VENEZUELA

OZONE PROJECTS TRUST FUND GRANT
FOR "CFC-12 TO HFC-134a
CENTRAL AIR CONDITIONING SYSTEMS
CONVERSION"

PHASEOUT OF OZONE DEPLETING SUBSTANCES
(ODS PHASEOUT II)

PROJECT DOCUMENT

JUNE 1994

FILE COPY
VENEZUELA

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JUNE 1994
CURRENCY EQUIVALENTS

Currency Unit = Venezuelan Bolivar (BS)
US$1.00 = 164.5 Bs (Exchange rate as of June 16, 1994)

UNITS AND MEASURES

Metric ton - Ton (T) = 1,000 kg

FISCAL YEAR

January 1 - December 1

ACRONYMS

ATIAS : Clinica Atias Hospitalizacion y Servicios, C.A.
CCI₄ : Carbon Tetrachloride, a controlled ODS
CFCs : Chlorofluorocarbons
CMDLT : Centro Medico Docente La Trinidad
FONDOIN : Foundation to implement Montreal Protocol in Venezuela
HCFC : Hydrochlorofluorocarbon
HFC : Hydrofluorocarbon
IMPRES : Instituto de Prevencion Social del Medico
IVSS : Instituto Venezolano de los Seguros Sociales
IWG : Interministerial Working Group
MCF : Methylchloroform, a controlled ODS
MFEC : Multilateral Fund Executive Committee
### ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>MFMP</td>
<td>Multilateral Fund for Implementation of the Montreal Protocol</td>
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<tr>
<td>ODS</td>
<td>Ozone Depleting Substances</td>
</tr>
<tr>
<td>OTF</td>
<td>Ozone Projects Trust Fund</td>
</tr>
<tr>
<td>OORG</td>
<td>Ozone Operations Resource Group</td>
</tr>
<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
</tr>
<tr>
<td>UNEP</td>
<td>United Nations Environment Programme</td>
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<td>USEPA</td>
<td>United States Environmental Protection Agency</td>
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</table>
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Project and Grant Summary

Financial Agent
None. Direct disbursement from the Bank to Supplier.

Guarantor
None. Guarantor not required - OTF grant to GOV.

Executing Agencies
The four beneficiary institutions under the supervision of the World Bank and FONDOIN.

Beneficiaries
IMPRES, ATIAS, IVSS, and Congreso de la Republica.

Amount
US$1.081 million (Incremental Cost)

Terms
Grant

Project Cost Summary

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<tr>
<th>Component</th>
<th>US$ Thousand</th>
</tr>
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<tbody>
<tr>
<td>Equipment, Refrigerant</td>
<td>1,388</td>
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<td>Installation Services</td>
<td>293</td>
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<tr>
<td>Supervision and Admin.</td>
<td>36</td>
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<tr>
<td>Contingency</td>
<td></td>
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<tr>
<td>CFC-12 Resale Value</td>
<td>(17)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>US$1,700</td>
</tr>
</tbody>
</table>

Unit Abatement Cost
Retrofits: US$3.71/kg/year.
New: US$0.94/kg/year. (Incremental cost basis; assumed 20 year useful life.)

Economic Rate of Return
N/A

Staff Appraisal Report
N/A
VENEZUELA

CFC-12 TO HFC-134a
CENTRAL AIR CONDITIONING SYSTEMS CONVERSION PROJECT

1. The grant amount of US$1.1 million will finance the incremental cost share of the total estimated project cost of US$1.7 million. The distribution of grants by institution will be: (i) IVSS - US$851,000; (ii) ATIAS - US$115,000; (iii) IMPRES - US$69,000; and (iv) Congreso de la Republica - US$46,000. A fifth institution, CMLDT, for whom a US$63,000 grant originally had been approved, has withdrawn from the project. The proposed project includes: (i) retrofitting with proprietary technology of 25 existing chiller units currently operating with CFC-12 to permit use of zero ODS HFC-134a refrigerant; and (ii) installation of four new HFC-134a chillers to replace old CFC-12 units which were not suitable for retrofits. This is the first ODS phaseout for central air conditioners for which OTF funding has been approved.

2. The estimated unit abatement cost for the retrofitted chillers is US$4.12/kg ODS consumption eliminated for an assumed 20 year useful life, and for the new chillers, US$9.39/kg, both on a total cost basis: the corresponding figures are US$3.71/kg and US$0.94/kg on an incremental cost basis. The overall composite figure is US$5.03/kg ODS eliminated on a total cost basis, and US$3.23/kg on an incremental cost basis.

