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

Tenth Meeting
Montreal, 28-30 June 1993

1993 UNDP WORK PROGRAMME AMENDMENT

EXECUTIVE COMMITTEE OF THE MULTILATERAL FUND
FOR THE IMPLEMENTATION OF THE MONTREAL PROTOCOL

(Tenth Meeting, 28-30 June 1993, Montreal)

AMENDMENT TO THE 1993 WORK PROGRAMME

OF THE

UNITED NATIONS DEVELOPMENT PROGRAMME

AMENDMENT TO THE 1993 UNDP WORK PROGRAMME

UNDP's Progress Report to the Tenth Meeting of the Executive Committee specified several of the missions undertaken by UNDP staff and sectoral experts at Government request during the March-May 1993 period to finalize projects for submission to the Executive Committee.

Accordingly, the following project proposals under $500,000 are submitted for Executive Committee approval:

1. BRAZIL: Institutional Strengthening ($403,095).

2. CHINA: Elimination of CFCs in cleaning operations at the Nanjing Wire Works ($459,000).

3. CHINA: Elimination of CFCs in cleaning operations at the Chengdu Qianfeng Radio Instrument Factory ($444,700).

4. CHINA: Strategy and action programme for the elimination of CFCs in the manufacture of foams ($325,000).

5. CHINA: Revising design standards for cold storage ($200,000).

6. CHINA: Testing of vacuum insulation panels for domestic refrigerators and freezers ($50,000).

7. CHINA: Implementation of the halons phaseout plan for China: current situation, revision of national codes and education and training ($480,000).

8. CHINA: Implementation of the halons phaseout plan for China: transfer of technology on alternatives to halon fire protection systems ($350,000).

9. ECUADOR: Training and technology dissemination ($150,000).

10. INDONESIA: Institutional Strengthening ($314,780).

11. MALAYSIA: Elimination of CFC-12 in the manufacture of extruded polystyrene foam sheet at Jumaya Industries ($254,000).

12. MALAYSIA: Automobile retrofitting demonstration project with alternates to CFC-12 ($426,806).

13. MALAYSIA: National ODS Conference: 20-21 July 1993 ($40,000).

14. MALAYSIA: Investment project preparation ($50,000).

15. THAILAND: Investment project preparation ($50,000).

The detailed documentation for the above 15 project proposals has been sent to the Fund Secretariat. Attached are the one page summaries of the various projects.

The direct project cost for the above 15 projects amounts to $ 3,997,381. To this must be added the standard project support cost of $ 519,660, giving a total requested addition of $ 4,517,041 to UNDP's approved 1993 work programme.

PROJECT OUTLINE

COUNTRY	:	CHINA
SECTOR COVERED	:	Primary Sector: Solvents
SECTORAL ODS CONSUMPTION	:	4311 tonnes of ODP in 1991
PROJECT TITLE	:	Elimination of CFCs in Cleaning Operations at the Nanjing Wire Works
PROJECT DURATION	:	Three years
PROJECT IMPACT	:	This project will eliminate the use of at least 11 tonnes of ODP/yr, increasing at the rate of about 10% per year. The project will also provide a demonstration site for training and dissemination of the technical know-how required to replicate the results at 120 computer manufacturing sites throughout China.
PROPOSED BUDGET	:	US$459,000
IMPLEMENTING AGENCY	:	UNDP
NATIONAL COORDINATING AGENCY	:	National Environmental Protection Agency (NEPA) through Ministry of Electronic Industries (MEI)

PROJECT DESCRIPTION

The China Country Programme addresses the rapidly growing solvent sector by employing a strategy of subsectoral demonstration projects, followed by replication. Nanjing wire works is the third demonstration project, following Dandong and Dalian which were approved in 1992. The Nanjing Wire Works represents the computer/peripherals subsector (120 factories), and the technology planned includes replacement of existing ODS cleaning lines with a semi-aqueous cleaning line for the critical circuit boards, and an aqueous cleaning line for the non-critical boards and peripherals.

Nanjing Wire Works currently uses primarily CFC-113, with some methyl chloroform, in the manufacture of its product lines, consuming 11t/y of ODP. The company has selected aqueous and semi-aqueous technology for its two batch cleaning lines that are to be replaced. In addition to the equipment to be replaced, instrumentation will be needed to define and establish a quality manufacturing process during startup. This process definition equipment will also be used by other firms during the replication process. Peripheral equipment will consist of a D.I. water generating unit and an aqueous effluent monitoring system to assure product quality requirements are retained and environmental responsibilities are met. A subsectoral technology specific study tour is built into the project in order to select the exact process and equipment, and to develop an adequate startup plan which takes advantage of the experiences of others who have adopted this technology, and to prepare some local experts for the training tasks associated with the replication process.

PROJECT OUTLINE

COUNTRY	: CHINA
SECTOR COVERED	: Primary Sector: Solvents
SECTORAL ODS CONSUMPTION	: 4311 tonnes of ODP in 1991
PROJECT TITLE	: Elimination of CFCs in Cleaning Operations at the Chengdu Qianfeng Radio Instrument Factory
PROJECT DURATION	: Three years
PROJECT IMPACT	: This project will eliminate the use of at least 9 tonnes of ODP/yr, increasing at the rate of about 14% per year. The project will also provide a demonstration site for training and technology transfer to an additional 180 similar manufacturing sites throughout China, which in 1991 consumed 711 tonnes/year of ODS.
PROPOSED BUDGET	: US$444,700
IMPLEMENTING AGENCY	: UNDP
NATIONAL COORDINATING AGENCY	: National Environmental Protection Agency (NEPA) through Ministry of Electronic Industries (MEI)

PROJECT DESCRIPTION

The China Country Programme employs a strategy of subsectoral demonstration projects, followed by replication in order to phase out ODS in the rapidly growing solvent sector by employing . The Chengdu factory is the fourth demonstration project. It represents the sector associated with the manufacture of electronic instrumentation (180 firms, 20% of the ODS consumption), and the technology planned includes replacement of existing ODS cleaning lines with a semi-aqueous cleaning line for the critical, high reliability, high frequency circuit boards, and an aqueous cleaning line for the non-critical boards and peripherals.

