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Report No. 13811-VE

MEMORANDUM AND RECOMMENDATION

OF THE

DIRECTOR OF LAC COUNTRY DEPARTMENT II

OF THE

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

TO THE

REGIONAL VICE PRESIDENT, LATIN AMERICA AND THE CARIBBEAN REGION

ON A

PROPOSED OZONE PROJECTS TRUST FUND GRANT

IN AN AMOUNT EQUIVALENT TO US$4.422 MILLION

TO VENEZUELAN PRIVATE ENTERPRISE

AIRE ACONDICIONADO INTEGRAL, S.A.

FOR A MOBILE AIR CONDITIONER FACTORY CONVERSION PROJECT

JUNE 27, 1995

Environemtn and Urban Development Division
Country Department II
Latin America and the Caribbbean Regional Office

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CURRENCY EQUIVALENTS

Currency Unit = Venezuelan Bolivar (BS)
US$1.00 = 169.6 Bs (Exchange rate as of June 27, 1995)

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
FONDOIN	:	Foundation to Implement the Montreal Protocol in Venezuela
GOV	:	Government of Venezuela
HFC	:	Hydrofluorocarbon
MAC	:	Mobile Air Conditioner
MCF	:	Methyl choroform, a controlled ODS
MFEC	:	Multilateral Fund Executive Committee
MFMP	:	Multilateral Fund for the Implementation of the Montreal Protocol
ODS	:	Ozone Depleting Substances
OORG	:	Ozone Operations Resource Group
OTF	:	Ozone Projects Trust Fund
USEPA	:	United States Environmental Protection Agency

FISCAL YEAR

January 1 - December 31

VENEZUELA

MOBILE AIR CONDITIONER FACTORY CONVERSION PROJECT

Project and Grant Summary

Financial Agent	None. Direct disbursement from the Bank to the Beneficiary.
Guarantor	None. Guarantor not required
Executing Agencies	The Beneficiary under the supervision of the World Bank and Fondo Venezolano de Reconversion Industrial y Tecnologica (FONDOIN)
Beneficiaries	Aire Acondicionado Integral, S.A. (AAISA)
Poverty	N/A
Amount	US$4.422 Million (Incremental Cost)
Terms	Grant
Estimated ODS Consumption Eliminated	100 tons annually (Basis: 40,000 compressors and 35,000 heat exchangers production per year)
Financial Plan	See Schedule A
Cost Effectiveness	Unit Abatement Cost: US$6.49/kg/year (Basis: Incremental costs only)
Economic Rate of Return	N/A
Staff Appraisal Report	N/A

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MEMORANDUM AND RECOMMENDATION
OF THE
DIRECTOR OF LAC COUNTRY DEPARTMENT II
TO THE REGIONAL VICE PRESIDENT
LATIN AMERICA AND CARIBBEAN REGION
OF THE INTERNATIONAL BANK FOR RECONSTRUCTION
AND DEVELOPMENT ON A PROPOSED OZONE PROJECTS
TRUST FUND GRANT FACTORY CONVERSION PROJECT
FOR A MOBILE AIR CONDITIONER FACTORY CONVERSION PROJECT

1. I submit for your approval the following memorandum and recommendation on a proposed Ozone Projects Trust Fund (OTF) grant in an amount equivalent to US$4.422 million which will be disbursed to Aire Acondicionado Integral (AAISA), an auto air conditioner (MAC) fabricator, to finance the incremental costs associated with the retooling of a heat exchanger fabrication and compressor assembly line, and related training and technical assistance costs. An OTF grant of US$620,000 has already been approved for conversion of a compressor assembly line at AAISA/COROVEN, a wholly-owned AAISA affiliate. This proposal for approval consolidates both MP operations, AAISA's heat exchanger fabrication line (US$3.802 million) and the compressor assembly line (US$620,000), in one free standing project (see Annex I, Explanatory Notes on Project Costs After Consolidation of January, 1995). This project will be the fourth Bank executed Montreal Protocol (MP) grant to Venezuela and will fund a key activity to reduce Venezuela's consumption of ozone depleting substances (ODS). Another MAC fabricator, FAACA, has already received MFEC approval for its own evaporator/condenser line conversion project. An OTF grant agreement will be entered into directly between the Bank as OTF trustee and AAISA as the Recipient. Estimated ODS eliminated by the project is 100,000 kg. annually.

2. **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 4,150 tons, or 6%. MCF consumption in 1991 was 130 tons, down from 570 tons in 1990. All $CC1_4$ (1,350 tons in 1991) is used as a chemical intermediate feed stock. CFC/Halon consumption in Venezuela in 1990 was 3,420 tons, but rose to 3,820 tons in 1991, still a decrease of 12% since 1986. Distribution of ODSs by end use in 1991 was MACs 25%; other AC/refrigeration 52%; foaming agent 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. The 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 available in the Project File.

3. **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 automobile inventory of registered vehicles is approximately 1,200,000. 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 (FAACA and AAISA) 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 subsector 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 fabrication and compressor assembly line conversion project, for which OTF funding is requested, is an integral part of the phase-out strategy. 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, as already mentioned, has already received MFEC approval for its own evaporator/condenser line conversion project.

4. **AAISA 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. The firm's annual compressor production is approximately 40,000 units. AAISA reported earnings of US$301,400 and US$329,000 on sales of US$8.7 and US$8.4 million

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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.

respectively in 1991 and 1992. Net income declined to US$111,000 in 1993, followed by an increase of US$460,000 in 1994 and projected to reach US$630,000 in 1995. Current and anticipated production levels indicate that AAISA is a viable concern.

5. **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 exchange 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.

6. **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 have five separate components, including the previously approved compressor assembly line (See Annex II and III, Technical and Cost Assessment, for complete project description):

Component 1:	Refitting of the evaporator/condenser assembly line;
Component 2:	Customer qualification testing;
Component 3:	Service training;
Component 4:	Engineering services;
Component 5:	Compressor assembly line

7. **Project Cost and Financing.** Total project cost estimates were US$4.8 million for the heat exchanger line and US$0.6 million (already approved) for the compressor assembly line, including contingencies. Incremental costs for the heat exchanger fabricator line project were US$4.230 million when first presented to the MFEC in the Bank's Initial Project Summary (IEPS) dated June 7, 1994. At the 14th Meeting of the MFEC in September 1994, a reduced amount of US$3.802 million was approved due to technological advances in the evaporator line which were considered ineligible for funding as incremental capital costs. Total project cost estimate is summarized in Table 1. AAISA, itself, will finance the approximately US$1.0 million in non-incremental costs.

Table 1: AAISA Project Cost Estimate

	(US$ 000's)
Component 1 - Evaporator/Condenser	
Investment:	
Equipment	2,216
Tooling	592
Freight	132
T/A Agreement	110
Civil Works/Utilities	83
Sub-total (Component 1)	3,133
Component 2 - Customer Qualification Testing	82
Component 3 - Training Program	103
Component 4 - Engineering Services	140
Component 5 - Compressor Assembly Line	563
Incremental Project Costs (excl. 10% contingency)	4,021
Incremental Project Costs (incl. 10% contingency)	4,422
Non-incremental Investment by AAISA	1,020
Total	5,442

8. **Incremental Costs.** All plant rearrangements, tooling/equipment, technology license, training and engineering services are incremental, as they are required to effect the changeover to production of HFC-134a compatible evaporators and condensers. Component 5 has only one non-incremental cost item for reclaim/recycle/recharge of CFC emissions. This investment, US$27,000 generates savings in terms of CFC-12 recovered and recycled of US$7,800 annually, which for 5 years of operation generates a 14% internal rate of return (IRR). This cost item will therefore be financed by AAISA. The heat exchanger line non-incremental investment by AAISA of US$990,000 consists primarily of conversion costs due to technological advances which do not meet eligibility criteria, as well as customer qualification testing and a small share of the training program. Total incremental cost estimate is therefore US$4.021 million exclusive of contingency.