3. Venezuela Ozone Depleting Substance (ODS) Sector Background. Venezuela signed the Montreal Protocol on September 16, 1987, and ratified it on February 6, 1989. As an Article 5 signatory (annual per capita ODS consumption of less than 300 grams), Venezuela is eligible for OTF support. ODSs are produced in six developing nations, Argentina, Brazil, China, India, Mexico, and Venezuela. Total production of CFCs and MCF in these nations in 1989 was approximately 70,000 tons, of which Venezuela's share was 4150 tons, or 6 percent. CFC/Halon consumption in Venezuela in 1990 was 3420 tons, but rose to 3820 tons in 1991, still a decrease of 12 percent since 1986. Distribution of ODSs by end use in 1991 was A/C refrigeration 77 percent; foaming agent 16 percent; aerosols 4 percent; halon fire extinguisher 1 percent; and solvents 2 percent. Of the A/C refrigeration share, an estimated 80 percent was for aftermarket use for servicing and leak replacement. 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 A/C refrigeration subsectors and more detailed national data are found in Annex 1, National Production and Consumption Patterns.

4. ODS Phase-Out Strategy. With more than 75 percent of Venezuela's CFC consumption currently used in A/C refrigerator applications, these subsectors are the principal focus of the national ODS phaseout strategy. The action plan for the A/C refrigeration sector includes both ODS conservation and replacement measures. Conservation initiatives will include workshops and technology dissemination to promote: (i) establishment of programs to recover and recycle refrigerants; (ii) improvement of drainage and purging practices; and (iii) improved installation and maintenance techniques to reduce leakage. Replacement strategy will focus on retrofitting and/or replacement of ODS-using equipment with equipment that operates with final non-ODS substitutes as such new technology becomes commercially available. Increased use of transitional substances such as HCFC-22 and HCFC-123 will only be promoted when they can be used as drop-in replacements for ODS in existing equipment. Promotion of replacement technologies involving transitional substances which also require capital investments will
explicitly not be encouraged. This ordering of priorities leads to the following air conditioning subsector strategies: (i) auto air conditioners - introduction of HFC-134a units in new vehicles starting in 1994 or 1995 and better emissions control practices for the existing stock; (ii) central air conditioning (1000 chillers estimated national stock) - for the one half of existing chiller stock which uses HCFC-22, better leakage control; for the 25 percent using CFC-11, improved leakage and purge system control and operation; replacement/retrofitting to use HCFC-123 not to be promoted; for the 25 percent currently using CFC-12, retrofitting/ replacement as appropriate to substitute CFC-12 with HFC-134a; and (iii) individual window units - use HCFC-22, strategy depends on future HCFC-22 classification and world market developments.

5. The proposed project has been developed to eliminate CFC-12 consumption in 29 of the existing 115 Westinghouse/Snyder General McQuay central chillers in Venezuela. The Snyder General McQuay HFC-134a retrofit/replacement technology has been commercially available in the United States since early 1991, and as of October 1993 had already been proven in 100 installed retrofits, and over 600 new installations worldwide. Corresponding figures for all manufacturers in the American market as of October 1992 were 20 retrofits and 250-300 new chillers. For equipment which still has five years or more of expected useful life, the OTF subsidy provides a much stronger financial incentive for retrofitting, where technically feasible as an ODS phaseout measure, rather than replacement with new equipment. Where no subsidies exist, replacement with new equipment has been the preferred phaseout measure due to the improved energy efficiency of new HFC-134a chillers. For given air conditioning loads, the savings in energy costs often generate satisfactory financial rates of return on new chiller investment. These retrofits have been designed to maintain equivalent energy efficiency, the least capital intensive solution for the chillers in questions.

6. **Project Objectives.** The project's primary objective is to eliminate the use of CFC-12 refrigerant in the central air conditioning chillers through its substitution by HFC-134a. Its secondary objective is to demonstrate through the successful introduction of replacement technology for medical sector beneficiaries (26 of 29 chillers), the relative cost effectiveness of this application of OTF resources to eliminate ODS consumption among beneficiaries who could not afford the ODS phaseout in the absence of the Fund subsidy.