Chengdu Qianfeng Radio Instrument Factory currently uses primarily CFC-113, with some methyl chloroform, in the manufacture of its product lines, consuming 9t/y of ODP. The company has selected the use of aqueous and semi-aqueous technology for its two batch cleaning lines that are to be replaced. In addition to the equipment to be replaced, instrumentation will be needed to define and establish a high reliability, quality manufacturing process. This process definition equipment will also be used by other firms during the replication process. Peripheral equipment will consist of a D.I. water generating unit and an assembly process aqueous effluent monitoring system to assure product quality requirements are retained and environmental responsibilities are met. The factory will absorb the costs of new piping and transformer needs, as well as piping modifications, and some training expenses associated with startup and the replication process. A subsectoral technology specific study tour is built into the project in order to select the exact process and equipment, and to develop an adequate startup plan which takes advantage of the experiences of others who have adopted this technology, and to prepare some local experts for the training tasks associated with the replication process.

PROJECT OUTLINE

COUNTRY	:	CHINA
SECTOR COVERED	:	Primary Sector: Foamed Plastics
SECTORAL ODS CONSUMPTION	:	17,775 tons ODP in 1991
PROJECT TITLE	:	Strategy and Action Programme for the Elimination of CFCs in the Manufacture of Foams
PROJECT DURATION	:	One Year
PROJECT IMPACT	:	Preparation of a detailed action and monitoring plan for the elimination of the use of CFCs in foams (all categories). This action plan is a necessary precondition for an orderly, cost-effective phaseout
PROPOSED BUDGET	:	US$325,000
IMPLEMENTING AGENCY	:	UNDP
NATIONAL COORDINATING AGENCY	:	National Environmental Protection Agency (NEPA) through Ministry of Light Industry (MLI)

PROJECT DESCRIPTION

MLI is leading a coalition of ministries in the implementation of the phaseout of CFCs in foams in China. The foams sector is the largest user of ODS (36.8%) with the highest ODP (29.4%).

ODS phaseout technologies are evolving at a fast pace, and Chinese industry is currently somewhat lagging in knowledge of the newest developments. In addition, the government possesses insufficient knowledge about the current situation in this industry, e.g. amount of facilities, equipment used, applications, etc.

This project will update knowledge in both areas and ensure updated information in the future is maintained. In addition, the industry will be made aware of the need to phaseout CFCs in greater depth than has been acheived thus far. Thus the conditions will be met for the preparation of a detailed action plan for an orderly, fast and cost-effective phaseout of the use of CFCs in the foam industry in China.

Since the acquisition of these data and the formulation of such a plan will require a substantial amount of time, a separate plan for accelerated phaseout will be submitted for selected companies that have sufficient data and technical background to participate in such a program.

PROJECT OUTLINE

COUNTRY	:	CHINA
SECTOR COVERED	:	Foamed Plastics: Refrigeration/AC
SECTORAL ODS CONSUMPTION	:	17,773 tons ODP
PROJECT TITLE	:	Revising design standards for cold storage.
PROJECT DURATION	:	2 years
PROJECT IMPACT	:	Institutional project; the project is a precondition for a successful implementation of ODS-free technology in cold storage.
PROPOSED BUDGET	:	US$200,000
IMPLEMENTING AGENCY	:	UNDP
NATIONAL COORDINATING AGENCY	:	National Environmental Protection Agency (NEPA) through Ministry of Internal Trade (MIT)

PROJECT DESCRIPTION

The implementation of ODS-free technology in cold storage facilities requires changes of both storage rooms and the refrigeration machinery.

The purpose of the project is to revise the existing standards after collection of information on standard setting in other countries, and reviewing the available ODS-free technology for the sector.

The standard setting includes measurements on existing and prototype cold storages in order to ensure that they will be applicable to Chinese conditions. It will include energy standards as well as provisions on allowed (or disallowed) ODS-content.

A number of ministries and institutions will be involved in the formulation and review of revised standards. The results of this project therefore require review and concurrence from these institutions .

The project will consist of the following phases:

1. Survey on existing cold storage facilities.
2. Collection and review of standards from other countries.
3. Drafting of revised standards for CS in China.
4. Carry out of measurements to evaluate the standards.
5. Amending the standards and subsequent review by relevant institutions.
6. Publishing and dissemination of standards codes.
7. Reporting.

PROJECT OUTLINE

COUNTRY	:	CHINA
SECTOR COVERED	:	Foamed Plastics
SECTORAL ODS CONSUMPTION	:	17,773 tons ODP
PROJECT TITLE	:	Testing of vacuum insulation panels for domestic refrigerators and freezers
PROJECT DURATION	:	One year
PROJECT IMPACT	:	The project will contribute to the development of a very promising technology which will have the potentioal of eliminating the use of CFCs and HCFCs.
PROPOSED BUDGET	:	US$50,000
IMPLEMENTING AGENCY	:	UNDP
NATIONAL COORDINATING AGENCY	:	National Environmental Protection Agency (NEPA) through Ministry of Machinery Industry (MMI)

PROJECT DESCRIPTION

A number of research institutes all over the world are developing insulation panels for domestic refrigerators and freezers, using vacuum technology as a partial replacement of plastic foams. The panels seem promising with regard to the reduction of the use of ODS and with regard to the energy consumption from domestic refrigeration.

