conclusions of the technical reviews by the experts engaged by the Fund Secretariat and the World Bank led to difficulties in identifying and separating the eligible incremental costs due to the implementation of the HFC-134a technology, from those costs related to technological improvements and/or customer requirements.

SECRETARIAT'S RECOMMENDATION

9. The Fund Secretariat recommends that the project should be considered by the sub-committee on project review at its meeting on 24 July 1994.

REPORT OF THE FUND SECRETARIAT'S CONSULTANT

Background

Conversion of the MAC industry from CFC-12 to HFC-134a must be placed in context to understand what basic system modifications are required. For the purpose of the project under review, system component modifications were established by function of the system and identified need. An order of industry priority is listed below:

Compressor

The compressor required the major modifications so it could be operated with HFC-134a. Comparing existing CFC-12 compressors, design changes have ranged from major modifications to minor such as lubricant circuit and material changes. These changes have been capital intensive from testing to new manufacturing processes and tooling.

Condenser

Since HFC-134a requires increased condenser heat transfer capability, during high temperature low speed operation, condenser capacity must be increased by 25 to 30 percent to equal performance of CFC-12 systems. This can be accomplished by increased frontal area of existing designs (if vehicle space permits) or a more efficient exchanger design. The progression of condenser designs has been as follows:

- Copper/tube aluminum fin
- Aluminum tube/aluminum fin
- Aluminum serpentine
- Aluminum parallel flow

Serpentine condensers have been used for many years on CFC-12 systems. Current technology indicates that the parallel flow condenser provides HFC-134a systems with the required heat transfer capability and reduced weight as compared to serpentine condensers (about 50 per cent). In addition, this design helps the automobile manufacturer achieve goals for improved vehicle fuel economy. If latest technology is the prime concern then parallel flow condensers meet this requirement as compared to other condenser construction.

Hose Assemblies

Since HFC-134a is smaller in molecular size as compared to CFC-12 new flexible hose material was developed to reduce emission through the hoses. Several construction methods using Nylon material has accomplished this requirement.

Evaporator

In general no changes have been made to the evaporator when changing the system from CFC-12 to HFC-134a refrigerant. Evaporator changes that have been introduced are technological advances, applicable to either refrigerant. These changes reduce size allowing improved system vehicle packaging requiring less space and improved system air flow. The different types of construction of evaporators are:

- Copper tube/aluminum fin
- Aluminum tube/aluminum fin
- Aluminum serpentine
- Plate fin

General Motors, Ford and other auto companies have used plate fin evaporator construction for many years. While original plate fin designs had two end tanks, current technology has developed a single tank design with multi-pass refrigerant circuits.

Serpentine evaporator construction has also been used for many years, and can be used with CFC-12 or HFC-134a refrigerants. Generally, for equal evaporator performance the plate fin design is smaller and lighter in weight than the serpentine design, which is advantageous for the system designer.

Comments on AAISA project proposal

From the information contained in the project document, the tube and fin products that AAISA is currently producing is of older technology. If they currently supply the vehicle manufacturers listed in the report, they must meet their current specifications.

AAISA plans to use serpentine construction for both condensers and evaporators which limits the use of other technologies. The Nocolock process, which has been dominant in the fabrication of serpentine construction, can also be adapted for use in manufacturing parallel flow condensers that are currently produced by Modine. This process uses the same tube stock with a header and eliminates the need for the condenser tube bending equipment (at a cost of $244,400 plus $17,600 for tools).

This equipment is not adaptable to produce plate fin evaporators which is more commonly used by both U.S. and overseas auto manufacturers. It is therefore necessary to identify the requirements for future designs by their current and future customers. It is also necessary to determine if serpentine construction will continue to meet their customers' requirement or if plate fin evaporators will be required.

The CFC-12 evaporator can be used with HFC-134a refrigerant. Evaporator changes that have been introduced are technological advances, applicable to either refrigerant. Thus, the request to finance the following equipment (with tools and training) for the evaporator production seems not to be eligible (Annex I, Table II):

.	Evaporator qualifier	$88,500	plus $16,500 (tools)
.	Evaporator assy. table, bender	$65,700	$8,800 (tools)
.	Evaporator fin machine	$225,450	$99,550 (tools)

Any other equipment, tools and training associated with the production of evaporators should be identified and removed.

The following equipment indicated in Annex I, Table II, is also applicable to either refrigerant:

.	Parts washer	$45,600	plus $5,000 (delivery)
.	Batch dry oven	$33,775	$6,850 (delivery)
.	Di-water	$15,737	$595 (delivery)
.	Leak test (air under water)	$5,000	$5,000 (delivery)
.	Leak test (mass spectrometer)	$31,862	$2,000 (delivery)

The information in Annex I, Table XI, indicates that GM and Ford products would use serpentine evaporators and condensers. The FAACA information indicates use of plate fin evaporators. The two different types of evaporator construction are not directly interchangeable in the plastic evaporator case, and the refrigerant system control is different. This information needs to be clarified in determining the customer's current and long range need since component configuration between these two suppliers are different and not directly interchangeable.

The product testing for design qualification for product development, at a cost of $162,660 (Annex I, Table IV), has no direct bearing on elimination of CFC usage. This testing is a supplier's normal development and certification process for meeting the customer's engineering requirements.

In addition, there seems to be an indication that requirements to meet new vehicle design specifications (new product tooling costs), which are normal business costs, are included in the proposal. If the intent is to provide only basic manufacturing equipment for reduction of CFC usage, not customer and vehicle product line specifically, then this must be identified.

An additional production line is being requested to support manufacture of both CFC-12 and HFC-134a heat exchangers during the installation of the new line, at a cost of $157,000 to cover the civil works and utilities installation for the new line (Annex I, Table VII). This is not eligible since it represents an increase in the capacity of the plant.

The following two mistakes were found in the project document:

1. The cost of transport of equipment has been estimated in $102,842. However, $132,000 has been included in Table 1 (page 4 of project document). This mistake affects the total project cost and contingency cost.

2. While two leak test equipment (mass spectrometer) were included in the table on equipment cost breakdown (Annex I, Table II), the total equipment cost and total delivery cost accounts only for one unit.

WORLD BANK TECHNICAL REVIEW

PROJECT NAME: AAISA (Aires Acondicionados Integral, Sociedad Anonima). Automobile Air Conditioner (MACS) Factory Conversion for Fabrication of HFC-134a Heat Exchangers.

SUBJECT: Venezuela: Montreal Protocol / AAISA Heat Exchanger Fabrication Line Conversion Project for OORG Technical Opinion.

1. RECOMMENDATION: The proposal appears to be sound and consistent with the objectives of the Montreal Protocol Ozone Projects Trust Fund. Approval is recommended, without informed consideration by the writer of item seven below.

2. RELEVANCE AND ADEQUACY OF INFORMATION PROVIDED: The information, along with the proposal "Montreal Protocol/AAISA MACS Compressor Assembly Project OORG Technical Opinion" appears to define the project and the anticipated expenses adequately.

3. TECHNICAL SOUNDNESS: This proposal identifies the technical support sources and their anticipated costs. The sources identified are believed to be competent.

4. LESSONS FROM EXPERIENCE: It is believed that this program will enhance the program already approved at FAACA by providing both technical and economic competition.

5. ENVIRONMENTAL ISSUES: The proposal appears to cover all environmental issues and provides for local control of regulated issues. Although it was not referred to in the proposal it is strongly recommended that the component identification and interchangeability considerations be identified clearly for the product user to avoid cross contamination of the MACS systems (as S.A.E. has done for the U.S. market).

6. SAFETY ISSUES: The extensive training budget should cover all unique safety considerations.

7. COST EFFECTIVENESS: The cost of $7.09/ kg. /yr. seems expensive, however the total economic impact is beyond the scope of this review in the time available. It should be considered by those having more understanding of the consequences and alternatives with consideration for the comments in item four above.

R R Proctor

27 May 1994

THE WORLD BANK/IFC/M.I.G.A.

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FACSIMILE COVER SHEET AND MESSAGE

DATE: June 28, 1994 NO. OF PAGES: 3 (including this sheet) MESSAGE NUMBER: \

TO
Name: Dr. Omar El-Arini
Organization: Chief Officer/ Multilateral Fund
Fax Tel. No. 514-282-0068
City: Montreal
Country: Canada

FROM
Name: Bill H. Rahill
Dept./Div. ENVGC
Room No. S-2118
Fax Tel. No. 202-522-3258
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SUBJECT: AAISA Heat Exchanger Project

MESSAGE:

Dr. El-Arini,

With reference to your Fax of 23 June 1994, concerning the AAISA heat exchanger project, we have consulted with the Bank's technical engineering consultant and with FONDOIN - the Venezuelan Foundation to Implement the Montreal Protocol, and we are pleased to provide you with the following information concerning the issues and questions raised by the Secretariat's external consultant.

Comments on AAISA project proposal: The opinion regarding inclusion of the evaporator line, while correct with respect to current CFC-12 fabrication capability, implies a customer base with static specific customer requirements. The need for AAISA to change to serpentine designs is being driven by specific customer requirements for the new HFC-134a heat exchangers. This change would not have occurred had the new HFC-134a technology not been required. Paragraph by paragraph responses to the Secretariat's comments are stated below:

Responses to paragraphs in page 3 of 4 of Fax from Secretariat

Para. 1: Agree that AAISA's current tube and fin products are of older technology. Also agree that AAISA's product line meets current specifications of customers.