7. **Project Description.** The project comprises: (i) retrofitting of 25 existing chiller units with ten or more years of expected useful life, for three institutions at 9 different locations; and (ii) installation of four new HFC-134a chillers to replace CFC-12 chillers whose useful life had expired. All the chillers to be retrofitted are Westinghouse centrifugals. The retrofits are equipment specific, and have been engineered and specified by the Snyder General McQuay Co. (SGMQ), current owner of the former Westinghouse compressor technology. The four new SGMQ chillers will also replace Westinghouse chillers on a sole supplier basis. This latter procedure is considered acceptable as the SGMQ chillers are proven technology, and were the only HFC-134a chillers for which quotations could be obtained in Venezuela at the time of equipment selection (1992). The refitting is mechanical, involving changing of gears, seals, and gaskets. Energy and thermal efficiency after the retrofits is essentially equal to that of the original units.

8. **Project Cost and Financing.** The total project cost is US$1.7 million, of which US$1.081 million will be eligible incremental costs, equal to the OTF grants to the four beneficiaries. Supervision (US$36,000) will be financed through the Bank's own Work Program Budget. US$583 thousand will be nonincremental costs financed by beneficiaries. Of the nonincremental costs, US$108 thousand or 10 percent of total retrofit cost will be financed by retrofit beneficiaries. Purchasers of the new chillers have financed 90 percent of the total installed cost. Equipment and installation costs are firm, having been
based upon supplier quotations for purchase. The project costs and financial plan are summarized in Schedule A. The distribution of total project costs, approved incremental costs and physical installations by institution is given in Tables 1 and 2 of Annex 3, Summarized Project Capital and Incremental Costs. Table 3, Annex 3 indicates counterpart financing requirements by institution. Funding commitment of incremental costs of US$1.1 million was given final approval by the MFEC at the October 1992 meeting. Within this amount, there has been some reallocation. Three new chillers (incremental costs US$45,000) and two retrofits (incremental costs US$63,000) were deleted from the original project scope, whereas four condensers unique to the retrofit designs (also US$45,000 total), inadvertently omitted at time of presentation to the MFEC, are now included, as is a 5 percent adjustment (US$53,000) for manufacturer's price increases since the time of the original quotations (September 1992). It is possible that additional repairs to the retrofitted chillers will be required once disassembled for retrofitting. These will not be project costs, and will have to be borne by the respective institutions. As indicated in Schedule A and Annex 3, the counterpart contribution of US$583,000 is a net figure after rebate of US$17,000 to the beneficiaries for resold CFC-12.

9. **Determination of Incremental Costs.** Determination of incremental costs eligible for OTF grant funding was based upon the following criteria: (i) retrofits: equipment and installation costs of all modifications unique to retrofitting for HFC-134a, such as gears, seals, etc. are eligible. To allow for allocation of installation costs and generic parts to other programmed maintenance, particularly since some of the units to be retrofitted are now shut down for repairs, the basis for adjustment of quoted prices to estimate incremental costs was: incremental costs equal 75 percent of generic parts and installation plus 100 percent of all other costs, excluding heat exchangers except for replacement condensers unique to the retrofit design for four chillers (US$37,000 incremental costs); (ii) new or replacement chillers: Eligible incremental costs are, theoretically, the difference between the quoted installed costs of an HFC-134a system, and the least cost alternate quotation for a CFC-11 or CFC-12 system for the same service. The CFC-11/12 quotations submitted as comparators during appraisal were deemed by the OORG reviewer as not sufficiently representative to establish comparability. In lieu of comparable quotations, the MFEC accepted as eligible incremental costs for the four new HFC-134a chillers, 10 percent of the installed chiller cost, a representative price differential then prevailing in the American market for SGMQ chillers at the time of appraisal (October 1992). This differential consists essentially of the price difference between the HFC-134a and the CFC-12 refrigerant charge. The adjusted incremental cost estimates are shown in Tables 1 and 2 of Annex 3, Project Capital and Incremental Costs.

10. **Project Implementation.** Each of the four beneficiary institutions will sign a Grant Agreement with the Bank, each for a grant equal to the amount of incremental costs approved for installation of the retrofits/new units in the respective institution. The manufacturer's approved representative in Venezuela for the proprietary retrofit technology will procure, install, and guarantee performance of the new and retrofitted chillers on a sole supplier basis. Each beneficiary will contract with the supplier. An external consultant acceptable to the Bank will certify supplier compliance with the terms of each contract. The Bank will disburse directly to the supplier upon request of the beneficiary institutions, except in the case of retroactive financing. To avoid financing shortfalls during implementation, disbursements will not be made on behalf of a beneficiary until the institution has first complied with advance payment terms with the supplier for the counterpart contribution not financed by the grant.