The Guangzhou Electric Apparatus Research Institute (GEARI) has developed a new type of vacuum insulation panel. In order to assess the feasibility of the panels, a number of tests of the insulation capability have to be carried out.

The main objective of the project is to carry out a number of physical and chemical measurements on vacuum panels that have been developed by GEARI.

The project will include comparison of the performance of these panels with other, similar, panels. Furthermore, the project will include considerations of the applicability to the existing design and production processes for refrigerators in China.

The project will be completed in the following phases:

1. Collection of information on testing standards
2. Testing of panels
3. Evaluation of test results and conclusions
4. Reporting

PROJECT OUTLINE

COUNTRY	:	CHINA
SECTOR COVERED	:	Primary Sector: Halon
SECTORAL ODS CONSUMPTION	:	Halon 1211: 4.000 Tons/year Halon 1301: 50 Tons/year
PROJECT TITLE	:	Implementation of the Halon Phase-out Plan for China: Transfer of Technology on Alternatives to Halon Fire Protection Systems
PROJECT DURATION	:	Three years
PROJECT IMPACT	:	No direct impact on ODS (relevant for the phase out of 12.500 tons ODP) Project will establish which technologies are acceptable for various applications in China and allow standards, quidelines, and specifications to be rapidly spread across all regions.
PROPOSED BUDGET	:	US$350,000
IMPLEMENTING AGENCY	:	UNDP
NATIONAL COORDINATING AGENCY	:	National Environmental Protection Agency (NEPA) through Ministry of Public Security

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PROJECT DESCRIPTION

To achieve the goals set in the Chinese phase out plan for halons and to ensure full implementation throughout the country, the following activities are required:

In order to utilize alternative fire protection systems presently operating in a number of countries for replacement of halons and to examine their performance and capability against a number of typical applications in China, prototypes of such systems will be installed and tested at Tianjin Fire Research Institute.

The following systems will be covered by this project: Fast Response Sprinkler Systems, Low Pressure CO2 Fire Extinguishing System, Nitrogen/Argon Fire Extinguishing Systems and Fine Water Mist Systems. The necessary education and training will be carried out through national and regional seminars and training courses.

In order to establish the necessary technical conditions for the transfer of technology covering alternatives to halon fire extinguishing systems, the project's main goal is to evaluate a number of alternatives to fixed halon fire extinguishing systems and their performance against typical uses for halon fire extinguishing system in China. The Tianjin Fire Research Institute will establish four working groups, each consisting of four to six persons and responsible for one of the the following types of systems:

* Fast response sprinkler and circulating on-off systems (control valve).
* Water spray systems
* Low pressure CO_2 fire extinguishing systems
* Mixed gases (N_2, CO_2, Ar) systems

Those systems are currently used instead of halon systems for protection of typical areas such as control rooms, computer rooms, stand-by generator rooms, engine and machinery rooms, storage of flammable liquids, etc.

The project will be carried out by the Tianjin Fire Research Institute. The Institute is the main testing centre for fire extinguishing systems and has considerable experience in this field. The various systems identified for this project will be imported and installed in the fire test hall belonging to the Institute.

Tests will be carried out on each of these systems in order to obtain necessary information to understand and use existing standards and installation rules. If necessary, modifications will be made to meet Chinese conditions.

PROJECT OUTLINE

COUNTRY	:	Ecuador
SECTOR COVERED	:	Several
SECTORAL ODS CONSUMPTION	:	570 Tons (1992 estimate)
PROJECT TITLE	:	Training and Technology Dissemination
DURATION	:	One Year
PROJECT IMPACT	:	Improve the ability and capacity of MICIP to provide technical assistance to enterprises interested in participating in the Government's programme to phaseout ODS.
PROPOSED BUDGET	:	US$150,000
IMPLEMENTING AGENCY	:	UNDP
NATIONAL COORDINATING	:	Ministry of Industries

PROJECT DESCRIPTION

The first phase of the training and technology dissemination programme titled "CFC Refrigerant Conversion and Material Handling Training Programme" was approved at the February 1992 Sixth Meeting of the Executive Committee with a budget of $100,000. Activities are underway and will be completed shortly. This is the proposed expansion of the approved programme to cover all sectors, with an additional budget request of $150,000.

The main objective of this project would be to organize training activities for MPPU's staff, for members of other public entities interested in elimination of ODS such as the Ministry of Health and local municipalities, for representatives of ODS-using industries and to contribute to general public awareness.

Training activities would consist of a series of conferences, seminars and workshops to be held in the three main cities (Quito, Guayaquil, and Cuenca) where most industries using ODS are located. International experts would assist local experts in dealing with technical aspects of the ODS phaseout programme. The organization of these events would be contracted out to experienced local private firms. The programme would be supplemented with the preparation of printed material, and with films and videos. It has been envisaged that the entire process of design, production and implementation of the program would be completed in about one year.

The result of this project would be to improve the ability and capacity of MICIP to provide technical assistance to enterprises interested in participating in the Government's ODS phaseout programme.

PROJECT OUTLINE

COUNTRY	:	Malaysia
SECTOR COVERED	:	Foamed Plastics
SECTORAL ODS CONSUMPTION	:	722 Tons ODS in 1991
PROJECT TITLE	:	Elimination of CFC-12 in the Manufacture of Extruded Polystyrene Foam Sheet at Jumaya Industries
PROJECT DURATION	:	18 Months
PROJECT IMPACT	:	150 Tons CFC-12 per year, based on 1991 consumption
PROPOSED BUDGET	:	US$254,000
IMPLEMENTING AGENCY	:	UNDP
NATIONAL COORDINATING	:	Malaysia Department of Environment (DOE)

PROJECT DESCRIPTION

Jumaya Industries SDN BHD ("Jumaya") is one of Malaysia's three manufacturers of extruded polystyrene foam sheet (EPS). Its products are aimed at the food service market. The company is a private sector enterprise.