Para. 2: Correct to note that AAISA plans to use serpentine construction for both condensers and evaporators and that selection of serpentine construction is a corporate decision not to use other technologies. However, it should be noted that all of AAISA's customers (except for one which has delayed this requirement for one year) have made internal decisions not to use plate and fin type construction for the new HFC-134a heat exchangers, and have informed AAISA accordingly. Agree with sentence two that the NOCOLOCK process has been dominant in the fabrication of serpentine construction and that it can also be adapted for use in manufacture of parallel flow condensers currently produced by Modine. Also agree that the process uses the same tube stock with a header and this would eliminate the need for the condenser tube bending equipment if AAISA were to use the parallel flow rather than serpentine construction.

Para. 3: Agree that equipment for serpentine construction is not adaptable to produce plate fin evaporators, and that identification of requirements for future designs by current and future customers is necessary. The Bank's technical engineering consultant is confident that, all things being equal, the serpentine construction will continue to meet AAISA's customers requirements and that plate fin evaporators will not be required. Serpentine construction is expected to be perfectly adequate for at least 6 years.

Para. 4: Specific customer requirements have been conveyed to AAISA, and verified independently, which call for completely new evaporator construction. AAISA has carefully studied its options and determined that serpentine construction will be the most viable given its short and long-term customer requirements and cost effectiveness. In addition, AAISA is confident about its current engineering and management expertise for manufacture of a serpentine design manufacturing process, as opposed to the plate and fin type process. Basing OTF eligibility on narrow scope for conversion could lead to the loss of AAISA's customer base which would have devastating results on the firm.

Responses to paragraphs in page 4 of 4 of Fax from Secretariat

Para. 5: Same response as given in para. 4.

Para. 6: Same response as given in para. 4.

Para. 7: Correct to note that Annex I, Table XI indicates the GM and Ford products would use serpentine evaporators and condensers. Also correct in noting that FAACA will use plate and fin construction for evaporators, and that "plate and fin" and "serpentine" types of evaporator construction are not directly interchangeable in the plastic evaporator case, and that the refrigerant system control is different. The Bank's engineering technology consultant concurs with Secretariat's external consultant observation that the different component configuration between the two suppliers (AAISA and FAACA) are not interchangeable, and therefore information on interchangeability and refrigerant system control has to be clarified in determining the current and long range needs of the customers. Both AAISA and FAACA have done so.

Para. 8: The project was prepared using interpretation that design qualification the first time through is a necessary part of the changeover, and that subsequently to initial qualification, it is a necessary business expense of the supplier. The allowed costs are lower than the total cost of design qualification because only 33% of cost of calorimeter testing was allowed in the pricing of the project.

Para 9.: Also subject to interpretation, as implied in sentence 2. Preparation of project was conducted on basis of existing customer base and specific customer requirements. Would apply same justification noted in para. 4., reiterating the eligibility of OTF funds to prevent de-industrialization.

Para. 10: If observation is that an additional production line is being requested to support manufacture of both CFC-12 and HFC-134a heat exchangers, observation is incorrect. The project requests a new HFC-134a line and during project implementation product will be imported in order to enable AAISA to maintain its customer base through transition period. The US$157,000 requested for civil works and utilities is for installation of part of the new line because AAISA's existing facilities cannot house the new line. The HFC-134a line is of a comparable production capability as the existing CFC-12 line. Both can increase capacity by increasing number of 8 hour shifts. The replacement line has been carefully screened in order to prevent stepping up to a different level of commercial scale capacity.

Mistakes Found in the Project Document:

1. Observation is incorrect. Transportation costs to POE (Port of Entry) and from POE total US$132,000. Annex I, Table I shows breakdown of costs for transportation as follows:

• Shipping Cost to POE Venezuela:	US$102,848
• Shipping/Handling of Equipment/Tools from POE to AAISA:	29,495
	US$132,343

2. Observation is correct. Will revise and adjust all figures downwards by US$32,000.

C. Conclusion

The requested amount is therefore reduced by US$32,000 to US$4.2 million.

.cc and cw Rhatigan (LA1IE)

.cc Sr. Eduardo Lopez (FONDOIN)
Batista (LA1IE), Oxman (ENVGC)

Caracas, 31 de mayo de 1994

Apreciado Dr. El-Arini:

Tengo el agrado de dirigirme a usted en la oportunidad de remitirle el proyecto denominado **Conversión de una planta de aires acondicionados automotores para la fabricación de intercambiadores de calor compatibles con HFC-134a,** a los fines de su revisión por la Secretaría a su cargo y su consideración por el Comité Ejecutivo del Fondo Multilateral para la Aplicación del Protocolo de Montreal (FMAPM).

Le informo, igualmente, que el Banco Mundial, agencia ejecutora designada por FONDOIN para este proyecto, ha concluido la evaluación del mismo, la cual será consignada en breve.

FONDOIN, por su parte, revisó el proyecto desde el punto de vista de su elegibilidad y de los costos adicionales, encontrando que calificaría para un subsidio del FMPAM. En consecuencia, la Junta Directiva de FONDOIN me autorizó para que presentase oficialmente el proyecto para la consideración del Comité Ejecutivo del FMAPM en su próxima reunión, a efectuarse entre el 25 y 27 de julio de 1994.

Mucho le agradecería, en consecuencia, disponga lo conducente para que la presente comunicación oficial, así como el documento del proyecto, el sumario, sus anexos y recomendaciones a ser consignados por el Banco Mundial, lo mismo que las recomendaciones de esa Secretaría sean presentados al Comité Ejecutivo del FMAPM en la oportunidad señalada.

Aprovecho, Dr. El-Arini, para reiterarle las seguridades de mi mayor consideración.

Atentamente,

Dr. Eduardo López
Presidente de FONDOIN
Representante de Venezuela en el
Comité Ejecutivo del FMAPM

Al Señor Doctor
Omar El-Arini
Director de la Secretaría del
Fondo Multilateral para la Aplicción del
Protocolo de Montreal
Montreal, Canadá

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

COUNTRY:	Republic of Venezuela
PROJECT NAME:	AAISA (Aire Acondicionado Integral, Sociedad Anonima). Automobile Air Conditioner (MAC) Factory Conversion for Fabrication of HFC-134a Heat Exchangers.
SECTORS COVERED:	Automobile Air Conditioning
ODS CONSUMPTION IN AFFECTED SECTORS:	Estimated annual CFC-12 Consumption in Automobile Air Conditioners: New: 80 tons; Aftermarket Service: 900 tons.
PROJECT IMPACT:	Direct Impact 11 tons/yr in Related Compressor Project: Indirect Elimination - Approximately 75-90 tons/yr in 30 - 35,000 units annual production.
PROJECT DURATION:	24 months for implementation.
TOTAL PROJECT COST:	US$4.8 million including 10% contingency.
PROPOSED ODS GRANT:	US$4.23 million including 10% contingency
COST EFFECTIVENESS:	Unit Abatement Costs: US$7.09/kg ODS eliminated/yr (Basis: 35,000 MACs annual production.)
IMPLEMENTING AGENCY:	World Bank
COORDINATING NAT. AGENCIES:	FONDOIN
BENEFICIARIES:	AAISA, a Venezuelan private enterprise

PROJECT SUMMARY

Please Refer to attached Executive Project Summary

Note: For purposes of implementation, the Bank will implement the AAISA Compressor Assembly Line conversion (US$620,000 approved in October 1993) and the proposed Heat Exchanger project as one common project.

CURRENCY EQUIVALENTS

Currency Unit = Venezuelan Bolivar (BS)
US$1.00 = 155.5 Bs (Exchange rate as of June 6, 1994)

UNITS AND MEASURES

metric ton - Ton (T) = 1,000 kg.

ACRONYMS

AAC	:	Automobile Air Conditioning
AC	:	Air Conditioning
CCl_4	:	Carbon Tetrachloride, a controlled ODS
CFCs	:	Chlorofluorocarbons
COROVEN	:	Wholly owned AAISA Affiliate
GOV	:	Government of Venezuela
FONDOIN	:	Foundation to Implement Montreal Protocol in Venezuela
HCFC	:	Hydrochlorofluorocarbon
HFC	:	Hydrofluorocarbon
MAC	:	Mobile Air Conditioner
MCF	:	Methyl Chloroform, a controlled ODS
MFEC	:	Multilateral Fund Executive Committee
MFMP	:	Multilateral Fund for the Implementation of the Montreal Protocol
OTF	:	Ozone Projects Trust Fund
ODS	:	Ozone Depleting Substances
OORG	:	Ozone Operations Resource Group
POE	:	Port of Entry
USEPA	:	United States Environmental Protection Agency

FISCAL YEAR

January 1 - December 31

MONTREAL PROTOCOL (MP) PROJECT FOR VENEZUELA

INITIAL EXECUTIVE PROJECT SUMMARY

COUNTRY:	Republic of Venezuela
PROJECT NAME:	AAISA: Automobile Air Conditioner (MAC) Factory Conversion for Fabrication of HFC-134a Compatible Heat Exchangers.
ASSOCIATED BANK PROJECT:	The MFEC has approved US$620,000 for a Factory Conversion for Assembly of HFC-134a Compatible Compressors
BORROWER:	None. Montreal Protocol Ozone Trust Fund (OTF) Grant to private enterprise.
GRANT AMOUNT:	US$4.23 million requested. Total estimated project cost is US$4.8 million.
BENEFICIARIES:	AAISA
TENTATIVE APPRAISAL DATE:	4th Quarter FY '94
RVP APPROVAL DATE:	1st Quarter FY '95
BOARD PRESENTATION DATE:	Not required per modified procedures for GEF and MP projects.
ENVIRONMENTAL CATEGORY:	B

1. Venezuela Ozone Depleting Substance (ODS) Sector Background: Venezuela signed the Montreal Protocol on September 16, 1987, and ratified it on February 6, 1989. As an Article 5 signatory (annual per capita ODS consumption of less than 300 grams), Venezuela is eligible for OTF support. ODSs are produced in six developing nations: Argentina, Brazil, China, India, Mexico, and Venezuela. Total production of CFCs and MCF in these nations in 1989 was approximately 70,000 tons, of which Venezuela's share was 4150 tons, or 6%. MCF consumption in 1991 was 130 tons, down from 570 tons in 1990. All CCl_4 (1350 tons in 1991) is used as a chemical intermediate feed stock. CFC/Halon consumption in Venezuela in 1990 was 3420 tons, but rose to 3820 tons in 1991, still a decrease of 12% since 1986. Distribution by end use in 1991 was MACs 25%; other AC/refrigeration 52%; foaming agents 16%; aerosols 4%; Halon fire extinguisher 1%; and solvents 2%. Of the AC/refrigeration share, an estimated 80% was for aftermarket use for servicing and leak replacement. 1992 consumption in the automobile and truck air conditioner (MAC) sector was estimated at 80 tons for newly assembled cars, and 900 tons for aftermarket use. Per capita annual consumption of CFCs decreased from 270 grams in 1986 to 170 grams in 1990. A breakdown of estimated CFC-12 consumption for 1992 in the AC/refrigeration subsectors and more detailed national data are found in project files under National Production and Consumption Patterns.