9. **Project Implementation.** In tandem with the implementation of the already approved conversion to HFC-134a of the Compressor Assembly Line (Component 5), 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 1995 model year (see Annex III, Table IX, Implementation Schedule for Serpentine Condenser/Evaporator and Table XIV, Schedule of AAISA Customer HFC-134a Quarterly Model Change Over). 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 and procurement oversight during installation and start up will be provided by a Bank contracted technical specialist. Procurement and disbursement arrangements will be as indicated in Schedule B.

10. **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. Development of local HFC-134a MAC production capacity is essential to retention of MAC production capacity in Venezuela. The grants to AAISA and FAACA will 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.

11. **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.

12. **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. 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. Approval by the Bank of a financial plan to fund non-incremental project costs will be a condition of negotiation.

13. **Environmental Aspects.** The elimination of CFC-12 consumption is the basic environmental objective of both the heat exchanger 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. The project is classified as Category B for environmental assessment purposes.

14. **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$6.49/kg/year based on an annual production level of 40,000 compressors and 35,000 heat exchangers. The calculations are presented in Annex IV, Calculation of Unit Abatement Costs.

15. **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.

16. **Technical Evaluation.** The Bank's technical assessment consisted of a detailed review of the technical/financial proposals with AAISA, field inspection of existing units, proposed replacement installations, and verification of appropriateness with market demands for assemblers and, in the case of the compressor line conversion project (see Annex II), aftermarket dealers. Annex III, Technical and Cost Assessment provides a complete description of the heat exchanger project and associated costs, and incremental cost determination. Annex V (A & B) 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.

17. On the basis of the assessment, the Bank considers both the compressor assembly line and condenser/evaporator fabrication proposals to be of sound technical design, and 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 VI.

18. **Recommendation.** I am satisfied that the proposed OTF grant would comply with relevant provisions of the ozone projects trust fund in the Executive Director's resolution No. 91/5, establishing the Global Environment Facility, and I recommend that the Regional Vice President of the LAC region approve the proposed Grant.

Kenneth Lay
Director (Understudy)
Country Department II
Latin America and the Caribbean Region

Washington D.C.
June 27, 1995
Attachments

Schedule A

VENEZUELA

AAISA Automobile Air conditioner Factory Conversion Project

Estimated Project Cost

	Local	Foreign	Total
	----------(US$ thousand)----		
Equipment (Including Freight)	70.6	2,810.9	2,881.5
Tooling (Including Freight)	14.9	726.0	740.9
Other Incremental	83.0	526.6	609.6
Other Non-Incremental	676.0	41.0	717.0
Contingency (10%)	82.0	411.0	493.0
Total Project Cost	926.5	4,515.5	5,442.0

Financial Plan
(US$ thousand)

	OTF	Beneficiary	Total
Equipment (Including Freight)	2760.5	121.0	2,881.5
Tooling (Including Freight)	650.9	90.0	740.9
Other Incremental	609.6	----	609.6
Other Non-Incremental	---	717.0	717.0
Contingency (10%)	401.0	92.0	493.0
TOTAL	4,422.0	1,020.0	5,442.0

Procurement and Disbursement

Procurement. Procurement of equipment, tools and dies to produce the evaporators/condensers and compressors will be characterized by a large number (35-40 estimated) of relatively small value purchase contracts. Maximum individual contract value is estimated at US$400,000. AAISA will carry out the vendor selection, subject to verification by the Bank. Standard commercial practices would be followed in the procurement of project financed equipment requiring comparison of no less that two proposals (except in cases covered under para. 3.7 of the Bank guidelines). The company's normal practice is to procure through competitive shopping. AAISA has already demonstrated, particularly with its reduced project cost reestimate, that it is capable of competently executing competitive shopping procurement procedures. Regarding the Technical Assistance (T/A) component, three specialized firms in the design to fabricate serpentine type evaporators/ condensers were short listed: Thermal Components Inc., Calsonic International Inc., and Emerson & Renwick Ltd (E&R). The latter was selected as offering the best terms and conditions for US$120,000 non-exclusive licensing agreement. All OTF financed contracts will be subject to ex-post review by the Bank in order to verify compliance with Bank procurement guidelines.

Procurement Methods (US$ 000's)

Category	ICB	LCB	Other	Total
Equipment (Inc. Freight)			2,760.5	2,760.5
Tooling (Inc. Freight)			650.9	650.9
Technical Assistance			110.0	110.0
Training			153.9	153.9
Unallocated			746.7	746.7

Disbursement. The grant is expected to be disbursed within a period of 24 calendar months and the closing date will be June 30, 1997. The Bank will disburse against 100% of eligible foreign expenditure and 100% of eligible local expenditures for eligible incremental costs, net of direct import, sales and value added taxes, for grant financed goods contracts. In accordance with decision of the MFEC, retroactive financing will be permitted for eligible expenditures incurred after the date of Venezuela's adhesion to the Montreal Protocol (February 6, 1989) under contracts signed prior to grant signature which are eligible incremental costs. Retroactive financing will amount to an estimated US$755,000 including technical assistance fees and selected equipment and tooling. Disbursements will be made against Statements of Expenditure (SOE), except for requests for direct payments to suppliers/contractors. These direct payment requests should be for amounts above US$30,000 equivalent, and be fully documented. Requests for disbursement will be transmitted by AAISA to the Bank. Payments for eligible retroactive expenditures will be made directly to AAISA. To facilitate project implementation, a Special Account in US dollars for US$300,000 will be opened and maintained in a commercial bank acceptable to the Bank.

Estimated Disbursement (US$ 000's)

	FY95	FY96
Annual	4,200	222
Cumulative	4,200	4,422

Schedule C

VENEZUELA

AAISA - CFC-12 to HFC-134 Conversion Project

Timetable of Key Project Processing Events

(a)	Time taken to prepare:	12 months
(b)	Prepared by:	Beneficiary in conjunction with Bank technical consultant
(c)	First Bank mission:	February 1993
(d)	MFEC Approval:	November 1993 (compressor assembly line) September 1994 (heat exchanger fabrication line)
(e)	Pre Appraisal:	June 1993
(f)	Appraisal:	May 1994
(h)	RVP Approval:	May 1995
(i)	Planned Signing:	June 1995
(j)	Planned Effectiveness:	June 1995
(k)	Planned Completion:	December 1996

Annex 1

AIRE ACONDICIONADO INTEGRAL, S.A. (AAISA)

Explanation of Project Costs After Consolidation of Heat Exchanger Fabrication Line and Compressor Assembly Line Projects (See Original Projects Technical Annexes 2 and 3 of September 1993 and May 1994, respectively) and Impact of Montreal Protocol Executive Committee Decision Regarding Eligibility of Forty-eight Percent of Evaporator Line Costs

January 1995

AIRE ACONDICIONADO INTEGRAL, S.A. (AAISA)

The original project cost of the AAISA/COROVEN compressor assembly line project was $650,000, of which $620,000 was approved as incremental costs eligible for Multilateral Fund Executive Committee (MFEC) financing. The subsequent heat exchanger fabrication line project, approved for financing by MFEC in the amount of US$3.8 million in September 1994 at the 14th MFEC meeting in Nairobi, has a total project cost of US$4.8 million.

The technical annexes submitted with the original project documents for both projects are included in Annexes II and III without modifications. Both projects in their original form included categories for non-incremental costs reflecting the investment required of AAISA itself.

AAISA's original proposal for MFEC funding of the heat exchanger line was discussed at length by the MFEC and FONDOIN, the Venezuelan agency mandated with MP implementation in Venezuela. The conclusion of the discussions resulted in an ad hoc compromise that reduced the eligible portion of the evaporator part of the heat exchanger line by 48%. In the compromise, specific reductions on an equipment- or tooling-specific basis for the evaporator line were not imposed by the MFEC.