CFC-12 was until recently used in the production process. Under this project, Jumaya will eliminate CFCs in this process through replacement by initially liquified petroleum gas (LPG), followed--as soon as locally available--butane, resulting in an annual reduction of 150 tons ODS, based on 1991 consumption. The project contains safety features to address the hazards generated by the use of a flammable substance.

The company expects no significant change in the incremental operating costs. LPG--an interim solution until butane will be available-- would theoretically lead to significant savings, but causes process, quality and yield problems that negate the effect of the lower material costs. A price for butane could not be established as this product is currently not offered in Malaysia. Based on the international market price (about USD 1.50/kg), no or insignificant incremental operational costs are expected.

PROJECT OUTLINE

COUNTRY	:	Malaysia
SECTOR COVERED	:	Automobile (Retrofitting)
SECTORAL ODS CONSUMPTION	:	1,071 MT
PROJECT TITLE	:	Automobile Retrofitting Demonstration Project with Alternates to CFC-12
DURATION	:	Two Years
PROJECT IMPACT	:	a) ODS Phase-out: 198.50 KG during Pilot Project b) Expected ODS Phase-out after Pilot Project (1995-2000): 939MT (CFC-12 Bank in 1995)
PROPOSED BUDGET	:	US$427,000
IMPLEMENTING AGENCY	:	UNDP
NATIONAL COORDINATING	:	Malaysia National Steering Committee for Montreal Protocol

PROJECT DESCRIPTION

Malaysia National Steering Committee for the Montreal Protocol has taken the initiative to submit this project to assist motorists in Malaysia in coping with the phase out of CFC12, used in most of the 2 million cars now in service. Projections of the available CFC12 from the planned recycle bank shows a highly probable need to retrofit some of the country's automobiles beginning in 1997. Car owners with relatively new cars will have to decide in 1996 on the path forward for their vehicles, and will need some guidance from the industry and from the government on the options they have available to them. Mechanics in the auto repair industry will not be equipped to answer the consumers questions or needs if they themselves are not trained to handle the technology options. This project is designed to prepare for these in-country needs by:

- a demonstration of HFC 134A, and blends, retrofit technologies in Malaysian mobile air conditioning service. 200 cars will be retrofitted - 150 with HFC134A, and 50 with a blend of HFC152a / HCFC22 /HCFC124 - from the government and the private sector.
- development of an initial group of 50 mechanics to become acore of trainers, leading to a goal of 2000 trained and certified technicians.
- establishment of 3 facilities in separate locations across Malaysia, which will be equipped with the necessary system and hardware to carry out the retrofit training.

These activities are planned for completion by mid-1995, with follow up activities to be established at that time. Policy details such as incentives, subsidies, etc, and any further project actions will be determined at that time, after the demonstration project results have been evaluated.

PROJECT OUTLINE

COUNTRY	:	Malaysia
SECTORS COVERED	:	All sectors
NATIONAL ODS CONSUMPTION	:	4,194 metric tonnes in 1991
PROJECT TITLE	:	National ODS Conference
DURATION	:	20-21 July 1993
PROJECT IMPACT	:	To bring 400 representatives from small and mid-sized, industries up-to-date on Malaysias national ODS phaseout programme and facilitate project preparation.
PROPOSED BUDGET	:	US$40,000
IMPLEMENTING AGENCY	:	UNDP
NATIONAL COORDINATING AGENCY	:	Department of Environment, Ministry of Science, Technology and Environment

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PROJECT DESCRIPTION

ODS consumption in Malaysia has increased significantly over the last few years. National ODS consumption in 1991 of 4,194 tonnes is distributed as follows: refrigeration/AC (56.3%), solvent cleaning (26.5%), foams (7.7%), aerosols (4.8%), halons (fire extinguishing) (4.7%) 4,194 tonnes

Given the critical role of the numerous small and mid-sized ODS-using companies in Malaysia, the Government has organized a National ODS Conference that will be held during 20-21 July 1993 in Kuala Lumpur. 400 representatives from small and mid-size companies will participate in the Conference which will be jointly organized by the Government and the Federation of Malaysian Manufacturers (FMM). The agenda for the Workshop has been finalized and is attached. The objective is to inform these participants of Malaysia's National ODS phaseout strategy and to specify in detail the options available sector by sector. The 400 participants would come down from the following sectors: refrigeration (25%), MAC (25%), solvents (25%), halons (5%) and aerosols, foams, suppliers, government officials, etc. (20%).

The lecturers for the National Conference will be provided free of charge by suppliers of ODS and ODS-replacement technologies.

Each participant would be charged a fee of RM$150 (around US$60) to attend the Conference which would provide revenue of RM$60,000. The total costs for the National Conference are estimated at RM$160,000 which includes hotel rental, organizational fees, telecommunications charges, secretarial fees and publicity for the Conference which amounts to a cost of RM$400 per participant.

The Government requests Executive Committee approval to meet the remaining costs of the Conference, namely RM$100,000 which amounts to US$40,000.