2. ODS Phase-Out Strategy for the Mobile Air Conditioner (MAC) Subsector: With more than 75% of Venezuela's CFC consumption currently used

in AC/refrigerator applications, these subsectors are the principal focus of the national ODS phase-out strategy. The MAC subsector alone accounts for 25% of national CFC consumption. Venezuela's eight auto assemblers produced 86,000 units in 1992, and imported another 20,000 units already assembled for local sale. An additional 44,000 assembly units, including trucks were imported directly, for total 1992 sales of 150,000 new units of all types. The total national inventory of registered vehicles in December 1991 was approximately 2,145,000. An estimated 60% of new autos and an unknown percentage of the current national inventory have installed MAC systems. Each currently installed unit has an average charge of 1.1 kg. of CFC-12. Two domestic MAC fabricators (AAISA and FAACA) produce a total of approximately 60-75,000 MAC units annually[1], assembling compressors and fabricating evaporators and condensers, selling to both assemblers and aftermarket distributors. AAISA's market share is estimated to be about one-half of the total. AAISA produces both complete MACs, including compressors and heat exchangers, and also sells components which are marketed separately to auto assemblers and aftermarket installers. 1992 CFC-12 consumption in the MAC sub-sector was estimated at 80 metric tons for testing and charging of systems for newly assembled vehicles, and some 900 tons for aftermarket servicing of all types. Current plans of the auto assemblers for conversion from CFC-12 to HFC-134a refrigerant units call for a transition which will begin as early as August 1993 for one company, with the others beginning during 1994. The total transition for new units to HFC-134a is expected to be complete by end 1995. Aftermarket servicing for CFC-12 units will be required for some time afterward. Nevertheless, almost complete phase-out of CFC-12 consumption in the MAC subsector is attainable by 2000. The AAISA factory evaporator/condenser line conversion project, for which OTF funding is requested, is an integral part of the phase-out strategy, as is the AAISA compressor assembly line conversion project, for which OTF funding has already been approved. The eight auto-assemblers, six of which are 100% foreign owned subsidiaries, will finance their own assembly line conversions, and training of their dealerships for servicing of HFC-134a MAC units. The second MAC fabricator, FAACA, has already received MFEC approval for its own evaporator/condenser line conversion project.

3. Background. AAISA is a diversified company employing 325 people in the fabrication of MACs as well as domestic AC/refrigeration products. The client base for its MAC line of components consists of the major auto assemblers and aftermarket clients. AAISA's evaporator/condenser lines are operated by AAISA itself, while the MAC compressor assembly line is owned and operated by COROVEN, one of the companies in the AAISA group. The last decade has been a period of steady growth for the firm, which is expected to continue due to the recently announced establishment of a common automotive policy between Colombia, Ecuador and Venezuela. AAISA reported earnings of US$301,400 and US$329,000 on sales of US$8.7 and US$8.4 million respectively in 1991 and 1992. Net income is projected to decline to US$111,000 in 1993, followed by increases in 1994 and 1995 reaching US$460,000 and US$630,000 respectively. Current and anticipated production levels indicate that AAISA is a viable concern.

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1 This statistic is difficult to verify because different numbers of compressors, evaporators and condensers are manufactured, and an equal number of each does not reflect a like number of integrated MAC units.

4. Project Objectives: The primary objective of the project is to enable AAISA to substitute production of HFC-134a MACs for its current product line of CFC-12 MACs. The conversion to HFC-134a of the heat exchanger line will complement AAISA's already approved project to convert its MAC compressor assembly line for production of HFC-134a MAC compressors, and to provide both in-house and dealer training for servicing of HFC-134a MACs.

5. Project Description: The proposed project consists of the retooling of a heat exchanger fabrication and assembly line and related training and technical assistance costs. The project will consist of 4 components:

Component 1 - Evaporator and Condenser Fabrication Line Retooling
Component 2 - Customer Qualification Testing
Component 3 - Training
Component 4 - Engineering Services

Annex I, Technical and Cost Assessment describes the project in detail.

6. Project Cost and Financing: The total estimated cost for project implementation, including capital costs and import duties, technical license fees, technical assistance, civil works and utilities, training, and contingencies, is US$4.8 million. Eligible incremental costs are US$4.23 million. A single OTF Grant will be requested for this amount plus the US$0.62 million already approved for the compressor assembly line, or a total of US$4.85 million. AAISA itself will finance the US$570,000 in non-incremental costs. The project cost estimate is summarized in Table 1.

Table 1: AAISA Heat Exchanger Project Cost Estimate (US$ 000's)

	INCREMENTAL	NON-INCREMENTAL
Component 1 - Evaporator/Condenser Fabrication Line:		
Equipment	2,337	
Tooling	682	
Transport (to/from POE)	132	
Technology License	110	
Civil Works/Utilities	157	243
Subtotals (Component 1)	3,418	243
Component 2 - Customer Qualification Testing:	163	
Component 3 - Training Program:	121	
Component 4 - Engineering Services:	140	
Project Costs (Excl. Contingency)	3,842	243
10% Contingency	388	27
Import Taxes		300
Total Incremental Costs (MFEC)	4230	
AAISA Funded Non-incremental		570
Total Project Cost:	4,800	

A detailed breakdown of project costs is given in Annex 1. The total cost of US$4.8 million compares with an estimate of US$4.1 million for FAACA. The primary source of the additional cost is investment in aluminum/aluminum brazing capacity, which FAACA already possessed. As a condition of Grant Effectiveness, the Bank will require AAISA to prepare a financial plan for funding of non-incremental costs, and obtain agreement to do so before entering into a grant agreement with the enterprise.

7. Determination of Incremental Costs: All Component 1 costs, including tooling and equipment, shipping, technology license fees, civil works/utilities, and product testing, are specific to the conversion of the facilities to permit production of HFC-134a compressors and heat exchangers. The heat exchanger line non-incremental investment by AAISA of US$570,000 consists of additional civil works/utilities installations and import taxes. Component 2 through Component 4 costs for Customer Qualification Testing, Training, and Consulting Engineering are all incremental. Total incremental costs including the 10% contingency are therefore US$4.23 million. Recurrent annual tooling costs for brackets, soft molds etc., are not included as project costs.

8. Project Implementation: In tandem with the implementation of the already approved conversion to HFC-134a of the Compressor Assembly Line, all major project components will be implemented during the next 24 months. Project implementation is directly tied to AAISA's customer requirements and introduction of HFC-134a MACs into the marketplace, which in Venezuela is planned for the 1994 and 1995 model years. Component 1 - Evaporator and Condenser Fabrication Line will have a lead time from purchase order to start-up of 15 months. Components 2 and 3 will be scheduled with Component 1 start-up. Component 4 will take place concurrently with the beginning of Component 1. AAISA, itself, will manage the project installation with the assistance of an external industry consultant. Outside contracts will be required for specific equipment relocation and hook-up tasks during installation. FONDOIN will assist with administrative liaison as required. Technical oversight during installation and start up will be provided by a Bank contracted technical specialist. Procurement and disbursement will be in accordance with Bank guidelines.

9. Project Sustainability: The primary purpose of the OTF is to provide a financial incentive to facilitate ODS phase-out by compensating beneficiaries for incremental costs incurred as a result of converting to non-ODS technologies. An equally important benefit of the Fund is to permit beneficiary nations to implement phase-out strategies without incurring a process of deindustrialization. ODS phase-out in the MAC subsector in Venezuela will take place with or without the projects. The grants to AAISA and FAACA will, however, not only permit factory conversion without financial prejudice to the firms, but will, at the same time, ensure continued production of auto MAC components in Venezuela, and facilitate aftermarket servicing of HFC-134a units. In the absence of the subsidy, AAISA domestic markets would disappear as assemblers would still have the option, albeit at higher cost, of importing all HFC-134a units. Moreover, without HFC-134a component production capacity, aftermarkets for both AAISA and FAACA would eventually disappear.

10. Rationale for Montreal Protocol Financing: With or without the project, and that of FAACA, auto assemblers will only assemble cars with HFC-134a compressors after 1996. It is estimated that the transition of assembly and aftermarket to HFC-134a units will be virtually complete by 2000. The integrated program of assembler-financed transition, supplemented by OTF subsidies to the two MAC fabricators, will thus result in the elimination of

over 25% of current national CFC consumption, while, at the same time, permitting the retention of domestic MAC production capacity and employment generation. Given the decision of the auto industry to undertake worldwide conversion, failure to convert one or both Venezuelan MAC fabricators would result in a loss of market share to imports, and eventual disappearance of the non-converted enterprise(s). Protection against deindustrialization associated with the transition to non-ODS technologies is an approved use of OTF resources.