The revised project document summary table (Table I), to which this annex is attached, reflects the combined costs of the compressor assembly line project and the heat exchanger line project, including the 48% reduction applied to the evaporator part of the heat exchanger fabrication line. The cost adjustments resulting from the MFEC's decision to reduce funding for the evaporator line are reflected in "Components 1 through 3" of Table II in this annex (Annex I, Table II).

In order to faciliate the procurement process and final project processing within the Bank, the Bank operational division processing the project requested AAISA to provide estimates of equipment- and tooling-specific reductions that would reflect the 48% adjustment reached by compromise with the MFEC. The following "Annex Tables" summarize (Annex I, Table I) and detail (Annex I, Table II) the company's response to which the Bank had no objection.

Table I: Summary Table of Revised Project Costs
(US$ thousand)

	INCREMENTAL	NON - INCREMENTAL
COMPONENT 1 - Evaporator/Condenser Fabrication Line:		
Equipment	2216	121
Tooling	592	90
Transport	132	- 0 -
T/A Agreement	110	- 0 -
Civil Works/Utilities	83	318
Sub Total (Component)	3133	529
COMPONENT 2 - Customer Qualification Testing:	82	81
COMPONENT 3 - Training Program	103	18
COMPONENT 4 - Engineering Services	140	- 0 -
COMPONENT 5 - Compressors	563	27
Project Costs (Excl. Contingency)	4021	655
10% Contingency	401	65
Import taxes		300
Total Incremental Costs	**4422**	
AAISA Funded Non-Incremental Costs		**1020**
Total Project Cost		**5,442**
Total Incremental Cost (MFEC)	**4422**	
AAISA Funded Non-Incremental		**1020**

Table II: Detailed Breakdown of Revised Costs

	CONDENSER	COMMON	EVAPORATOR	OTHER INVESTMENTS	TOTAL
COMPONENT 1					
- Equipment	1950		266		2216
- Tooling	393		199		592
- Transport		132			132
- T/A Agreement		110			110
- Civil Works/Utilities	83	- 0 -	- 0 -		83
Sub Total (Component 1)	2426	242	465		3133
COMPONENT 2 -					
- Customer Qualification Testing	82				82
COMPONENT 3					
- Training Program	103				103
COMPONENT 4					
- Engineering Services		140			140
COMPONENT 5					
- Compressors	- 0 -	- 0 -	- 0 -	563	563
Incremental Project (Excl. Contingency) Costs	2611	382	465	563	4021
10% Contingency	260	38	46	57	401
TOTAL INCREMENTAL COSTS	2871	420	511	620	4422
NON-INCREMENTAL INVESTMENTS BY AAISA (Equipment Services)	251		440	29	720
IMPORT TAXES					300
AAISA COUNTERPART FUNDING					1020
TOTAL PROJECT COST					5442

The following tables (Annex I, Table III and Annex I, Table IV) supercede the original heat exchanger "Equipment Cost" tables included in the original technical Annex (Annex II, Table I of September 1993, and Annex III, Tables I and II of May 1994). The new tables reflect the equipment and tooling requirements of the compressor assembly line, and the 48% reduction in eligible incremental costs in terms of specific tooling and equipment adjustmens to the evaporator line.

Table III: Equipment Cost Breakdown

EQUIPMENT	IMPORT OR LOCAL	EQUIPMENT COST	TOOLS	TOTAL COST	DELIVERY TO POE	IMPORT DUTY 10%	TOTAL US DOLLARS
Tube Uncoil /Straighten Cut System	I	15,000	105,000	120,000		12,000	13,7000
Serpentine Tube Bender	I	244,400	17,600	262,000		26,200	289,900
Serpentine Evaporator Qualifier	I	88,500	16,500	105,000		10,500	117,200
Serpentine Condenser Qualifier	I	96,900	12,100	109,00		10,900	121,660
Extruded Tube Saw	I	31,000	-	31,000	17,000	3,100	35,800
Horn Die Press/Ext. End Qualifier	I	98,950	11,550	110,500		11,050	123,250
Serp. Condenser Assy. Table and Banders	I	68,000	11,000	79,000		7,900	88,600
Serp. Evaporator Assy. Table and Banders	I	65,700	8,800	74,500		7,450	83,650
Condenser Fin Machine	I	245,250	79,750	325,000		32,500	359,200
Evaporator Fin Machine	I	225,450	99,550	325,000		32,500	359,200
Side Plate Cutting	I	31,000	-	31,000	2,000	3,100	36,100
Parts Washer	I	45,600	-	45,600	5,000	4,560	55,160
Batch Dry Oven	I	33,775	-	33,775	6,850	3,378	44,003
Degreaser	I	52,610	-	52,610	4,000	5,261	61,871
DiWater	I	15,787	-	15,737	595	1,579	17,961
Continuous Fluxer	I	97,800	-	97,800		9,780	116,863

Table III: Equipment Cost Breakdown

EQUIPMENT	IMPORT OR LOCAL	EQUIPMENT COST	TOOLS	TOTAL COST	DELIVERY TO POE	IMPORT DUTY 10%	TOTAL US DOLLARS
Continuous Dry Oven	I	66,500	-	66,500	27,850	6,650	82,433
Nocolok Braze Furnace	I	382,425	-	382,425		38,243	429,952
Leak Test (Air Under Water)	I	5,000	-	5,000		0	5,000
Surface Treatment Wash	I	152,888	-	152,888	20,553	15,289	88,730
Paint and Brake Oven System	I	71,816	-	71,816	8,000	7,182	86,998
Leak Test (Mass Spectrometter)	I	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	I	100,000	-	100,000	4,000	10,000	114,000
Sigs (600 Sets Braze Plates at 500/set	I	-	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)	I	31,862	-	31,862	2,000	3,186	37,048
Machine Wash	L	70,440	3,949 (L)	74,380	-	7,044	87,384

Table III: Equipment Cost Breakdown

EQUIPMENT	IMPORT OR LOCAL	EQUIPMENT COST	TOOLS	TOTAL COST	DELIVERY TO POE	IMPORT DUTY 10%	TOTAL US DOLLARS
Shaft Key Press for Machine		16,910	12,280 78,870(L) 4,410 (I)	29,190	-	2,132	33,661
Charge Machine	L/I	28,170	5,500 4,720 (I) 780 (L)	33,670	-	3,289	39,657
Leak Check Equipment	I	14,080	390	14,470	-	1,447	17,076
Performance Test Machine	I	129,300	-	129,300	-	12,930	152,592
Oil Charging	L/I	-	5,500 4,720 (I) 780 (L)	5,500	35,000	472	6,413
Assembly Torque Check	L/I	-	3,120 1,570 (L) L,550 (I)	3,120	-	150	3,520
Charging Machine	I	34,470	-	34,470	-	3,447	40,679
Performance Test Stand/Table	I	21,130	-	21,130	-	2,113	24,936
Moisture/Foreign Material Check Inst.	I	35,220	-	35,220	-	3,522	41,564
Thermometer for Opaque	I	28,170	-	28,170	-	2,817	33,244
Attachment	I	-	28,170	28,170	-	2,817	33,244
Total		**2,714,703**	**740,750**	**3,455,453**	**137,848**	**334,488**	**3,927,799**
Incremental		**2,593,703**	**650,750**	**3,244,453**	**137,848**	**-**	**3,382,301**
Non-Incremental		**121,000**	**90,000**	**211,000**	**-**	**334,488**	**545,488**

NOTE: Delivery to Puerto Cabello, Venezuela costs have been averaged 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.