PROJECT OUTLINE

COUNTRY	:	Malaysia
SECTORS COVERED	:	Foams, Halons and Refrigeration Sectors
NATIONAL ODS CONSUMPTION	:	10,044 metric tonnes in 1991
PROJECT TITLE	:	Project preparation assistance
DURATION	:	Six Months
PROJECT IMPACT	:	Preparation of technical assistance, demonstration and investment projects in the foams, halons and refrigeration sectors.
PROPOSED BUDGET	:	US$50,000
IMPLEMENTING AGENCY	:	UNDP
NATIONAL COORDINATING	:	Department of Industrial Works, Ministry of Industry

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PROJECT DESCRIPTION

ODS consumption in Thailand has increased rapidly over the recent past due to the rapid expansion of the national economy which has resulted in higher demand for ODS-containing products. Thailand's ODS 1991 ODS consumption by sector has been estimated as follows:

a)	Solvent Cleaning	4,318 tonnes	(43%)
b)	Refrigeration/AC	3,314 tonnes	(33%)
c)	Foams	1,507 tonnes	(15%)
d)	Halons (fire extinguishing)	603 tonnes	(6%)
c)	Aerosols	301 tonnes	(3%)
		10,044 tonnes	

The Government has already identified several projects in the solvents sector and several investment project proposals have been submitted or are in the process of being submitted through the World Bank to the Executive Committee for approval.

In a meeting in Bangkok with UNDP technical officials on 5 April 1993, the Director, Planning Division, Department of Industrial Works, requested UNDP's assistance in the formulation of technical assistance, demonstration and investment projects in the foams, halons and refrigeration sectors to implement ongoing activities in the Solvents.

The funds requested will be utilized for the recruitment of international and national consultants for the preparation of project proposals in these three sectors. The finalized projects should be ready for submission to the Executive Committee for approval at its Eleventh and Twelfth Meetings.

PROJECT OUTLINE

COUNTRY	:	Thailand
SECTORS COVERED	:	Foams, Halons and Refrigeration Sectors
NATIONAL ODS CONSUMPTION	:	10,044 metric tonnes in 1991
PROJECT TITLE	:	Project preparation assistance
DURATION	:	Six Months
PROJECT IMPACT	:	Preparation of technical assistance, demonstration and investment projects in the foams, halons and refrigeration sectors.
PROPOSED BUDGET	:	US$50,000
IMPLEMENTING AGENCY	:	UNDP
NATIONAL COORDINATING	:	Department of Industrial Works, Ministry of Industry

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PROJECT DESCRIPTION

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PROJECT COVER SHEET

COUNTRY:	BRAZIL
PROJECT TITLE:	Institutional Strengthening Support for the Implementation of the Montreal Protocol
GNP/CAPITA IN US$	$ 2,800 (1992)
IMPLEMENTING AGENCY:	UNDP
NATIONAL COORDINATING AGENCY:	Executive Secretariat of Interministerial Group of Ozone
PROJECT DURATION:	3 years

DESCRIPTION:

The Industrial Policy Secretariat - SPI of the Ministry of Industry, Commerce and Tourism - MICT is the Executive Secretariat of the Interministerial Technical Group of Ozone - GTO. The GTO is responsible for establishing strategies and coordinating the implementation of the Montreal Protocol objetives in Brazil. The SPI was recently created by government. Its infrastructure is presently very limited.

The project intends to improve these infrastructure and provide better conditions for the Executive Secretariat to carry out its functions.

CONTEXT

Brazil is one of the signatories of the Vienna Convention for the Protection of the Ozone Layer, and of the Montreal Protocol on Substances that Deplete the Ozone Layer.

In view of its commitment to these Conventions, an Interministerial Technical Group of Ozone - GTO was created by the Government, in October 04, 1991 to establish strategies and coordinate the implementation of the Montreal Protocol objectives. The Industrial Policy Secretariat (SPI) is the Executive Secretariat of the GTO.

Brazil is a producer and consumer of ozone depleting substances (ODS). In 1989, total ODS consumption was estimated at 10.000 tons.

Domestic demand is supplied by internal production and imports. The domestic market is dominated by DuPont, Hoechst and Dow Chemicals.

The end-uses of ODSs CFC and HCFC in Brazil are:

- air conditioning and refrigeration (47%)
- foaming agent (40%)
- solvent cleaning (7%)
- aerosols (1%)
- others (5%)

Methyl Chloroform is used in:

- solvent (92%)
- aerosols, adhesives and coatings (5%)
- others (3%)

Carbon tetrachloride produced locally is entirely used as a raw material for CFCs and other intermediate goods.

The activities of the GTO Executive Secretariat have been adressed to:

- ODSs producers - two chemical plants that produces aproximately 24 000 tons per year.
- ODSs consumers (air conditioning and refrigeration industry).
- Industries that uses ODSs as raw material.
- Maintenance and technical assistance services.
- Consumers in general.

PROJECT JUSTIFICATION

Brazil signed the Montreal Protocol in March 19, 1990 and ratified its adjustments in 1991. The GTO was created in October, 1991 to implement the Montreal Protocol.

At this time the Industry and Trade Department from Ministry of Economy Finance and Planning was indicated as its Executive Secretariat. Presently the Executive Secretariat is the Industrial Policy Secretariat - SPI part of the Ministry of Industry Commerce and Tourism.

The GTO has been meeting periodically since it was created and its main results are:

- National diagnostic of the production and consumption of the ozone depleting substances (up dating the IBAMA and EPA's first work).
- Elaboration of the procedures to the projects approval.
- Elaboration of the guidelines for previous consult.
- Send to World Bank the previous consults.

Despite these results and the group efforts to implement the Montreal Protocol according to the terms of the agreement the Executive Secretariat and IBAMA activities have been limited because of the lack of equipments and full time professionals dedicated to the subject.

The present Brazil's economic situation and the lack of Governmental funds make remote the possibility for GTO's Executive Secretariat to improve its situation. For these reasons the decision was made to request the support of the Multilateral Fund.

OBJECTIVES

- Strengthening the Executive Secretariat of GTO by means of providing required resources to implement and coordinate projects and programs to reduce or eliminate production, consumption and control of the ozone layer depleting substances.