11. Issues and Actions: There are no major technical issues associated with project implementation. Disbursement will take place via a Grant Agreement between the Bank and AAISA. Clarification of the ownership structure of AAISA/COROVEN will be required in order to prepare an agreement encompassing the already approved project to convert AAISA/COROVEN's compressor line for HFC-134a production. Procurement may involve numerous small contracts. Procurement and disbursement arrangements will be developed with a view towards minimizing direct Bank involvement in the processing of transactions, while maintaining adequate oversight. Finalization of a technology license agreement with an acceptable technology supplier will be a condition of OTF Grant Effectiveness.

12. Environmental Aspects: The elimination of CFC-12 consumption is the basic environmental objective of both the heat exchanger line and compressor line conversions. Implementation of the Compressor Line conversion project will reduce direct in plant CFC-12 consumption now used for compressor testing, product development and service shops from 11,365 kg/year to 320 kg/year. In addition, each installed MAC system uses an estimated 2.5 kg of CFC-12 over its useful life. Indirect consumption eliminated in installed MAC units is estimated at 100,000 kg/year for both conversion projects together. There are no major environmental issues associated with the installation or operation of the converted assembly lines themselves, other than routine workplace safety measures.

13. Project Benefits: The major environmental benefit of the project is the enabling of AAISA to now produce both MAC heat exchangers and compressors for use with non-ODS HFC-134a as the refrigerant in place of CFC-12. Elimination of CFC-12 used and emitted into the atmosphere in compressor testing is a secondary benefit associated with the already approved project. The direct economic benefit is the retention in Venezuela of production capacity to supply both assemblers and aftermarket users with HFC-134a units, the associated net savings in foreign exchange, and the employment level retained by avoiding the demise of the local MAC industry. The consolidated unit abatement cost associated with the project, including both compressor and heat exchanger lines, is US$7.09/kg/year based on an annual production level of 40,000 compressors and 35,000 heat exchangers. The calculations are presented in Annex 3, Calculation of Unit Abatement Costs.

14. Project Risks: There are no significant technical project risks, the technologies to be employed having already been proven through application in parent countries of assemblers. There is a potential commercial risk of AAISA/COROVEN being able to compete with imported MAC units and with FAACA for both original equipment and aftermarket shares. The same risks also apply to FAACA. Nevertheless, AAISA/COROVEN is a financially viable concern of proven technical competence. The fact that both enterprises have sizable export

markets (approximately 20% of production), including, occasionally, the USA would indicate that both probably have reasonably competitive cost structures. Two additional factors expected to mitigate risk are: i) the new Andean Common Market agreement which will provide opportunities to export MACs to the member countries, none of which has a MAC fabrication capability; and ii) the recently passed Venezuelan Local Content Resolution which aims for approximately 45% of automobile components to be of Venezuelan origin.

15. Technical Evaluation: The Bank's technical assessment consisted of a detailed review of the technical and financial proposals with AAISA, field inspection of existing units, and proposed replacement installations, and verification of appropriateness with market demands for assemblers and, in the case of the compressor line conversion project, aftermarket dealers. Annex 1, Technical and Cost Assessment provides a complete description of the heat exchanger project and associated costs, and incremental cost determination. Annex 4 presents the technical opinion of the Bank's Ozone Operations Resource Group (OORG) technical expert for mobile air conditioning (MAC) systems projects, approving the project.

16. On the basis of the assessment, the Bank considers the proposals to be of sound technical design, and to be qualified for OTF grant financing of eligible incremental costs. AAISA and its compressor affiliate, COROVEN, are judged to be technically and organizationally capable of implementing both projects. A copy of the letter from FONDOIN to the MP Secretariat officially requesting the project is included in Annex 5.

17. Staff Review Arrangements: The following staff are responsible for the project and for the review:

Task Manager:	Donald Rhatigan, LA1EI
Division Chief:	Stephen J. Ettinger, LA1EI
CD Director:	Rainer B. Steckhan, LA1DR
RED Chief:	Dennis J. Mahar
Bank Technical Advisor:	Donald Brown
Outside Specialist:	Peter Turner
OORG Reviewer:	Robert Proctor

June 7, 1994

Annex 1

AIRE ACONDICIONADO INTEGRAL, S.A. (AAISA)

Automobile Air Conditioner Factory Conversion for Production of HFC-134a Refrigerant Mobile Air Conditioner (MAC) Condensers and Evaporators

Technical and Cost Assessment by F. Peter Turner

May 1994

I. SUMMARY OF RECOMMENDATIONS

1. **Project Description:** The proposed project consists of the installation of a new heat exchanger manufacturing process. This new manufacturing process will permit production of mobile air conditioning (MAC) components which substitute HFC-134a for CFC-12 as the refrigerant agent. The project is necessary to permit AAISA to produce HFC-134a MACs for installation in Venezuelan assembled vehicles, and for export to Colombia, Ecuador, Peru, Bolivia and Chile (common market agreements). Auto assemblers are planning to carry out their transition during the 1994 and 1995 model years (Annex I, Table XIV).

2. **Cost Estimates:** Total cost estimate for project implementation, includes capital costs, technical assistance, training, import duties, and contingency is US$4.8 million. The project cost estimate is summarized in Annex I, Table 1. This cost is US$1.1 million more than FAACA's revised estimated project cost of US$3.7 million to install an equivalent heat exchanger line. The major component of the increased cost is installation of the aluminum brazing capacity which FAACA already possessed and without which the HFC-134a serpentine heat exchangers cannot be fabricated. The justification for the cost difference is detailed in Annex 2.

3. **Incremental Costs:** All tools/equipment, shipping/delivery, technical exchanges, engineering consulting, and some of the civil works/utilities costs are required to effect the change over to production of HFC-134a compatible evaporators and condensers. Resale value of the existing CFC-12 line is negligible, in spite of most equipment having further expected useful life of 5 years or more. The alternative to implementing the project would be direct importation at higher costs of already fabricated HFC-134a evaporators/condensers, by assemblers, and the disappearance of AAISA local client base.

4. **Proposed Project Implementation:** All phases of this project will be implemented during a 24 month period following project approval by the Bank (Annex I, Table IX). Project implementation is directly tied to AAISA's customers requirements (Annex I, Table X, XI). All of AAISA's customers approve of the use of serpentine design evaporators/condensers. AAISA is currently contacting Thermo Components, Inc. (TCI) and Modine to import condensers/evaporators to maintain the AAISA customer base until the heat exchanger conversion project is fully implemented. Both TCI and Modine manufacture serpentine design condensers/evaporators and have verbally committed to supply necessary product required by AAISA. AAISA staff contends that the Venezuelan government will allow product import until the project is fully implemented; thereafter, recently announced local content requirements in the 45% range will come into effect.

5. **Reduction of ODS CFC-12:** Direct CFC-12 use in AAISA's current heat exchanger manufacturing processes for testing and cleaning purposes is non-existent. Therefore, project implementation will not directly reduce CFC-12 consumption in the heat

exchanger line, but the HFC-134a compressor assembly conversion will reduce direct use for testing purposes there by approximately 11,000 kg/yr. Indirect consumption of CFC-12 foregone through production of the HFC-134a MACs is approximated by the estimated average lifetime consumption of 2.5 kg CFC-12 per installed MAC unit.

6. <u>Environmental Issues:</u> There are considered to be no adverse environmental issues associated with this project. All washes and cleaners are environmentally compatible.

7. <u>Recommendations</u>: Following a review of this project with AAISA personnel and their consulting engineer, appropriate modifications have been made in the design and configuration of the relevant production areas of the facility. The project is found to be technically correct and consistent with AAISA's customer requirements. The project will replace the current fabrication line for CFC-12 MACs with a substitute line for HFC-134a MACs. Neither the existing CFC-12 line, now, nor the new HFC-134a line, will in the near future operate anywhere near close to full capacity, one shift operation being the standard sufficient to meet current market requirements. Implementation of the project will therefore allow AAISA to maintain its current project customer base, but based on the serpentine design concept. This project will allow AAISA to potentially expand its customer base in the future due to increased capacity utilization (double or triple shifting). Annex I, Table XI indicates AAISA's projected future product volume for HFC-134a products to be approximately 98,000 units/yr. Similar quantities of CFC-12 units could also be produced by greater capacity utilization of the existing line, if market conditions warranted. The customer base described in Annex I, Table II further illustrates the proposed serpentine designed product is acceptable for the Venezuelan common market for several years.

II. PROJECT DESCRIPTION:

8. <u>The Proposed Project</u>: Is the result of new AC component design needs to meet new Thermo Dynamic requirements that arise in the conversion from CFC-12 to HFC-134a refrigerant. AAISA plans to use the following design to meet the needs of its customers when HFC-134a MACs are introduced in the Venezuelan market.

<u>Evaporators</u>: SPT (Serpentine type): produced with one straight extruded multi-port tube, formed several times to dimension, with corrugated fins between every two tubes and brazed together utilizing a non-corrosive flux process.

AAISA designs call for 2 different tube widths, 85MM and 105MM, utilizing two centers for each tube width of 9MM and 22MM.

<u>Condensers</u>: SPT (Serpentine type): Similar to SPT evaporator but produced with several formed tubes to divide the core in several internal circuits to decrease pressure drop.

AAISA designs call for 2 different tube widths, 22MM and 28MM utilizing center height of 16MM for each tube width.