11. **Project Sustainability.** The purpose of the OTF is to provide a financial incentive to facilitate ODS phase-out. In operational and environmental terms, the operation is sustainable due to the fact that the subsidy will accelerate the permanent elimination, within 18 months of CFC consumption in 29 central air conditioning systems. In the absence of the subsidy, each chiller would continue to use and to leak CFC-12 into the atmosphere until the end of its useful life.
12. **Rationale for Montreal Protocol Financing.** The project will provide: i) a demonstration of successful use of commercial retrofit technology for phase-out in the central A/C sector; and ii) a good empirical unit abatement cost data base for use of OTF resources for retrofits which can be used to judge the merit of OTF subsidies for retrofits in the future. Introduction of non-ODS refrigerants in new systems by all major suppliers since 1992 has rendered use of ODSs in new systems a moot issue. CFC-12 recovered from replaced and retrofitted units will be recycled to supply the needs of other CFC-12 equipment users, thereby reducing demand for new CFC production.

13. **Issues.** No major issues remain. FONDOIN will assist beneficiaries, as required, with preparation of disbursement requests. The supplier and three institutions have negotiated procurement contracts, none being required for CONGRESO, for whom the Grant is to reimburse retroactive expenses. LEGLA has communicated documentation requirements for beneficiaries; and the implementation schedule has been arranged. Approval by the Bank of a signed procurement contract between the supplier and the institution will be a condition of effectiveness of each grant.

14. **Environmental Aspects.** The elimination of CFC-12 consumption is the basic objective of the conversions. There are no major environmental issues associated with the installation or operation of the converted chillers themselves, other than routine workplace safety measures.

15. **Project Benefits.** Total immediate elimination of CFC-12 will reach 10,000 kg for all 29 units, less than one percent of current consumption, but at the same time, permanently eliminating ODS use in over 20 percent of the nations stock of Westinghouse and Snyder General McQuay chillers. An additional 30,000 kg of potential ODS consumption will be prevented, equivalent to the refrigerant required throughout 20 years of assumed useful life, at an assumed annual leakage rate of 15 percent, if retrofitting or replacement were not carried out. Credible actual consumption rates could not be estimated with data made available by beneficiaries. The estimated unit abatement cost for the retrofitted chillers is US$4.12/kg ODS consumption eliminated for an assumed 20 year useful life. For the new chillers, the corresponding figure is US$9.39/kg ODS on a total cost basis, and US$0.94/kg on an incremental cost basis. The overall composite figure is US$5.03/kg ODS eliminated on a total cost basis, and US$3.23 on an incremental cost basis. As will be the case with virtually all A/C refrigeration replacement/retrofit technology, these abatement costs per unit of ODS consumption eliminated, which are dictated by the nature of the technology involved, will be higher than those associated with aerosol, solvent, and foaming agent applications. Nevertheless, over 75 percent of Venezuela's CFC consumption is concentrated in A/C and refrigeration. To materially diminish CFC consumption, it is necessary to begin investment in these relatively capital intensive types of phase-outs.

16. **Project Risks.** The potential risks to project implementation, and the mitigating measures are as follows: (i) availability of counterpart funding of nonincremental project costs. In some cases, the vendor will not start work until advance payments have been received from institutions, for others payment is not required until after completion of installation; (ii) effective supervision of works and disbursements given the multiplicity of beneficiary institutions and sites. The Bank will use an external consultant to verify beneficiary acceptance of equipment and installations. Disbursements will be made from the Bank directly to vendors; (iii) chilling capacity, energy efficiency, and mechanical performance of both retrofitted and new systems. The manufacturer, Snyder General McQuay, guarantees the energy efficiency and chilling capacity stated in the technical proposal if the chillers are operated properly. The manufacturer's standard factory warranties for mechanical defects are 1 year for new units and 4 months for retrofits. The local SGMQ representative will increase the guarantee period to 4 years for new units.
and 1 year for retrofits, if the beneficiaries enter into operation and maintenance contracts with them. Such contracts are outside the cost of the project.

17. **Technical Evaluation.** The Bank's technical assessment consisted of a detailed review of the technical and financial proposals with both the manufacturer's sales engineering department and its Venezuelan representative, field inspection of existing units and proposed replacement installations, and verification of local consultants technical reports and financial proposals. The technical consultants' findings and recommendations are presented in Annex 4, "Technical Evaluation".