OUTPUTS

- Promoting the consciousness in Government, industry and the public in general to the destructive effects of the substances controlled by the Montreal Protocol to the ozone layer, by means of seminaries, lectures and activities of information and training.

- Establish the link between Government, industry and the scientific and technological comunity, intending to discuss and to evaluate the Montreal Protocol implementation.

- Promote the implementation of the Montreal Protocol objectives.

- Create a National Data Bank on ozone depleting chemicals.

- Provide the Ozone Secretariat with information from the data bank about the ozone depleting chemicals as was stablished in the Montreal Protocol.

- Assist industry, universities and research centers by means of specific information, studies and needs identification and ways of technical cooperation among them.

- Concentrate scientific and technological information in the subject.

- Specify the procedures to the projects applications to be supported by the Multilateral Fund.

- Promote the use, development and implementation of alternative and environmental secures technologies.

- Provide the necessary organization to have Brazil's Country Programme completed and presented by the XI EXCOM Meeting.

INPUTS

Brazilian Government inputs

- The Executive Secretariat of GTO operate in the Industrial Policy Secretariat offices and uses its presently infrastructure.

Multilateral Fund inputs

- Although having installations, personnel and equipment they are not adequate to attend efficiently all the activities originated by the Montreal Protocol implementation.

To adequate these infrastructure the needs are:

Personnel

01 coordinator
01 engineer or equivalent (Fluent in English)
02 secretaries

Equipment

		Costs (US$)
- microcomputer (486 DX 33MHz SVGA)	02	4 000
- laser printer	01	2 000
- impact serial printer (Epson LQ 1170)	01	700
- modem	02	300
- mouse	02	50
- laptop 386	01	1 000
- "data show"	02	1 000

- softwares		2 300
- fax machine	02	500
- desk photocopy machine 02		6 000
- over head projector 02		600
	TOTAL	18 450

YEARLY COSTS
(US$)

	TOTAL
Salaries	
coordinator (01)	30 000
engineers (01)	24 000
secretaries (02)	12 000
yearly total	66 000
Miscelaneous	
Publicity	10 000
Office Material	2 000
Mail and telephone calls	4 000
Equipment Maintenance	2 000
Contracting Services (2nd and 3rd years)	30 000
Local Travel	12 000
yearly total	60 000

FIXED COSTS

Equipment	18 450

YEARLY TOTALS

1st year total		114 450
2nd year total		126 000
3rd year total		126 000
	Sub-total	366 450
contingency (10%)		36 645
Project total		403 095

version 5.0
PNUDPROJ.DOC

PROJECT PROPOSAL

Project Title	:	Institutional Strengthening of the Ozone Layer Protection and Ozone Depleting Substances (ODS) Phaseout Unit
Country	:	INDONESIA
National Coordinating/ Executing Agency	:	State Ministry for Environment
Implementing Agency	:	UNDP
GNP/Capita	:	$500
Proposed Total Budget	:	US$ 314,780

1. BACKGROUND

a. Consumption of Controlled Substances

The State Ministry for Environment (SME) is about to set up the Ozone Layer Protection and ozone depleting substances Unit solely devoted to the phaseout of the ozone depleting substances (ODSs)'s consumption. ODSs are widely used in Indonesia's industry as reflected by the current consumption, which is now approaching 4,000 tonnes (1992 figure).

Indonesia's calculated weighted consumption of CFCs and Halon in 1990 was 5,051.94 tonnes which amounted to a per capita consumption of 0.027 kg. Out of these, 2,387.81 of CFC-12 was consumed, followed by 1,084.52 and 1,182.27 of CFC-11 and other CFC, respectively (Further data see Appendix 1).

b. Consumption of Controlled Substances by Sector

ODS usage by industrial sectors in 1992 showed that the refrigerant and airconditioning industry was the largest user accounting for 63.22 % of the total. The other users were the foam (7.86%), aerosols (19.42%) and halons (4.42%) industries. Methyl Bromide alone accounted for 5.08 % of the total.

2. OBJECTIVES

a. Long Term Objective

The operational objective of Institutional Strengthening is to monitor provision of financial assistance and technical assistance to the Government to carry out the projects in accordance with the recommended ODS phaseout strategy and action plan in Indonesia's Country Programme (CP).

The overall objective is to assist the State Ministry for Environment (SME) and related institution to effectively and efficiently phaseout ODS through the adoption of policy, technological and monitoring measures in compliance with the provisions of the Montreal Protocol.

b. Short Term Objective

1. to set up the Ozone Layer Protection Unit;
2. to strengthen implementation capacity within SME to facilitate expeditious implementation of the projects to reduce ODS;
3. to provide a national institutional mechanism for coordinating national and international efforts for the protection of the ozone layer;
4. to assist the factories in developing and implementing the ODSs phaseout activities;
5. to plan and affect the reduction and control of import/export of ODS;
6. to improve data collecting system for better monitoring of the consumption of controlled substances, and for providing the industry with the latest development of the non-ODSs technology;
7. to recommend policy and legislation to the National Committee on the implementation of the Montreal Protocol;
8. to exchange experiences in implementing the phaseout activities with other national and international organizations;
9. to establish an exchange for the dissemination of information and to promote activities for ODS phaseout;
10. to audit and monitor the implementation of ODS phaseout projects; and
11. to administer the Application Permit (AP) System for ODS usage control.
12. to increase public awareness on the issues of the ODSs.

3. SCOPE OF THE PROJECT

The scope of the Institutional Strengthening Project is to provide the necessary policy direction, data collection and evaluation, public awareness and financial monitoring control needed for implementation of the Country Programme.

The project will have a country wide impact. Due to the national policy of desentralisation, factories were established in most major cities over the country. This fact makes the effort of the unit more difficult.