Annex I, Table X demonstrates the SPT designs and their application to AAISA customer base.

9. AAISA currently produces tube and fin design evaporators/condenser for OEM MAC, after market products, drinking fountain coolers, and window air conditioners.

All OEM and after market products will be replaced as AAISA's customers change to HFC-134a refrigerant.

Water cooler designs and window AC units will utilize tube/fin designs until project is implemented. At this time, design changes utilizing SPT type instead of tubefin type units can be designed and implemented.

10. Design Basis for Equipment and Tools Requirements: An analysis of AAISA's customer requirements indicated three types of design applications for which equipment and tools specific to conversion to HFC-134a evaporator/condenser production will be required.

    1. Carry over models with complete AC component design changes required for HFC-134a.

    2. Current requests for new model quotations, utilizing SPT designs for HFC-134a designs.

    3. Potential business utilizing SPT designs for HFC-134a use.

11. Annex I, Table XI summarizes AAISA's customers, vehicle models reason for design change and anticipated volumes when production of HFC-134a MAC units begins.

12. To develop cost estimates based on equipment and tooling specifications, customer design change requests were validated, and then equipment and tooling requirements to manufacture the new designs were reviewed in detail.

13. Criteria used to review and justify equipment/tools lists included the following:

    - Were requests consistent with actual design changes?
    - Was there duplication of existing tooling and equipment?
    - Could current tooling be modified to accommodate new tooling requirements.

14. Annex I, Table XII was developed to establish reference numbers for tooling/equipment.

15. Annex I, Table XIII was developed to show the relationship between the

tooling/equipment list (Annex I, Table XII) and AAISA's customer requirements.

16. Annex I, Table XV was developed to demonstrate the assembly line process flow integrating both condensers and evaporators into a single assembly line process flow.

This manufacturing layout offers the optimum in assembly scheduling flexibility.

The project has been designed to produce a minimum of 25 units/hr. An expected maximum output of 52 units/hrs can be achieved with additional manpower added to the manufacturing process.

17. Estimated Costs: Total project costs excluding contingency are estimated at US$4,401,499 divided as follows:

1. Equipment/Tooling costs are contained in Annex I, Table II. (US$3,018,663) Table II shows not only cost of tools/equipment, but origin of manufacture (I-imported, L-Local made), shipping charges to port of entry, Venezuela, (POE) and import taxes and required for imported equipment.

2. Shipping cost to POE in Venezuela are US$102,848 - Annex I, Table II.

3. License Agreement with Thermo Components, Inc. (TCI) cost is US$110,000.

   As of this writing no formal agreement between TCI and AAISA has been signed. Annex I, Table III outlines general license items discussed between TCI and AAISA. The Bank's technical consultant has reviewed correspondence to date which indicates AAISA is headed in the correct technical direction. AAISA has been told by the Bank's consultant that the lack of a signed technical agreement may jeopardize the final project agreement with the bank for OTF financing.

4. Product Testing US$152,660. Annex I, Table IV shows the breakdown of services and costs provided by TCI. This incremental cost is required to show the heat transfer characteristics of each SPT design to ensure designs meet customer requirements.

5. Consulting Engineering Services: AAISA hired a consulting engineer at total cost of US$140,000, in order to develop SPT designs and Nocolock braze technology. Annex I, Table V describes the duties and responsibilities required of the engineer, who is personally known to the Bank's technical consultant, and is well qualified to assist AAISA with this project. The consultant has had 36 years experience with Harrison Division, GMC. He has administered manufacturing engineering groups and has been specifically responsible for development and procurement of manufacturing Nocolock brazing process and manufacturing equipment used to manufacture SPT design AC components.

6. Training: Training of key AAISA personnel is estimated to cost US$120,525. The training program is paramount to the business success of this project. Table VI, Annex I describes training and related costs i.e.:

   - Training of AAISA engineering at TCI.

   - Manufacturers equipment/tooling engineers to train AAISA personnel on equipment/tooling operation at AAISA.

   - Additional ongoing training which is not covered in the training program will be provided to AAISA by the same technical consultant.

7. Plant Rearrangement: Annex I, Table VII shows anticipated costs related to plant rearrangement for the new SPT process totalling US$400,000. Eligible incremental costs are US$156,996.

8. Shipping/Handling of Equipment: Rental of large material-handling equipment is estimated at US$29,495 from POE to the location inside the plant. AAISA does not have large material handling equipment at the plant. All transport and installation of equipment will be done by outside contractors. The above costs are for estimate purposes only.

ANNEX I, TABLE I

AAISA PROJECT COST ESTIMATES

	INCREMENTAL		NON-INCREMENTAL
• Equipment:	$2,336,813		
• Tooling:	681,850		
• Shipping Cost to Port of Entry (POE) Venezuela:	102,848		
• License Agreement with Thermo Components, Inc. (TCI):	110,000		
• Product Testing (Component 2):	162,660		
• Engineering Services (Component 4):	140,000		
• Training (Component 3):	120,525		
• Manufacturing Trial Run:			35,000
• Civil Works/Utilities:	156,996		243,004
• Import Tax:			292,308
• Shipping/Handling of Equipment/Tools from POE to in place at AAISA:	29,495		
INCREMENTAL	$3,841,187		
NON-INCREMENTAL			$570,312
TOTAL		US$4,411,499	
10% Contingency:	384,119		57,031
TOTAL COST (Including Contingency):		4,852,699	
TOTAL INCREMENTAL:	4,225,306		
TOTAL NON-INCREMENTAL: (Including import taxes):			627,343

<u>ANNEX I, TABLE II</u>

<u>EQUIPMENT COST BREAKDOWN</u>

EQUIPMENT	IMPORT OR LOCAL	EQUIPMENT COST	TOOLS	TOTAL COST	DELIVERY TO POE	IMPORT DUTY 10%	TOTAL US DOLLARS
Tube Uncoil/Straighten Cut System	1	15,000	105,000	120,000		12,000	133,700
Serpentine Tube Bender	1	244,400	17,600	262,000		26,200	289,900
Serpentine Evaporator Qualifier	1	88,500	16,500	105,000		10,500	117,200
Serpentine Condenser Qualifier	1	96,900	12,100	109,000		10,900	121,660
Extruded Tube Saw	1	31,000	-	31,000	17,000	3,100	35,800
Horn Die Press/Ext. End Qualifier	1	98,950	11,550	110,500		11,050	123,250
Serp. Condenser Assy. Table and Banders	1	68,000	11,000	79,000		7,900	88,600
Serp. Evaporator Assy. Table and Banders	1	65,700	8,800	74,500		7,450	83,650
Condenser Fin Machine	1	245,250	79,750	325,000		32,500	359,200
Evaporator Fin Machine	1	225,450	99,550	325,000		32,500	359,200
Side Plate Cutting	1	31,000	-	31,000	2,000	3,100	36,100
Parts Washer	1	45,600	-	45,600	5,000	4,560	55,160
Batch Dry Oven	1	33,775	-	33,775	6,850	3,378	44,003
Degreaser	1	52,610	-	52,610	4,000	5,261	61,871
DiWater	1	15,787	-	15,737	595	1,579	17,961

Continuous Fluxer	1	97,800	-	97,800		9,780	116,863
Continuous Dry Oven	1	66,500	-	66,500	27,850	6,650	82,433
Nocolok Braze Furnace	1	382,425	-	382,425		38,243	429,952
Leak Test (Air Under Water	1	5,000	-	5,000		0	5,000
Surface Treatment Wash	1	152,888	-	152,888	20,553	15,289	88,730
Paint and Brake Oven System	1	71,816	-	71,816	8,000	7,182	86,998
Leak Test (Mass Spectrometer	1	31,862	-	31,862	2,000	3,186	37,048
Block Checker (Alignment)	L	25,400	-	25,400	-	0	25,400
Repair Station (Torch Braze)	L	25,200	-	25,200	-	0	25,200
Pressure Burst Test	L	20,000	-	20,000	-	0	20,000
Induction Braze Pipes	1	100,000	-	100,000	4,000	10,000	114,000
Sigs (600 Sets Braze Plates at 500/set	1	-	300,000	300,000	5,000	30,000	335,000
2 Condenser Bracket Dies	L	-	20,000	20,000	-	0	20,000
Leak Test (Mass Spec-	1	31,862	-	31,862	2,000	3,186	37,048
TOTALS		2,336,813	681,850	3,018,663	102,848	292,308	3,413,819

NOTE: Delivery to Puerto Cabello, Venezuela costs have been average over the pieces of equipment involved in determining the total cost for each piece. This has been done for the first 10 items, as illustrated by the arrow in the appropriate column. These are all being purchased from one supplier (McKennica) and shipped together. The same is true for the Nocolok Braze System comprising three pieces of equipment.

ANNEX I, TABLE III

PROPOSED LICENSE AGREEMENT WITH THERMO COMPONENTS, INC. (TCI)

Technology Transfer	US$110,000

- Agreement will cover:
  - Commitment to sell TCI produced serpentine design evaporators/condenser to AAISA
  - Cost outline for:
    - Heat Exchanger Design -
    - Cycle Testing -
    - Vibration Test -
    - Calorimeter Tests -
    - Corrosion Tests -
  - Training of AAISA Personnel at TCI
  - TCI Engineering and Technical support of (3) Engineers for 15 days at AAISA to assist in start-up of process.