Table IV: AAISA Project Cost Estimates

	INCREMENTAL	NON-INCREMENTAL
· Equipment:	2,593,703	121,000
· Tooling:	650,750	90,000
· Shipping Cost to Port of Entry (POE) Venezuela	166,700	
· Technical Assistance Agreement with Calsonic International Inc. (CII)	110,000	
· Customer Qualification Testing	82,000	81,000
· Engineering Services	140,000	
· Training	180,994	18,000
· Civil Works/Utilities	83,000	318,000
· Other Incremental	13,506	
· Other non-incremental		26,343
INCREMENTAL	4,020,653	
NON-INCREMENTAL		$654,343
TOTAL	US$4.674.996	
10% Contingency:	401,000	65,434
Import Tax:		300,000
TOTAL COST (Including Contingency):	US$5.441.430	
TOTAL INCREMENTAL:	4,421,653	
TOTAL NON-INCREMENTAL: (Including import taxes):		1,019,777

AIRE ACONDICIONADO INTEGRAL, S.A. (AAISA)

Automobile Air Conditioner (AAC) Factory Conversion for Production of HFC-134a Refrigerant Mobile Air Conditioner (MAC) Compressors

Technical and Cost Assessment

By

F. Peter Turner

September 1993

A. SUMMARY AND RECOMMENDATIONS

Project Description: The proposed project is to convert AAISA's Mobile Air Conditioner (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. In addition, a program to reuse and recycle both HFC-134a and CFC-12 MAC systems/components will be established.

Principal Components: The project involves 4 major components: Each component is described in detail in Appendixes I to IV respectively.

Component 1 - Coroven Compressor Assembly Line
Component 2 - Technical Training Program for AAISA Personnel
Component 3 - Service Training for Selected Venezuela Dealerships and Service Shops.
Component 4 - Reclaim/Recycle/Recharge CFC-12 automotive AC systems/components.

Cost Estimates (US dollar): Total Cost Estimate for Major Project Components is US$588,010.

Component 1 - Coroven Compressor Assembly Line:

Equipment/Tooling Costs (Table I, Appendix I)	$436,790
Other Incremental Costs (Table II, Appendix I)	$ 91,883
Project Implementation Schedule (Table III, Appendix I)	
Schedule of Payments (Table IV, Appendix I)	
Total Investment	$528,673

Component 2 - Technical Training Program for AAISA Personnel: (See General Information in Appendix II)	$ 5,900
Component 3 - Service Training for Selected Venezuelan Dealers: (Table V, Appendix III; Item 1, Table VII, Appendix IV)	$ 27,094
Component 4 - Reclaim/Recycle and Recharge (CFC-12): (Tables VI and VII; Appendix IV)	$ 26,343
Total Investment (less contingency)	$588,010

Incremental Costs: Components 1, 2, and 3 are eligible incremental costs. Component 4 is not, due to its favorable financial rate of return. Its installation is, however, essential to in plant reduction of CFC-12 consumption. Plant rearrangements, tooling/equipment, training and product evaluation tests are required to effect the changeover to use of HFC-134a.

Proposed Project Implementation: All major project components will be implemented during the next 18 months. Due to the late notice of HFC-134a implementation by AAISA and COROVEN customers, and the necessary investigation into Nippondenso's technical and license requirements, most projects will not commence until Dec. 1993 time frame, or as soon as possible after MFEC approval.

Components 3 and 4 (**Service Training for Selected Venezuelan Dealers and Reclaim/Recycle, and Recharge (CFC-12)**, will commence as soon as AAISA/COROVEN have new assembly line installation under way and their customer's vehicles, utilizing HFC-134a AC systems, are manufactured and released to Venezuelan markets. Components 3 and 4 will be considered an ongoing process during the succeeding 24 months.

Technical Evaluation: Technical Assessment consisted of a detailed review of the technical and financial proposals with AAISA/COROVEN engineering and administration departments. An in depth review of current manufacturing processes was conducted. In addition, a review of AAISA/COROVEN market strategy, rationale/justification for required tooling/equipment and an overview of their proposed training programs was made. I consider their project request technically correct, consistent with their customer requirements, and qualified for OTF financing of eligible incremental costs.

CFC Consumption Eliminated: Table VI demonstrates that implementing Components 1 and 4 will result in a potential CFC-12 emissions reduction of 97% of current estimated in house consumption of 25,000 lbs/year, through elimination of 17,600 lbs/year, and recycling of 6,700 lbs/year.

COROVEN's current compressor assembly process utilizes CFC-12 as a test media in performance testing resulting in all CFC-12 being vented to the atmosphere following the performance test.

AAISA manufacturing, engineering, development area and service shops utilize CFC-12 for AC component/system manufacturing and development testing where all CFC-12 used is vented to the atmosphere.

Component 1, COROVEN Compressor Assembly Line, will not use CFC-12 as a test media, but will utilize dry air and HFC-134a to conduct performance tests, thus eliminating completely the use of CFC-12.

Component 4, Reclaim/Recycle/Recharge, will allow manufacturing, product engineering development shops, and service shops (7,400 lbs/year consumption) to reclaim/recycle/recharge CFC-12 currently being vented to the atmosphere. Full use of recycling equipment should reduce and allowing a 10% loss of CFC-12 due to processing errors/leaks etc. should reduce CFC-12 loss by 90% (Table VI), assuming a 10% loss of CFC-12 due to processing errors/leaks etc.

As HFC-134a refrigerant is introduced into the AAISA manufacturing/engineering/service areas, reclamation and reuse of HFC-134a will be possible.

Additional reductions in CFC-12 consumption are possible only when COROVEN/AAISA customers convert their automotive and commercial AC systems to HFC-134a refrigerant designs.

Recommendations: Following a review of all proposals with COROVEN/AAISA personnel appropriate modifications have been made. I find all components technically correct and consistent with COROVEN/AAISA customer requirements, however, only Components 1 through 3 are qualified for OTF financing.

B. DETAILED PROJECT DESCRIPTION

PROJECT COMPONENT NUMBER 1 - COROVEN COMPRESSOR ASSEMBLY

Project Component 1 - COROVEN Compressor Assembly: A new compressor assembly line for processing Nippondenso designed compressors is required due to the incompatibility of P.A.G. oil used in HFC-134a systems and mineral oils used for lubricating AC systems utilizing CFC-12.

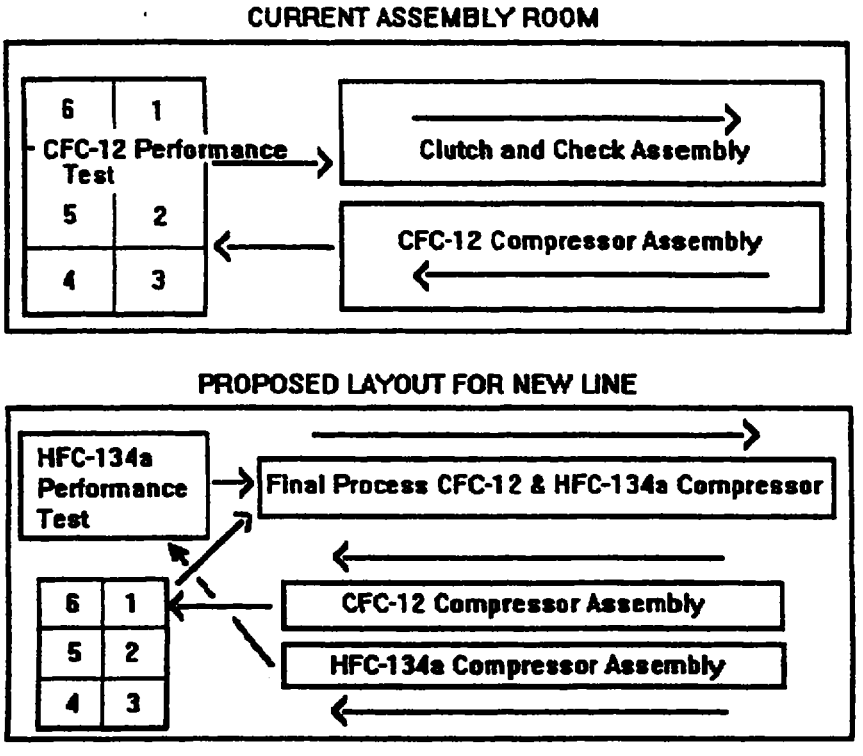
In addition, the following Nippondenso parts have been redesigned for compressors using HFC-134a refrigerants. These parts have been assigned new/exclusive part numbers which cannot be mixed with similar parts designed for CFC-12 refrigerant compressors.