Economic growth has also brought with it a high involvement in construction. A large number of large air-conditioning units (chillers) were installed all over the country. Furthermore, demand for cars equipped with air-condioners has also drastically increased, which results directly in the increase of mobile air- conditioner repair shops.

The detailed projects for ODS phaseout has been developed on the basis of the key recommendation made in Indonesia' Country Programme (CP). These proposed project activities will provide the Indonesian Government with financial and technical resources to carry out the implementation of ODS reduction projects.

4. JUSTIFICATION

In recent years, Indonesia's consumption of controlled substances has increased with high pace due to the rapid expansion of its national economy. With high purchasing power, the demand for products produced with or containing controlled substances has drastically raisen.

The consumption of the controlled substances by sector (in 1992) is as follows :

Refrigeration (domestic and commercial)	698.6 tonnes
Air Conditioning	1728.4 tonnes
Foam Blowing	301.8 tonnes
Fire Extinguishing/Halon	169.6 tonnes
Aerosols	745.4 tonnes
Methyl Bromide	195.1 tonnes
Solvent Cleaning	
TOTAL	3838.9 tonnes

Thus, an effective plan to reduce the consumption of ODSs must comprise two major components; one is to curb down the new demand for ODSs, and another is to assist existing factories to convert their facilities to use alternative technologies.

SME is the national centre for coordinating, monitoring and implementing all MP activities including ODS phaseout project under the CP. However, SME has a limitation on its ability to speedily and effectively implement as well as monitor the approved projects. SME is presently under-staffed. The State Ministry is responsible not only for matters relating to the Montreal Protocol, but also all matters relating to environment. Institutional Strengthening support will greatly relieve this shortage and help to speed up the implementation of the projects related to ODS phaseout.

With full commitment to the Montreal Protocol, Indonesia is determined to conform with all terms and conditions directed by the Protocol. Since the controlled substances or ODSs are widely used in various industries with different degrees of complexity, any government attempts in reducing the consumption of such substances must be carried out concertedly and effectively not only to ensure the success of each phaseout activity, but also to attain high degree of cost-effectiveness.

The Ozone Layer Protection and ODS Phaseout Unit is going to be established within the SME to respond to the requirements set in the Montreal Protocol. The Unit will be underequipped both in terms of personnel and office equipment. In order to fulfill its objectives in implementing and facilitating actions aimed at speedy phaseout of the ODSs in Indonesia, the Ozone Layer Protection and ODS Phaseout Unit urgently requires assistance from the Multilateral Fund to strengthen its capabilities.

5. BENEFICIARIES OF THE PROJECT

The Institutional Strengthening will help the Government to implement an accelerated ODS phaseout programme. This component of the project will set into place the development of a central coordinating system with key management personnel.

6. STRUCTURE AND MANAGEMENT

SME currently has the responsibility to coordinate, supervise and monitor the ODS phaseout programme in compliance with the provisions of the MP. SME is responsible for the administration as well as monitoring and enforcement of national legislation, namely the Environmental Management Act Number 4, 1982 and its subsidiary regulations. Under the current SME organisational structure, there is no provision nor allocation for the management of MP - related activities. The officer given the responsibility to implement the provisions of the MP is indeed a borrowed one. responsible for activities related to IRPTC, the London Guidelines and Chemicals management.

Since 1987, the responsibility of dealing with activities realted to the MP was undertaken by a devision of Assistant Minister for Natural Resources Management under the Ministry of Environment. SME is hard pressed by the ever growing work load including the rapid growth of ODS-related matters while the central agencies are reluctant to increase allocation to SME. It will require additional manpower to meet the added responsibilities under an ODS phaseout programme. Institutional Strengthening assistance is therefore required for the setting up of a specific unit in SME that will be responsible for policy and data issues as well as monitoring the implementation of ODS reduction projects in Indonesia.

The main responsibilities of this Unit will be as follows:

1. Liaison between Government and industries;
2. Secretariat to Working Group, Technical Working Group, National Technical Committee, National Steering Committee;
3. Development of an ODS reduction and phaseout action plan based on the Country Programme;
4. Development and preparation of legal and administrative measures for effecting the reduction and phaseout of controlled substances;
5. Development and preparation of non-legal measures, codes of practices suitable for adoption by all controlled substances users and organizations;
6. Implementation, monitoring, review, and adjustment of activities and programmes from time to time;
7. Approve and enforce a controlled substance import control system as well as CFC / Halon use and authorisation;
8. National focal point for the UNEP Ozone Secretatiate and the Multilateral Fund Secretariat;
9. Collection, collaboration and ratification of CFC/Halon consumption data; and
10. Central reporting authority on CFC/Halon projects funded by the Multilateral Fund.

7. THE STAFF STRENGTH:

The unit would comprise 2 professional staff members and 3 supporting staff or assistants (including a computer programmer). The Assistant for the Minister, at the Division for Natural Resources, will be responsible for the overall management of the staff of this unit. During the implementation he will be assisted by the Deputy 1 of the Assistant to the Minister.

8. ACTIVITIES

In order to achieve the objectives and outputs of the project, the following activities will be carried out during the 3-year period of the programme.

a) Develop a detailed work plan for the Ozone Layer Protection and ODS Phaseout unit;
b) Identify all factories currently using controlled substances in their operations;
c) Assist the factories in developing and facilitating implementation plans for their ODS phaseout programmes;
d) Monitor and evalute progress of phaseout activities by these factories;
e) Improve the data collecting system on ODS production, consumption and imports on the phaseout activities and the use of alternative technologies for better monitoring of the consumption of controlled substances in Indonesia;
f) Provide the factories with the latest information on appropiate non-ODS technologies;
g) Participate in regional ODS-related conferences;
h) Recommend policies and measures/plans on ODS phaseout activities to the National Committee on the Implementation of the Montreal Protocol;
i) Prepare information and develop programmes for the media to raise the public awareness on the issues of ODS consumption. (This will be financed from the Government input).
j) Exchange information on Indonesia ODS phaseout activities with the Ozone Secretariate in Nairobi, with the Executive Committee of the Multilateral Fund, with other countries, and with national and international organizations;
k) Organize and award programme for the factories with the most effective ODS phaseout activities.