ANNEX I. TABLE IV

PRODUCT TESTING FOR DESIGN QUALIFICATION

A BREAKDOWN OF THE VARIOUS COSTS INCLUDE:

HEAT EXCHANGER DESIGN AND DETAIL	
6 DESIGNS @ $4,410 EACH	US$26,460
VIBRATION TEST	
6 DESIGNS @ $12,000 EACH	72,000
CORROSION TEST	
6 DESIGNS @ $6,500 EACH	39,000
CYCLE TEST	
6 DESIGNS AT $3,200 EACH	19,200
CALORIMETER TESTING	
6 DESIGNS AT $3,000 EACH (allowed $1,000 per test)	6,000
TOTAL	US$162,660

ANNEX I, TABLE V

CONSULTING ENGINEERING SERVICES US$140,000

PROJECT WORK WAS INITIATED OCTOBER 1, 1993. FEE PAYS FOR SERVICES RENDERED FOR 24 MONTHS WORK PLUS EXPENSES FOR THE FOLLOWING ACTIVITIES:

- DEVELOPMENT OF EQUIPMENT AND TOOLING SPECIFICATIONS
- EQUIPMENT AND TOOLING PROCUREMENT PROCESS WHICH INCLUDES ESTABLISHING SUPPLIER NETWORK, CONTACT FOR QUOTATION, SELECTION AND FOLLOW UP THROUGH FABRICATION, TESTING AND SHIPMENT.
- START UP ASSISTANCE AT AAISA.
- TRAINING OF AAISA PERSONNEL ON EQUIPMENT I.E. WASHES, DEGREASER, SAFE HANDLING OF CHEMICALS, ETC.
- TROUBLESHOOTING EQUIPMENT AND MANUFACTURING PROCESS.
- GENERATING OPERATING INSTRUCTIONS FOR PROPER USE OF EQUIPMENT.
- ESTABLISHING MATERIAL SAFETY DATA SHEETS FOR PLANT EMPLOYEE PROTECTION.

ANNEX I, TABLE VI

TRAINING COSTS

- Training of three (3) AAISA Engineers at TCI for one week — $4,200.00
  Total costs include: Air Fare, Hotel, meals and ground transport.
- Transportation, Food and Lodging for three (3) Engineers for 15 days at AAISA. — $6,400.00
- In addition to equipment costs AAISA has commitments from major equipment suppliers to train AAISA personnel in equipment operation as follows:

EQUIPMENT SUPPLIED	ERECTION AND TRAINING MONIES
TUBE UNCOIL/STRAIGHTEN/CUT SYSTEM	5,000
SERPENTINE TUBE BENDER	5,000
SERPENTINE EVAPORATOR QUALIFIER	5,000
SERPENTINE CONDENSER QUALIFIER	5,000
EXTRUDED TUBE SAW	5,000
HORN DIE PRESS/EXT. END QUALIFIER	5,000
SERP. CONDENSER ASSY. TABLE AND BANDERS	5,000
SERP. EVAPORATOR ASSY. TABLE AND BANDERS	5,000
CONDENSER FIN MACHINE	5,000
EVAPORATOR FIN MACHINE	5,000
SIDE PLATE CUTTING	---
PARTS WASHER	---
BATCH DRY OVEN	3,000
DEGREASER	---
D.I. WATER	---
CONTINUOUS FLUXER	5,242
CONTINUOUS DRY OVEN	5,242
NOCOLOCK BRAZE FURNACE	5,242
LEAK TEST (AIR UNDER WATER)	---
SURFACE TREATMENT WASH	5,000
PAINT AND BAKE OVEN SYSTEM	26,200
LEAK TEST (MASS SPECTROMETER)	5,000
BLOCK CHECKER (ALIGNMENT)	---
REPAIR STATION (TORCH BRAZE)	---
PRESSURE BURST TEST	---
INDUCTION BRAZE PIPES	5,000
JIGS (BRAZE FIXTURES)	---
CONDENSER BRACKET DIES	---
TOTAL	109,925
TOTAL TRAINING	US$120,525

ANNEX I. TABLE VII

CIVIL WORKS AND UTILITIES INSTALLATION FOR HFC-134a CONDENSER AND EVAPORATOR LINES

SERVICE	INCREMENTAL COST ($)	NON-INCREMENTAL COST ($)	TOTAL COST ($)
Electrical services (transformers, cables, brakers, complete finished wiring to equipment, etc.)	79,552	45,448	125,000
Gas, compressed air and water services	10,417	24,583	35,000
Utility service (ventilation, lab, restrooms, lunch area, tools, etc.	0	56,000	56,000
Building modifications and services (floor preparation ie pits to collect liquids, foundations, sewer lines, exhaust stacking to roof, roof openings and repairs, etc.)	31,250	30,750	62,000
New boiler to provide steam heat for washes	32,652	36,348	69,000
Lay-out	3,125	49,875	53,000
TOTAL	**156,996**	**243,004**	**400,000**

NOTES:

ELECTRICAL SERVICES
Once the actual line is shut down, there will be a free capacity of 200 KYA, this added to the total finished wiring assumed by AAISA will raise cost to $45,448. Total capacity of the new line will be 1000 KYA, of which incremental costs to finance 800 KYA are estimated at $79,552.

UTILITY SERVICES
AAISA will assume all the costs of civil works and utilities required to make the area where the line is going to be installed liveable.
Services of ventilation, restrooms, lab, etc. will be financed by AAISA.

BUILDING MODIFICATIONS AND FACILITIES
AAISA will assume the construction of exhaust stacking to roof and all modifications on roof and walls, considering that foundation for equipment and pits to collect liquids that contaminate the ambient should be financed by the Montreal Protocol.

STEAM SERVICES
AAISA does not have any service to provide steam to their actual installations, but it is considering part of the cost as its own.

LAY OUT
AAISA'S Engineering Department will assume all the costs in design and labor of new lay out. It is only left the cost of final drawings, drafts and permits.

ANNEX I, TABLE VIII

EQUIPMENT, TOOLS AND MANUFACTURING PROCESS TRIAL RUN NON-INCREMENTAL

METAL TO TRY OUT TUBE AND FIN FORMING EQUIPMENT AT MCKENNICA

2 BOXES OF CUT TUBES - EVAPORATOR AT $175/BOX	350
2 COILS (1200/LBS) TUBING - CONDENSER AT $2,75/LB	6,600
1 COIL TUBING FOR PIPES AT 1000/LBS at $3.00	3,000
4 COILS FIN STOCK AT 1,000/LBS EACH AT $2,00/LB	8,000
	17,950
TRANSPORTATION AND PACKAGING COST TO SHIP PRODUCT AND UNUSED METAL TO AAISA	-5,000
SIDE PLATE STOCK	
1 COIL AT 1,000/LBS at $3,00/LB.	-3,000
CHEMICALS TO CHARGE EQUIPMENT	
PARTS WASHER - ALKALINE CLEANER - 1 DRUM	-1,500
DEGREASER - 4 DRS TRICHLOROETHYLENE AT $7.50/GAL	-1,500
SURFACE TREATMENT - 650 GAL LIQUID/TANK	
ACID - 2 DRUMS at $500/DR	-1,500
CONVERSION COATING AND ACCELERATOR - 3 DRS AT $500/DR	-1,500
NOCOLOCK FLUX - 1 DRUM at $20/GAL	-1,000
BRAZE RINGS	- 500
PAINT AND SOLVENT - 2 DRS AT $500/DR	-1,000
8 HRS LABOR AT 25 PCS\HR FOR 200 PC RUN FOR APPROXIMATELY 20 PEOPLE	-1,050
	35,000

NOTE:

WHEN PURCHASING MATERIALS, SMALL QUANTITIES ARE NOT AVAILABLE FOR PURCHASE. THEREFORE, COSTS ARE BASED ON BUYING SOMEWHAT LARGER THAN NEEDED QUANTITIES FOR TRIAL RUNS. PRODUCTS MANUFACTURED DURING PROCESS TRIAL RUN WILL BE SCRAPPED.

ANNEX I. TABLE IX

IMPLEMENTATION SCHEDULE FOR SERPENTINE CONDENSER AND EVAPORATOR

NUMBER	STEP	PHASE	TIME
1	Initiate Technology	-Technology Exchange at TCI with AAISA Personnel	1/8 Month
		-Train AAISA Personnel on Serpentine Manufacturing Process - TCI	1/8 Month
2	Product Design and Test	-Design to meet Customers Spec's	2 Month
		-Build Prototypes and Qualify Performance at TCI Functionability, Durability and Spec)	3 Month
3	Order Equipment	-Purchase Orders to Various Suppliers	1/2 Month
		-Build to Specifications	12 Month
4	Arrangement	-Site Preparation	1 Month
		-Certification and Functional Check of Equipment	1/2 Month
5	Transportation	-Packing and Dispatch	1/2 Month
		-Overseas to Puerto Cabello, Venezuela	1 Month
		-Transport to AAISA	1/2 Month
6	Installation	-Complete Equipment Installation	1 Month
		-Complete Site Preparation	1 Month
7	Process Capability Check	-Train AAISA Personnel on Proper Equipment Operation-Equipment Manufacturer's Personnel/Consulting Engineer	2 Month
			1 Month
		-Trial Run and Debug Problems	
8	Production	-Start of Full Production TCI Personnel/Consulting Engineer on hand to Assist	24 Month

NOTE: 1-Some phases can be done at the same time as others are ongoing.
2-Due to having several sources of equipment supply, longest lead time equipment fabrication will be used for timing. Other equipment with shorter lead times will be completed and be installed when longest lead time items come in.