- Shaft Seals
- Compressor Heads
- O-rings
- Gasket
- Thrust Bearings
- Swash Plate
- Valve Plate
- Cylinder Block
- Relief Valve
- Clutch Rotor Bearing
- Clutch Rotor Ring
- Shield
- P.A.G. Oil

The new assembly line will be built using available space in the assembly room of the current compressor building.

Tooling and equipment layouts have maximized existing CFC-12 assembly space allowing for both CFC-12 and HFC-134a compressors to be assembled separately and then share a common assembly line when differences in parts/process allow common operations (See Figure 1).

Figure 1: Assembly Line Layouts



Tool and Equipment Proposals: Tool and equipment proposals were reviewed and found to be technically correct and necessary for HFC-134a compressor assembly (See Table I).

The Performance Test Stand (Table I), for testing HFC-134a compressors comprises approximately 30% of total tooling and equipment costs.

Information supplied by Nippondenso indicates present test stands, which only measure pump capacity and electrical clutch engagement, will not meet 1994 customer contract requirements. Rebuilding them to meet customer requirements appears to be cost prohibitive.

Table I: Tooling and Equipment

Item No.	Process Description	Equipment	Tooling	Estimated Costs	
				Equipment	Tooling
1	Parts Wash	Machine Wash	Wash Basket	US$70,440	US$3,940
2	Parts Assembly	Shaft Keypress for Machine	Assembly Fixtures, Driver Torque Wrench & Assembly Table	$16,910	$12,280
3	Oil Charge I	Charge Machine	Digital Scale & Assembly Table	$28,170	$5,500
4	Leak Check	Leak Check Equipment	Air Driver	$14,080	$390
5	Performance Test	Performance Test Machine	Air Driver	$129,300	
6	Oil Charge II		Digital Scale & Assembly Table		$5,500
7	Assembly Torque Check		Assembly Table, Jig, & Torque Wrench		$3,120
8	Refrigerant Charge	Charging Machine		$34,470	
9	Quality Assurance Test	Performance Test Stand/Table		$21,130	
		Moisture/Foreign Material Check Instruments		$35,220	
		Thermometer for Opaque		28,170	
10	Attachment		Assembly Jigs & Shutes		$28,170
Subtotals				US$377,890	US$58,900
TOTAL				US$436,790	

Appendix I
Page 3 of 9

The new Performance Test Stand is designed to perform the following checks:

- Vacuum Leak Check
- Pressure Leak Check
- Noise/Vibration Test
- Clutch Speed (RPM) Verification
- "Pump Up" Cooling Capacity Check

Most significant of all is that the new performance test stand will not use CFC-12. The test stand is designed to function using dry air and HFC-134a.

Production capacity of the new test stand is approximately 50 units/hour as compared to 5 units/hour of the current test stand. New HFC-134a assembly line is designed for 69,000 units/year which is the same design capacity for the CFC-12 line utilizing 6 performance test stands. Design capacity is consistent with AAISA's production schedule forecast for the foreseeable future.

Other incremental costs (total US$92,000) include shipping (US$35,000), relocation of current CFC-12 line and installation of the HFC-134a line (US$12,000), and technical assistance and training expenses for operation of the new test stand (US$45,000).

Table II: Other Incremental Costs

ITEM	(US$ 000's)
-Transportation of Tools and Equipment	34,693
-Plant Rearrangement:	
• Relocated Part of Current CFC-12 Line	3,100
• Installation of New Line	9,300
-Technical Assistance from Nippondenso: 1 Man - Wages, Hotel, Meals & Lodging, and Transportation for 1 Month.	18,430
-Design and Process Validation Test: (Samples sent to Japan for Tests).	26,360
TOTAL	91,883

Project Implementation Timing: The implementation schedule consists of 6 main steps and requires 15 months as follows.

Table III: Project Implementation Schedule

NO.	STEP	PROCEDURE(S)	TIME
1	Order (COROVEN)	• Purchase order by Coroven	1/2 Month
2	Arrangement (Nippondenso Japan - NDJ)	• Verify Machine Specifications	2 Months
		• Machine Fabrication	5 Months
		• Inspection and Functionability of Machines	1 Month
3	Transportation and Installation (NDJ and COROVEN)	• Packing and Dispatch	1/2 Month
		• Shipping by Sea	2 Months
		• Installation at COROVEN	1 Month
4	Process Capability Check (COROVEN)		1/4 Month
5	Quality Check	• Sending of 10 Samples of Each Pilot to Japan	3/4 Month
		• Check of Functionability, Durablility and Specifications	2 Months
6	Production	• Start of Mass Production on Models Approved	

Table IV: Schedule of Payments
(US$)

Investment Item	Month 1	Month 8	Month 10	Month 12
Tools & Equipment	US$436,790			
Transportation			US$34,693	
Relocation of Current CFC-12 Line		US$3,100		
Installation of HFC-134a Assembly Line			$9,300	
Technical Assistance and Training			$18,430	
Design and Process Validation				US$26,360
Total by Month	US$436,790	US$3,100	US$62,423	US$26,360
Total Project Cost				US$528,673

General Marketing Information Background: Data provided by AAISA for the years 1992 and 1993 show total compressor production in Venezuela as follows:

1992 - 92,179 units[a]
1993 - Beginning in 1993, both AAISA and FAACA predict a 10% increase per year.

According to AAISA supplied information for the 1992 year, AAISA's 42.4% share of the market exceeds the market share of imports by over 8% in a market producing more than 92,000 units

Market Shares

AAISA	42.37%	39,056 Units
FAACA	23.5%	21,662 Units
IMPORTED	34.13%	31,461 Units
		92,179 Units

[a] Figures are from "EAVENDA" Venezuela Parts Manufacturing Association Publication.

AAISA Market Strategy: AAISA's market strategy in the compressor business is based on its ability to completely develop HFC-134a technology by December 1994. Using the HFC-134a technology in its production, AAISA's objectives are to:

- Maintain and improve current local compressor markets.
- Actively pursue "Port of Entry" (POE) business.

Port of Entry (POE) business develops when customers of imported automobiles not equipped with air conditioning systems decide to have them installed. POE vehicles are imports which may or may not have an air conditioning system. Following is a list of vehicles imported during 1992.

1992 POE VEHICLES - VENEZUELA[b]

MODEL	UNITS/MONTH
VW "GOL"	170
VW "GOLF"	120
DACIA	200
SKODA	250
LADA	650

TOTAL IMPORTS THROUGH DECEMBER 1992 = 63,000

Most manufacturers that have assembly lines in Venezuela will import vehicles without the A/C system and retrofit the A/C system with parts produced from their assembly plants in Venezuela.

Most orders by distributors and individuals will be imported with A/C system installed.

Approximately 30% of the vehicles imported in 1992 (19,000 units) were imported from manufacturers without MAC units, thus creating the best POE potential for Venezuela built AC component systems (See Figure 2).