18. On the basis of the assessment, the Bank considers the proposals to be of sound technical design, and qualified for OTF grant financing of eligible incremental costs. The Snyder General McQuay authorized representative in Venezuela is judged to be technically and organizationally capable of implementing the project. The Synder General Corporation has also agreed to have retrofit installations field supervised directly by its own technicians, if so requested. Annex 5 indicates concurrence with the project by the Bank's Ozone Operations Resource Group (OORG) technical expert for air conditioning and refrigeration projects, subject to the incremental cost adjustments already discussed.
Schedule A

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CFC-12 to HFC-134a Central Air Conditioning Systems Conversion Project

Estimated Project Cost

<table>
<thead>
<tr>
<th>Local</th>
<th>Foreign</th>
<th>Total</th>
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<tr>
<td>-----------</td>
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</tr>
<tr>
<td>Equipment, Refrigerant, Oil</td>
<td>492</td>
<td>896</td>
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<tr>
<td>Installation Services</td>
<td>293</td>
<td>--</td>
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<tr>
<td>Supervision</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>CFC-12 (Resold Value)</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>786</strong></td>
<td><strong>914</strong></td>
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Financial Plan

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<th>Beneficiary</th>
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</tr>
<tr>
<td>Equipment</td>
<td>832</td>
<td>556</td>
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<tr>
<td>Installation Services</td>
<td>249</td>
<td>44</td>
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<tr>
<td>Supervision</td>
<td>36</td>
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</tr>
<tr>
<td>CFC-12 (Resold value)</td>
<td>--</td>
<td>(17)</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1,117</strong></td>
<td><strong>583</strong></td>
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</table>

1 OTF Grants US$1,081 million; Bank Work Program US$36,000.

2 Counterpart financing requirements for individual beneficiaries are: Congreso de la Republica - US$411,000; IVSS - US$93,000; IMPRES - US$86,000; and ATIAS - US$10,000, excluding value added taxes on imported equipment.
Schedule B: Procurement and Disbursement

Procurement. Procurement of chiller retrofit components and the new chillers on a sole supplier basis, subject to reasonableness of price quotations, is acceptable since the retrofits involve redesign of proprietary equipment and installation will be carried out by the manufacturer's authorized service representative in Venezuela, who will also be able to provide service warranties. The supervision consultant will be contracted directly by the Bank. All OTF financed contracts, including those between the local supplier and the three beneficiary institutions (excluding CONGRESO), will be subject to approval by the Bank as a condition of Grant effectiveness in order to verify: i) compliance with Bank procurement guidelines; and ii) availability of counterpart funding requirements at the beneficiary institutions.

<table>
<thead>
<tr>
<th>Category</th>
<th>ICB</th>
<th>LCB</th>
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<td>Equipment</td>
<td>1388</td>
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<td>Installation Services</td>
<td>293</td>
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<td>293</td>
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<tr>
<td>Supervision</td>
<td>--</td>
<td>--</td>
<td>36</td>
<td>36</td>
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</table>

Disbursement. The grant is expected to be disbursed within a period of 18 months. The Bank will disburse against 100 percent of eligible foreign expenditure and 100 percent of eligible local expenditures for eligible incremental costs, net of direct import, sales and value added taxes, for grant financed goods and works 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. These will include US$46,000, the full amount of the Grant to the Oficina del Congreso de la Republica; and IMPRES US$9,000, and possibly other small amounts. Disbursements will be made against Statements of Expenditure (SOE), except for requests for direct payments to suppliers/contractors. These direct payment requests will be fully documented. Each beneficiary will prepare its own disbursement requests, which will then be transmitted to FONDOIN. FONDOIN will consolidate disbursement requests and documentation and submit consolidated requests for disbursement to the Bank. The Bank will then disburse directly to the manufacturer or local supplier. Payments for eligible retroactive expenditures will be directly to beneficiaries.

Estimated Disbursements

(US$ 000's)

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<tr>
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<th>FY95</th>
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<tbody>
<tr>
<td>Annual</td>
<td>450</td>
<td>667</td>
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<tr>
<td>Cumulative</td>
<td>450</td>
<td>1117</td>
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Schedule C

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Aires Acondicionados CFC-12 to HFC-134 Conversion Project

Timetable of Key Project Processing Events

(a) Time taken to prepare: 6 months
(b) Prepared by: Beneficiaries in conjunction with Interministerial Work Group (IWG) (since replaced by FONDOIN).
(c) First Bank mission: October 1992
(d) MFEC approval: October 1992
(e) Pre Appraisal: February 1993
(f) Appraisal: June 1993
(g) Planned Negotiations: May 1994
(h) Planned Bank approval: June 1994
(i) Planned Signing: June 1994
(j) Planned Effectiveness: July 1994
(k) Planned Completion: December 1995