ANNEX I, TABLE X

SERPENTINE TYPE DESIGNS SUITABLE FOR HFC-134a (AC) AIR CONDITIONING SYSTEM AND THEIR APPLICATION FOR AAISA'S CUSTOMERS

DESIGN CHARACTERISTICS

AC Component	Tube Width	Center Height	HFC 134A Application
Condenser	22 MM	16 MM	A
	28 MM	16 MM	B
Evaporator	85 MM	9 MM	C
		22 MM	D
	105 MM	9 MM	E
		22 MM	F

DESIGN APPLICATION

CUSTOMER VEHICLE MODEL		EVAPORATOR	CONDENSER
Chrysler	XJ	F	B
	YJ	F	B
	Spirit	D	A
	ZJ	C	A
GM	Chevette	F	B
	Swift	C	A
	CK Truck	D	B
	Blazer	D	B
Ford	Festiva	D	A
Fiat	Uno	D	A
	Premio	D	A
	Selecta	D	A
Honda	Accord	F	A
ClasA	Renault	D	B
Facorca	Mini-car	C	B
Mitsubishi	Lanzer	D	A
Toyota	Corolla	E	A
Renault	Cleo	F	B
	Twingo	D	A
Mazda	323	F	B
	626	F	B

ANNEX I, TABLE XI

AAISA CUSTOMER DESIGN CHANGES BY VEHICLE MODEL AND DESIGN CHANGE TYPE

CUSTOMER	MODEL(s)	CHANGE TYPE			ESTIMATED YEARLY VOLUME	
		I	II	III	CONDENSER	EVAPORATOR
Chrysler	XJ YJ Spirit	X X X			4,400 600 2,900	4,400 600 2,900
GM	Chevette	X			2,700	2,700
Fiat	Uno Premio Selecta	X X X			31,200 1,560 2,640	31,200 1,560 2,640
Mazda	323 625	X X			2,040 600	2,040 600
Facorca	Mini-Car	X			550	550
	TOTAL	X			49,190	49,190
Chrysler	ZJ		X		1,920	1,920
GM	Swift CK1500 Blazer		X X X		6,100 8,500 5,500	- - -
Ford	Festiva		X		4,200	4,200
Honda	Accord		X		1,400	1,400
ClasA	Renault		X		15,600	15,600
	TOTAL		X		43,220	23,120
Mitsubishi	Lancer			X	3,840	3,840
Toyota	Corolla			X	14,400	14,400
Renault	Civic Cleo			X X	2,400 1,800	2,400 1,800
	TOTAL			X	22,440	22,440

The application of serpentine evaporator and condenser to AAISA customer base has been defined as follows:

Type I	Carry over models with complete AC component design changes required for HFC-134a use.
Type II	Current requests for new model quotations for serpentine design condenser and evaporators for HFC-134a
Type III	Potential business utilizing serpentine design evaporators and condensers for HFC-134a.

ANNEX I, TABLE XII

TOOL AND EQUIPMENT LIST

EQUIPMENT/TOOLS	REFERENCE NUMBER
Tube Uncoil/Straighten/Cut System	1
Serpentine Tube Bender	2
Serpentine Evaporator Qualifier	3
Serpentine Condenser Qualifier	4
Extruded Tube Saw	5
Horn Die Press/Ext. End Qualifier	6
Serp. Condenser Assy. Table and Banders	7
Serp. Evaporator Assy. Table and Banders	8
Condenser Fin Machine	9
Evaporator Fin Machine	10
Side Plate Cutting	11
Parts Washer	12
Batch Dry Oven	13
Degreaser	14
Diwater	15
Continuous Fluxer	16
Continuous Dry Oven	17
Nocolock Braze Furnace	18
Leak Test (Air Under Water)	19
Surface Treatment Wash	20
Paint and Bake Oven System	21
Leak Test (Mass Spectrometer)	22
Block Checker (Alignment)	23
Repair Station (Torch Braze)	24
Pressure Burst Test	25
Induction Braze - Pipes	26
Jigs	27
Condenser Bracket Dies	28

ANNEX I, TABLE XIII
EQUIPMENT/TOOLS REFERENCE NUMBERS/APPLICATON TO CUSTOMER MODELS

CUSTOMER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	APPLICATIONS TOTAL
CARRY OVER MODELS																													
CHRYSLER																													
XJ	X	x	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	28
YJ	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	28
SPIRIT	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	28
GM																													
CHEVETTE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	28
FIAT																													
UNO	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	28
PREMIO	X	x	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
SELECTA	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	28
MAZDA																													
323	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	28
626	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	28
FACORCA																													
MINI CAR	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	28

EQUIPMENT TOOLS REFERENCE NUMBERS

CUSTOMER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	APPLICATION TOTAL
CHRYSLER																													
ZJ	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	28
GM																													
SWIFT	X	X		X	X	X	X			X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	24
CK 1500	X	X		X	X	X	X			X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	24
GRAND BLAZER	X	X		X	X	X	X			X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	24
FORD																													
FESTIVA	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	28

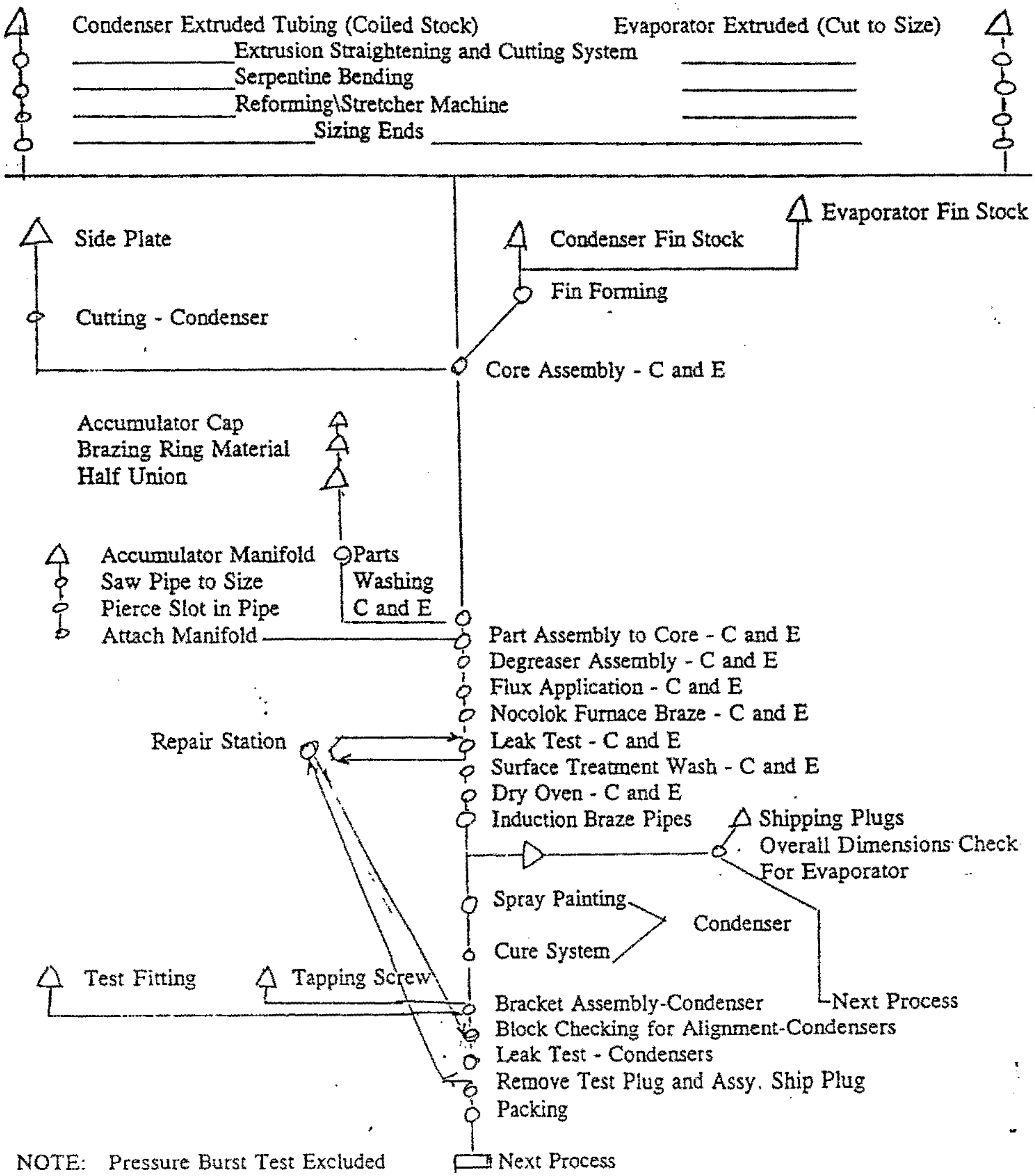
CUSTOMER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	APPLICATIONS TOTAL
HONDA																													
ACCORD	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	28
CIASA																													
RENAULT 11	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	28
POTENTIAL NEW PRODUCTS																													
TOYOTA																													
COROLLA	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	28
RENAULT																													
CLEO	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	28
TWINGO	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	28

ANNEX I. TABLE XIV
SCHEDULE OF AAISA CUSTOMER HFC-134A QUARTERLY MODEL CHANGE OVER

		1994				1995				1996			
Customer	Model	I	II	III	IV	I	II	III	IV	I	II	III	IV
Chrysler	XJ		X										
	YJ			X									
	Spirit				X								
	ZJ				X								
GM	Chevette						X						
	CK-1500				X								
	Grand Blazer				X								
	Swift			X									
Fiat	Uno					X							
	Premio						X						
	Selecta					X							
Mazda	323							X					
	626						X						
Facorca	Minicord								X				
Ford	Festiva				X								
Honda	Accord	X											
Ciasa	Renault						X						
Mitsubishi	Lancer					X							
Toyota	Corolla	X											
Renault	Cleo							X					
	Twingo												

ANNEX I, TABLE XV

PROCESS FLOW CHART - CONDENSER AND EVAPORATOR



NOTE: Pressure Burst Test Excluded from this Process Chart

Annex 2

AIRE ACONDICIONADO INTEGRAL, S.A. (AAISA)

Justification for Investment Cost Price Differential Between AAISA and FAACA HFC-134a Heat Exchanger Projects

1. The originally estimated cost of the equivalent FAACA project was US$4.1 million (since revised to US$3.7 million) as compared with US$4.8 million for AAISA.