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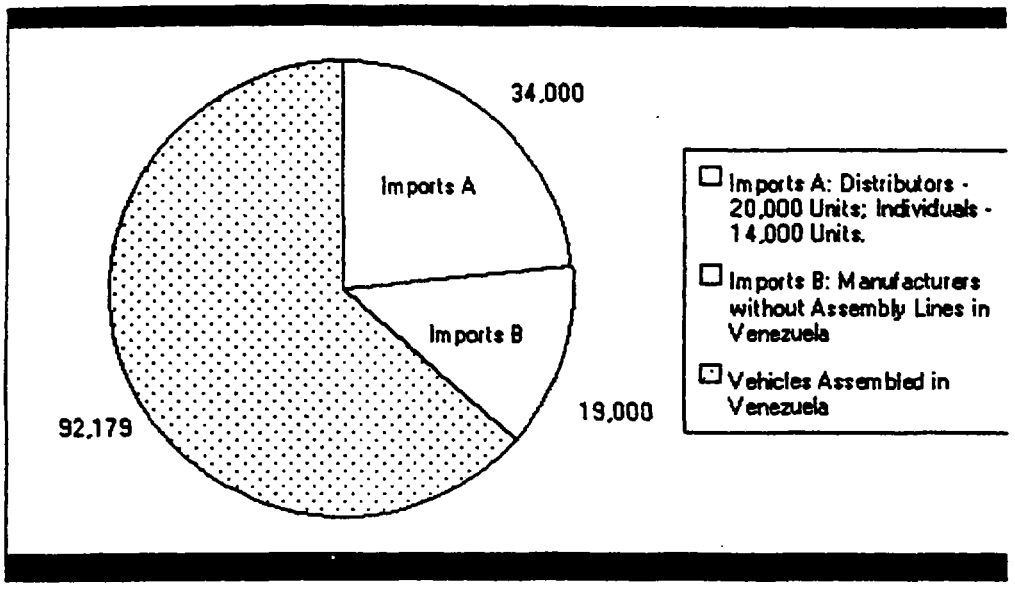
[b] January 1993 "CAVENEZ" Venezuela Association of Assembly Lines.

Figure 2: 1992 Total Vehicles



Implementing strategic business plans is very difficult at this time due to lack of information relating to choice of refrigerant to be used by AAISA's customers.

Following is a chart of AAISA's customers utilizing CFC-12 refrigerant and new customers expected by December 1994 utilizing HFC-134a.

Refrigerant Utilization of AAISA Customers Current and December 1994			
MODEL	Units/ Month	HFC-134a; Dec. '94 New Business[c]	CFC-12 Carryover[d]
Cherokee	350	X	
Wrangler	50	X	
Spirit	240	X	
F150-Ford Bronco	370	X	
R11 Renault	60		X
R21 Renault	40		X
Fiat	250		X
Toyota	1,050	X	
Mitsubishi Montero	150	X	
Mitsubishi Van	80	X	
Mini Cooper	200		X
TOTAL	2,840		
AFTER MARKET			
VW "GOL"	150	X	
VW "GOLF"	85	X	
DACIA	150		X
SKODA	250	X	
LADA	150		X
TOTAL	785	2775	850

The statistics shown in the chart indicate that by December 1994, AAISA expects to build monthly:

- 2,775 new HFC-134a units
- 850 CFC-12 carry over units

On that basis, AAISA will have a monthly compressor business potential of 3625 units

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[c] New Business - Not supplied at this time but expected by December 1994.

[d] Carryover - CFC-12 business with no HFC-134a information from customer.

PROJECT COMPONENT 2 - TECHNICAL TRAINING PROGRAM FOR AAISA

Project Component Number 2 - Technical Training Program for AAISA

Personnel: AAISA has developed a 40 hour training program which will be given to 86 employees. Attendees will be selected from the following departments:

- Engineering
- Quality Assurance
- Manufacturing
- Sales
- Aftermarket Sales
- Service Shop

The program will consist of the following subject areas and hours of training:

HOURS	DESCRIPTION
5	Philosophy of changes in today's world.
5	Theory of changes from CFC-12 to HFC-134a.
10	Practical elements of changes in design of products to utilize HFC-134a.
16	Practical use of reclaim/recycle/recharge equipment. Diagnostic steps to use on vehicles utilizing HFC-134a.
4	Review/question/answer session.

The cost of the whole program is estimated at US$5,900. With the confusing and often conflicting conceptions surrounding the conversion of AC Systems from CFC-12 to HFC-134a, a course of this nature is fundamental. I strongly endorse and recommend its consideration.

PROJECT COMPONENT 3 - SERVICE TRAINING

Project Component Number 3 - Service Training: AAISA will develop a Training Program for Selected Venezuela Dealerships and Service Shops. The following are its objectives:

- Develop understanding of the ozone layer and Montreal Protocol requirements.
- Upgrade service personnel on new AC system products and service techniques.
- Recovery and recycling principles relating to refrigerant when servicing automotive AC systems utilizing CFC-12 and HFC-134a refrigerants.
- Training in the use of CFC-12 and HFC-134a recovery and recycling equipment.

AAISA will arrange for procurement and training of instructors which will consist of an engineer and automotive technician. In addition, AAISA will supply a truck to transport the instructors, equipment and training materials to the training sites. The truck will have an HFC-134a system installed which will be used for demonstration purposes and for "hands on" training.

Duration of the training program will be 8 hours: 5 hours theory and 3 hours "hands on" practice with equipment. Maximum trainee attendance is recommended at 12 persons per session.

The training program will utilize training materials developed by: i) Chrysler Corporation; ii) Nippondenso; iii) ASE (Automotive Service Excellence - Washington, D.C.); and iv) IMACA (International Mobile Air Conditioning Association - Grande Prairie, Texas).

AAISA, in conjunction with its customers, has identified the list of cities in Table V where training will be conducted. The costs associated with each city include:

- Hotel and Meals for Instructors
- Transportation
- Training Materials (Manuals)

Costs: Total costs of Component 3, Service Training (US$27,094), include US$15,000 for "Recovery/Evacuation & Recycling/Charging" equipment and tooling required for CFC-12 demonstrations as detailed in Item 1 of "Service Tools" in **Table VII, Tooling and Equipment Required for HFC-134a**, and US$12,094 in training expenses.

Table V: Service Training

CITY	NEW ESTIMATED COSTS (US$)
Acarigua	1,076
Barquisimeto	763
Caracas	763
Maracaibo	1,282
Maracay	600
Maturin	1,410
Porlamar	1,550
Puerto LaCruz	1,410
Puerto Ordaz	1,410
San Cristobal	1,300
Valencia	530
	12,094

I have reviewed program materials from ASE and IMACA and find the programs consistant and technically sound with respect to servicing automotive AC systems using CFC-12 and HFC-134a.

AAISA does not hesitate to point out that the cost of Reclaim/Recycle/Recharge equipment is prohibitive for 99% of Venezuela's AC service shops. Dealerships with direct financial support from parent companies may have the equipment by 1994.

The initial cost of certified reclaim/recycle equipment and the fact that Venezuela will not mandate the use of HFC-134a until the year 2006 leaves little doubt that the amount of CFC-12 used by the Venezuelan automotive service industry will not be dramatically reduced until CFC-12 is not available.

The reality of the service situation should not preclude the implementation of the training program. There is a definite need for training when HFC-134a is introduced mid-year 1994.

PROJECT COMPONENT 4 - RECLAIM/RECYCLE/RECHARGE SERVICE

Project Component Number 4 - Reclaim/Recycle/Recharge Service Tooling: Total cost of Component 4 is US$26,343. Service tools described in table VII are the minimum tools required to reclaim/recycle/recharge either CFC-12 or HFC-134a components/systems and must be considered essential to reduce CFC-12 consumption. Average annual consumption of CFC-12 for testing purposes is now 25,000 lbs./year (11,365 kg.), of which 17,600 lbs. is consumed in the CFC-12 compressor assembly line for testing, and the remainder (7,400 lbs.) in the service shop and other areas of the factory. All of this is now vented to the atmosphere. The CFC-12 consumption used in the compressor assembly line will be eliminated by the switchover to HFC-134a compressors, which use a mixture of air and HFC-134a as the testing medium. It is estimated that 90% of the remaining consumption or approximately 6,700 lbs. (3050 kg./year) can be captured and resold as a result of the installation of the recycling apparatus. Total annual CFC-12 emissions will therefore be reduced from 11,365 kg. to 320 kg. Even using the current low price (US$2.57/kg.) for CFC-12 in Venezuela, and assuming no change in price, the return on the investment in recycling equipment is US$7,800/year. Over an assumed five years of operation, the internal rate of return on the investment is 14%, indicating that it is a worthwhile financial investment, and, therefore not eligible to be included as an incremental cost.

Though not recommended for OTF financing, Component 4 is an integral part of the in plant CFC-12 elimination strategy, and should, therefore, be retained within the project scope.

Table VI: AAISA Current CFC-12 Consumption and Potential Reduction

COROVEN - AAISA							
	AVERAGE CURRENT CFC-12 CONSUMPTION				POTENTIAL CFC-12 REDUCTION		
FACILITY	LBS/Month	US$/Lb.	COST/Mo.	Total Use Lbs./Year	Lbs./Year	US$ Year	Percent Reduction
	A	B	(A * B)	C	D	(D * B)	E
				(A * 12)	(A*E*12)		
Coroven	1,452	1.17	1,699	17,424	13,417	15,698	.77[a]
AAISA	219	1.17	256	2,628	2,364	2,766	.90[b]
Service Shop	396	1.17	463	4,752	4,272	4,998	.90[b]
Total	2,067	1.17	2,418	24,804	20,053	23,462	.81 (D/C)

a Jan '94 Production (Est.)
2775 Units/Month HFC-134a
850 Units/Month CFC-12
3625 divided by 2775 = 77%

b
- Assuming '93 and '94 production levels are the same
- 100% use of reclaim/recycle/recharge equipment
- With 10% loss of CFC-12 due to process errors/leaks, etc.

Table VII: Tooling and Equipment Required for HFC-134a -

SERVICE TOOL	ENGINEERING DEPARTMENT REQUIRED	SERVICE SHOP REQUIRED	PRODUCTION REQUIRED	TOTAL REQUIRED	ESTIMATED COST US$	TOTAL COST US$	BRAND	MODEL
* 1. Recovery/Evacuation & Recycling/Charging HFC-134a	1	1	3	5,000	15,000	26,343	ROBINAIR	17,734
2. Recovery/Evacuation & Recycling/Charging CFC-12	1	1	1	3	5,000	15,000	ROBINAIR	17,701
3. Couplers (Low Side and High Side)	50	540	0	90	50	4,500	ROBINAIR	18,190/1
4. Oil Injection	2	2	0	4	80	320	ROBINAIR	34,065
5. Filter-Drier 7100oo	4	4	0	8	50	400	ROBINAIR	34,430
6. Enviro-Guard Hoses	9	9	0	18	18	324	ROBINAIR	60,072
7. Scale	1	1	1	3	800	2,400	TIF	VA105
8. Electronic Leak Detector	1	1	1	3	500	1,500	TIF	6,501
9. Gauge Set	3	4	2	9	211	1,899	TIF	9,575

* For Charging of Refrigerator Products
N.A. = Not Available

* Item to be used for Project Component No. 4.

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 III, 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 III, 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.

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 III, Table IX). Project implementation is directly tied to AAISA's customers requirements (Annex III, Table X, XI). All of AAISA's customers approve of the use of serpentine design evaporators/condensers. AAISA is currently contacting Calsonic International Inc. (CII) and Modine to import condensers/evaporators to maintain the AAISA customer base until the heat exchanger conversion project is fully implemented. Both CII 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. **Environmental Issues:** There are considered to be no adverse environmental issues associated with this project. All washes and cleaners are environmentally compatible.

7. **Recommendations:** 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 III, 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 III, Table II further illustrates the proposed serpentine designed product is acceptable for the Venezuelan common market for several years.

II. PROJECT DESCRIPTION

8. **The Proposed Project:** 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.

9. **Evaporators:** 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.

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

11 **Condensers:** 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.

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

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

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

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

16. 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.

17. 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.

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

(b) Current requests for new model quotations, utilizing SPT designs for HFC-134a designs.

(c) Potential business utilizing SPT designs for HFC-134a use.

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

19. 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.

20. 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.

21. Annex III, Table XII was developed to establish reference numbers for tooling/equipment.

22. Annex III, Table XIII was developed to show the relationship between the tooling/equipment list (Annex III, Table XII) and AAISA's customer requirements.

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

24. This manufacturing layout offers the optimum in assembly scheduling flexibility.

25. 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.

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

(a) Equipment/Tooling costs are contained in Annex III, 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.

(b) Shipping cost to POE in Venezuela are US$102,848 - Annex III, Table II.

(c) License Agreement with Calsonic International Inc. (CII) cost is US$110,000.

(d) As of this writing no formal agreement between CII and AAISA has been signed. Annex III, Table III outlines general license items discussed between CII 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.

(e) Product Testing US$162,660. Annex III, Table IV shows the breakdown of services and costs provided by CII. This incremental cost is required to show the heat transfer characteristics of each SPT design to ensure designs meet customer requirements.

(f) 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 III, 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.

(g) 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, describes training and related costs i.e.:

- Training of AAISA engineering at CII
- 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.

(h) Plant Rearrangement: Annex III, 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.

(i) 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.

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 Calsonic International Inc. (CII)	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

Table II: Equipment and Cost Breakdown

EQUIPMENT	IMPORT OR LOCAL	EQUIPMENT COST	TOOLS	TOTAL COST	DELIVERY TO POE	IMPORT DUTY 10%	TOTAL US DOLLARS
Tube Uncoil /Straighten Cut System	I	15,000	105,000	120,000		12,000	13,7000
Serpentine Tube Bender	I	244,400	17,600	262,000		26,200	289,900
Serpentine Evaporator Qualifier	I	88,500	16,500	105,000		10,500	117,200
Serpentine Condenser Qualifier	I	96,900	12,100	109,00		10,900	121,660
Extruded Tube Saw	I	31,000	-	31,000	17,000	3,100	35,800
Horn Die Press/Ext. End Qualifier	I	98,950	11,550	110,500		11,050	123,250
Serp. Condenser Assy. Table and Banders	I	68,000	11,000	79,000		7,900	88,600
Serp. Evaporator Assy. Table and Banders	I	65,700	8,800	74,500		7,450	83,650
Condenser Fin Machine	I	245,250	79,750	325,000		32,500	359,200
Evaporator Fin Machine	I	225,450	99,550	325,000		32,500	359,200
Side Plate Cutting	I	31,000	-	31,000	2,000	3,100	36,100
Parts Washer	I	45,600	-	45,600	5,000	4,560	55,160
Batch Dry Oven	I	33,775	-	33,775	6,850	3,378	44,003
Degreaser	I	52,610	-	52,610	4,000	5,261	61,871
DiWater	I	15,787	-	15,737	595	1,579	17,961
Continuous Fluxer	I	97,800	-	97,800		9,780	116,863
Continuous Dry Oven	I	66,500	-	66,500	27,850	6,650	82,433
Nocolok Braze Furnace	I	382,425	-	382,425		38,243	429,952

Leak Test (Air Under Water)	I	5,000	-	5,000		0	5,000
Surface Treatment Wash	I	152,888	-	152,888	20,553	15,289	88,730
Paint and Brake Oven System	I	71,816	-	71,816	8,000	7,182	86,998
Leak Test (Mass Spectrometter)	I	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	I	100,000	-	100,000	4,000	10,000	114,000
Sigs (600 Sets Braze Plates at 500/set	I	-	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)	I	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 averaged 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.

Table III: Proposed License Agreement with Calsonic International Inc. (CII)

Technology Transfer — US$110,000

- Agreement will cover:
  - Commitment to sell CII 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 CII
  - CII Engineering and Technical support of (3) Engineers for 15 days at AAISA to assist in start-up of process.

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

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.

Table VI: Training Costs

- Training of three (3) AAISA Engineers at CII 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	26,000
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	
Sub - Total	109,925
Total Training	US$120,525

Table VII: Civil Works and Utilities Installation for HFC 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 in 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.

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	-1,500
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 onbuying somewhat larger than needed quantities for trail runs. Products manufactured during process trial run will be scrapped.