2. The primary sources of the differences in Capital costs estimates for the two projects are:

   i) FAACA produces for 11 different designs versus 6 designs for AAISA. Therefore FAACA's tooling costs are higher.

   ii) Aluminum/aluminum brazing capacity is required to produced the HFC-134a serpentine designs. FAACA sister companies to which it has access already possess this capacity. AAISA must invest over US$1,000,000 to upgrade to be able to acquire this capacity.

   iii) Civil Works / Utilities: FAACA has sufficient space in existing buildings to install the HFC-134a line without shutting down the existing operation during installation of the new line. AAISA must invest in refitting a warehouse building due to lack of space in the existing production area.

   iv) AAISA will require consulting engineering services for design, equipment specification, and procurement. FAACA will do with existing staff.

3. The cost breakdown and rationale for the cost differentials between FAACA and AAISA projects follows:

I. TOOLING:

FAACA -	US$1,362,757
AAISA -	681,850

Tooling costs are directly related to the basic designs used by each enterprise:

Designs:	FAACA -	11 Designs
	AAISA -	6 Designs

II. EQUIPMENT:

FAACA -	US$ 842,007
AAISA -	2,336,813

FAACA has a number of major equipment pieces in place prior to requests for funds and therefore did not include the same equipment costs in fund requests. i.e.:

NOCOLOCK Braze Furnace	-	USS$382,425
Surface treatment wash	-	152,888
Induction Brazing Equip.	-	100,000
Continuous Fluxer	-	97,800
Continuous Dry Over	-	66,500
Die Press Ext.	-	98,950
Wash - S.A. Daytrex	-	52,610
Paint - Bake Oven System	-	71,816
		$1,022,989

* Note that FAACA's prior need for the above equipment was generated by its License Agreement with G.M. for similar aluminum to aluminum MAC units.

III.	LICENSE AGREEMENTS:	FAACA - US$360,120 AAISA - 110,000

FAACA has agreements with GM and SANDEN (Japan) with specific financial responsibilities.

AAISA has a technology transfer agreement with TCI (Thermo, Components, Inc.)

IV.	SHIPPING:	FAACA - US$180,598 AAISA - 132,343

Directly related to the number/costs of tooling and equipment orders.

V.	TRAINING:	FAACA - US$ 52,000 AAISA - 120,525

FAACA's acquired expertise in processing aluminum/aluminum heat exchangers has been learned through a ten year association with General Motors Corporation and, therefore, requires much less personnel training associated with new tooling/equipment.

AAISA has no prior manufacturing experience with all aluminum heat exchangers and, therefore, needs to learn technologies associated with new tooling and equipment.

VI.	CIVIL WORKS/UTILITIES:	FAACA - US$000,000 AAISA - 156,996

AAISA will utilize/set-up a new manufacturing line in a building currently used for storage and the product engineering garage. The building facility will, therefore, require all new and additional utilities (Power, Electrical line, Plumbing, etc.).

FAACA will place the new assembly process in a plant already set-up with the required facilities.

VII.	CONSULTING ENGINEERING:	FAACA - US$000,000 AAISA - 140,000 24 month man hours. Duties spelled out in Technical Annex.
	TOTAL PROJECT(S) INCREMENTAL COST(S): (Excluding AAISA Product Testing - Component 2, contingencies, and already approved AAISA compressor project)	FAACA - US$2,797,482 AAISA - 3,678,527

FAACA - AAISA PROJECTS COST DIFFERENCES

EQUIPMENT:

8E More accurate process than originally estimated, to meet quality standards. New cost chosen between three (3) quotations received.

IBT:	US$300,000
Advanced Technology:	383,000
	For similar equipment

14E/15E Different machines needed for each condenser model.

SPT:	Total of eight (8) different models. Two machines can assemble two similar cores. Total needed: 2 machines.
Parallel Flow:	Two different models. Total needed: 2 machines.

16E New additional operation needed to perform forming of "tube" as per final design. The additional operation should be performed with a new machine and tooling not available in plant.

TOOLING:

7T Additional supplier quotation (ITALY) received after project presentation.

9T/10T Tools cancelled due to redesign of tool 11T to manufacture all three (3) parts with interchangeability of die inserts.

27T & 29-31T Design changed according to 28T.

32T New quotation received from a supplier in ESTONIA with good quality.

34T Supplier quotation received after project presentation. Estimation based on actual set of toolings for similar application purchased in 1986.

52T Application received after project presentation.

53T Part print received after project presentation; estimation of Ford evaporator tools components was based on experimental sample received.

Calculation of Unit Abatement Costs

A. Definition:

Capital costs are annualized and expressed as a ratio of the average annual amount of ODS reduction, weighted according to its ozone depleting potential.

The unit abatement cost is defined as follows:

$$c = \frac{CC.CRF + (OC - OS)}{M.ODP}$$

where:

c	=	unit abatement cost
CC	=	incremental capital costs (including all one-time costs such as training, installation, freight, etc., but excluding contingency).
CRF	=	capital recovery factor
OC	=	incremental annual operating costs
OS	=	incremental annual operating savings
M	=	annual average mass of ODS not released as a result of the phaseout action
ODP	=	ozone depleting potential of the ODS

B. Calculations:

1. Unit abatement costs were calculated to include both direct and indirect reduction of CFC consumption attributable to implementation of both projects, the already approved Compressor Assembly Line project and the Heat Exchanger Fabrication Line project. Direct reduction relates only to CFC consumption within the factory itself for cleaning and testing of MACs and equipment. Elimination of CFC-12 as a testing medium in the compressor line, and recycling of an estimated 90% of the remaining consumption in service areas reduces annual emissions from 11,365 kg. to 320 kg.

2. Indirect consumption relates to the CFC-12 which would be consumed in the MACs installed in vehicles over their useful expected life, if the project were not implemented. Based upon an estimated production level of 35,000 units annually, an average CFC consumption of 2.5 kg. CFC/MAC over useful life[1], annual indirect consumption eliminated is 35,000 (2.5) (.1) or 90,000 kg./year. Due to the competitive nature of the MAC market, operating margins after conversion should be similar to current margins, so that (OC - OS) = 0.

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1 Such figures are typical in the U.S.A. No reliable data on average lifetime consumption of CFC/MAC units are available for Venezuela.

3. Calculations:

CC	=	\$4,394,000 (incremental capital costs of compressor and heat exchanger lines, excluding contingency)
CRF	=	CRF/10 years/10% = .163
(OC - OS)	=	0; no significant difference in operating margins between HFC-134a and CFC-12 MACs.
M Direct	=	11,045 kg. (in plant)
M Indirect	=	90,000 kg. (in MAC units)
ODP	=	1
c	=	$\frac{(4,394,000)\ (.163)}{101,045 \text{ kg./year(1)}}$ = \$7.09/kg./year (for current capacity utilization)

4. Interpretation: The abatement cost is a measure of the cost effectiveness of replacing CFC-12 MAC production capacity with HFC-134a MAC capacity. Without investment in the production capacity, regardless of where the MAC producers are located, the transition is not possible. The calculated c of \$7.09/kg./year is based upon production levels of 40,000 compressors and 35,000 heat exchanger units, far below full capacity utilization of approximately 70,000 units. An increase in production levels would lead to a corresponding decrease in c. For purposes of estimation, it has been assumed that each CFC-12 MAC would have an average initial charge of 2.5 kg. of CFC-12 including the initial charge, over the useful life of the MAC. Such figures are available in the U.S.A.. No reliable data on replacement levels for Venezuela are available.

PROJECT NAME: AAISA (Aires Acondicionados Integral, Sociedad Anonima). Automobile Air Conditioner (MACS) Factory Conversion for Fabrication of HFC-134a Heat Exchangers.

SUBJECT: Venezuela: Montreal Protocol / AAISA Heat Exchanger Fabrication Line Conversion Project for OORG Technical Opinion.

1. RECOMMENDATION: The proposal appears to be sound and consistent with the objectives of the Montreal Protocol Ozone Projects Trust Fund. Approval is recommended, without informed consideration by the writer of item seven below.

2. RELEVANCE AND ADEQUACY OF INFORMATION PROVIDED: The information, along with the proposal "Montreal Protocol/AAISA MACS Compressor Assembly Project OORG Technical Opinion" appears to define the project and the anticipated expenses adequately.

3. TECHNICAL SOUNDNESS: This proposal identifies the technical support sources and their anticipated costs. The sources identified are believed to be competent.

4. LESSONS FROM EXPERIENCE: It is believed that this program will enhance the program already approved at FAACA by providing both technical and economic competition.

5. ENVIRONMENTAL ISSUES: The proposal appears to cover all environmental issues and provides for local control of regulated issues. Although it was not referred to in the proposal it is strongly recommended that the component identification and interchangeability considerations be identified clearly for the product user to avoid cross contamination of the MACS systems (as S.A.E. has done for the U.S. market).

6. SAFETY ISSUES: The extensive training budget should cover all unique safety considerations.

7. COST EFFECTIVENESS: The cost of $7.09/ kg. /yr. seems expensive, however the total economic impact is beyond the scope of this review in the time available. It should be considered by those having more understanding of the consequences and alternatives with consideration for the comments in item four above.

31 May 1994