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
		-Trial Run and Debug Problems	1 Month
8	Production	-Start of Full Production TCI Personnel/Consulting Engineer on hand to Assist	24 Month

TE: 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.

TABLE X: SERPENTINE TYPE DESIGNS SUITABLE FOR HFC-13a (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

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	X			4,400	4,400
	YJ	X			600	600
	Spirit	X			2,900	2,900
GM	Chevette	X			2,700	2,700
Fiat	Uno	X			31,200	31,200
	Premio	X			1,560	1,560
	Selecta	X			2,640	2,640
Mazda	323	X			2,040	2,040
	625	X			600	600
Facorca	Mini-Car	X			550	550
	TOTAL	X			49,190	49,190
Chrysler	ZJ		X		1,920	1,920
GM	Swift		X		6,100	-
	CK1500		X		8,500	-
	Blazer		X		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			X	2,400	2,400
	Cleo			X	1,800	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.

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

Table XIII: Equipment/Tools Reference Numbers/Application 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	
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	
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																													28
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

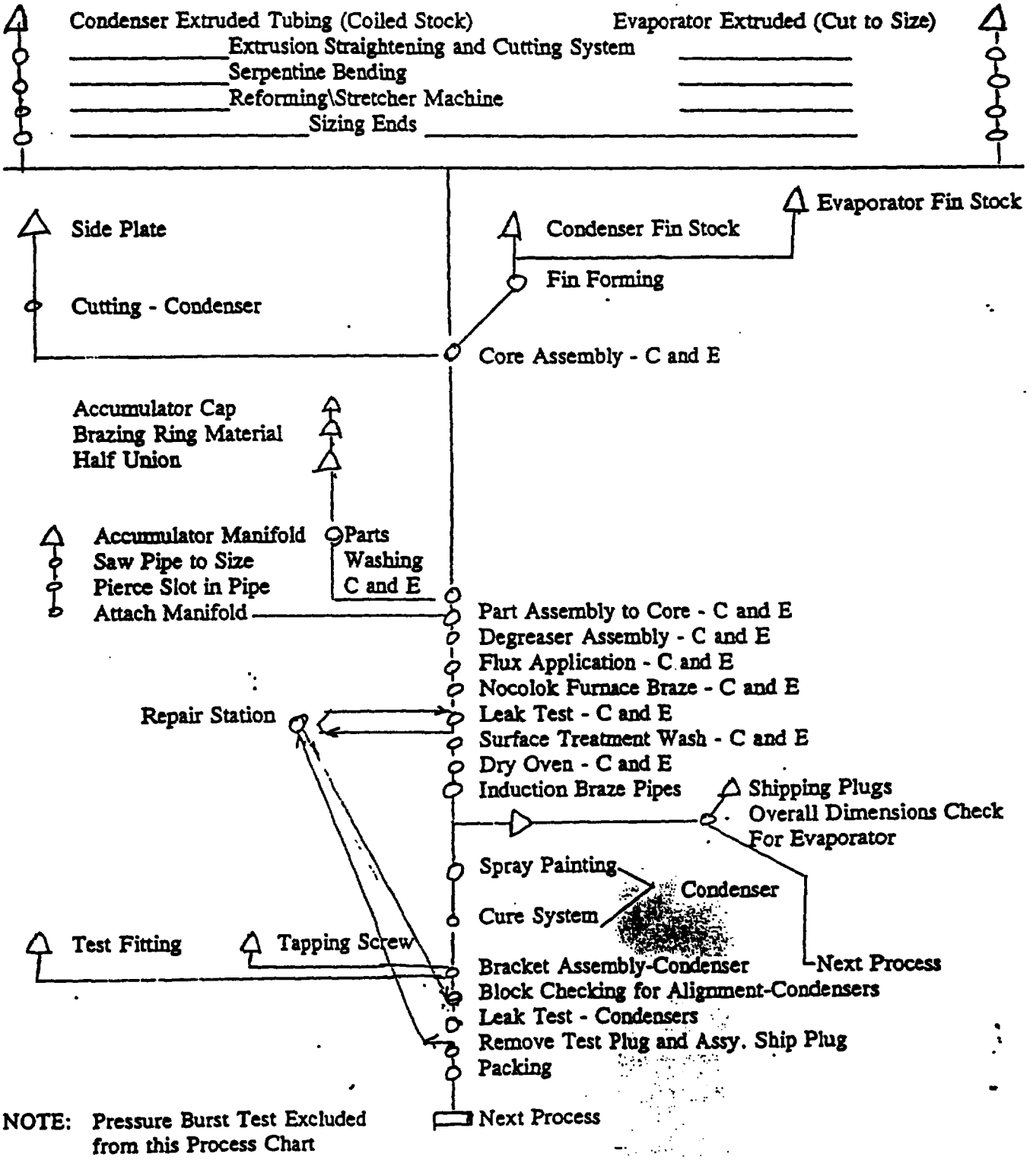
CUSTOMER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	APPLICATION TOTAL
CHRYSLER																													
ZJ	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	28
GM																													
SWIFT	X	X		X	X	X	X			X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	24
CK 1500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

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												

Table XV: Process Flow Chart - Condenser and Evaporator



NOTE: Pressure Burst Test Excluded from this Process Chart

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.

3. Calculations:

CC	=	$4,021,000 (incremental capital costss 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	=	$\frac{(4,394,000)(.163)}{101,045 \text{ kg./year(1)}}$ = $6.49/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 $6.49/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.

[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.

Venezuela : Montreal Protocol /AAISA MACS Compressor Assembly Conversion Project OORG Technical Opinion .

1. Recommendation : The proposal appears to be sound and consistent with the objectives of the Montreal Protocol Ozone Trust Fund . The personnel training must emphasize the recovery and salvage of not only R12 but of R134a also . This program ,along with the FAACA program should provide a sound domestic competitive program with maximum potential for success .

2. Relevance and Adequacy of Information Provided : The information supplied appears adequate .

3. Technical Soundness : AAISA and COROVEN are names respected in the industry . There appears to be adequate knowledge of and intent to rely on supporting services and facilities such as MACS and Nippondenso .

4. Lessons from Experience : I believe the implementation of this program will help expedite the use of R134a by providing competition to the O.E.M. manufactures . It will also provide competition in the service arena through a competitive source of training .

5 Environmental Issues : It is recommended that the implementation of this program , especially the training of the field personnel be monitored for techniques applicable to subsequent programs .

6 Safety Issues : I am not aware of any unique safety practices required for handling R134a and R134a products . There are however , safety practices associated with the interchangeability of parts for mechanical and functional reliability that service personnel must be aware of . There are also safety practices associated with the recovery and reuse of refrigerants that must be taught to the technicians as well as the consequences of mixing the refrigerants and their unique lubricants .

7 Cost Effectiveness : The proposal appears to be reasonably cost effective , with the grant recipient providing significant input to assure adequate motivation for success .

R . H . Proctor P.E.

9-28-93

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.

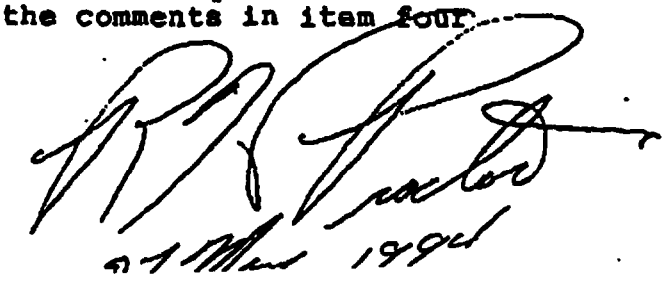
3. TECHNICAL SOUNDNESS: This proposal identifies the technical support sources and their anticipated costs. The sources identified are believed to be competent.

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.



FONDOIN

FONDO VENEZOLANO DE RECONVERSION INDUSTRIAL Y TECNOLOGICA

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 concluído 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 FMAPM. 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 Aplicación del
Protocolo de Montreal
Montreal, Canadá