9. INPUTS

a. Infrastructure and Capital Expenditure :

Office space is required to accomodate the function of this unit. The facilities and equipments required are :

	Items	No. of Units
Equipments		
1.	Personal Computer (disk drive, monitor, printer, and software)	1
2.	Leasing Photocopier	1
3.	Leasing car	1
Personnel (Detailed in Appendix 2)		
1.	Coordinator	1
2.	Secretary	1
3.	Staff	2
4.	Local experts	4

10. COST

Total cost required for the year period is estimated at US $ 315,000.00 including a consultant required for 3 work months each year.

11. OUTPUTS

The expected outcomes of the IS project are as follows :

1. The acceleration of ODS phaseout project implementation
2. Policy direction and coordination of national ODS phaseout efforts as well as reliance on a data base to monitor Indonesian's compliance with the provisions of the MP; and
3. The promotion of public awareness and understanding on ODS related issues.
4. Information system develop for better monitoring the consumption of controlled substances, and for providing the industry with information on the latest development of non-ODS technologies.
5. Programmes development for media, i.e. television, radio and press, to raise public awareness on the issue of the ODS;
6. Experiences with other countries and national and international organizations concerned with the implementation of the ODS phaseout activities;
7. Recommendations provided to government, and particular, to the National Committee on the implementation of the Montreal Protocol, on the policies, measures and plans on the ODS phaseout programme.

Appendix 1. Indonesia's Consumption Data on ODS 1986 -1990

Year	CFC-11	CFC-12	Other CFC	Halon	Carbon Tetrachlor	Total Consumption
1986	577.45	1127.52	784.04	5	0	2494.01
1987	540	1132.1	696.31	53.7	0	2422.11
1988	682.62	1665.85	782.83	156.8	43.8	3331.9
1989	879.28	1604.5	1273.83	167.1	0	3924.71
1990	1084.52	2387.81	1182.27	219.78	177.56	5051.94
Total	3763.87	7917.78	4719.28	602.38	221.36	17224.67

Appendix 2. Qualifications of Personnels Recruited

Type/rank	Number of Persons	Qualification
Coordinator	1	Engineering
Secretary	1	Management / Economist
Staff	2	Science / Engineering Economist
Local Experts	4	Engineering / Natural Science Physics / Economist

Appendix 3. Budget Estimated on Annual Basis Over a three-year Period

	Subject Matter	Estimated Cost (US $)			
		First	Second	Third	Total
1.	One time Setup Costs - Photocopier (Leased) - Personal Computer * Disk drive * Monitor * Printer * Software	12,500	-	-	12,500
2.	Recurrent Expenditure				
	<u>Personnel</u>	41,600	41,600	41,600	124,800
	- Professional Staff (1 person)	13,800	13,800	13,800	41,400
	- Supporting Staff (3 persons)	19,800	19,800	19,800	59,400
	- Experts (4 man months)	8,000	8,000	8,000	24,000
	<u>Operasional Cost</u> - Data processing and dessime-nation, telecomminications, Office supplies, office travel, Utilities, Leasing car, Office space, Equipment maintenance, etc.	50,000	50,000	50,000	150,000
	<u>Contingensis</u>	9,160	9,160	9,160	27,480
	TOTAL COST	113,260	100,760	100,760	314,780

AMENDMENTS TO THE 1993 UNDP WORK PROGRAMME

SUPPORTING DOCUMENTS

These documents include information on the following projects:

China:
- Elimination of CFCs in cleaning operation at the Nanjing Wire Works;
- Elimination of CFCs in cleaning operation at the Ghengdu Quianfeng Radio Instrument Factory;
- Strategy and action programme for the elimination of CFCs in the manufacture of foams;
- Revising design standards for cold storage;
- Testing of vacuum insulation panels for domestic refrigerators and freezers;
- Implementation of the halons phaseout plan for China: current situation, revision of national codes and education and training; and
- Implementation of the halons phaseout plan for China: transfer of technology on alternatives to halon fire protection systems.

Ecuador:
- Training and technology dissemination.

Malaysia:
- Elimination of CFC-12 in the manufacture of extruded polystyrene foam sheet at Jumaya Industries; and
- Automobile retrofitting demonstration project with alternatives to CFC-12.

PROJECT COVER SHEET

COUNTRY OR REGION:	China
SECTOR COVERED:	Primary Sector: Solvents
ODS CONSUMPTION IN AFFECTED SECTORS	4311 tonnes of ODP in 1991
PROJECT TITLE:	ELIMINATION OF CFCs IN CLEANING OPERATIONS AT THE NANJING WIRE WORKS
PROJECT DURATION:	Three years from funding availability
PROJECT IMPACT: ODS REDUCTION	11 tonnes reduced CFC-113
PROPOSED BUDGET:	US $401,000 project cost 58,000 NPV of 4yr op costs $459,000 TOTAL
IMPLEMENTING AGENCY:	UNDP
NATIONAL COORDINATING AGENCY:	National Environmental Protection Agency through the Ministry of Electronic Industry

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PROJECT SUMMARY

The China Country Programme addresses the rapidly growing solvent sector by employing a strategy of subsectoral demonstration projects, followed by replication. Nanjing wire works is the third demonstration project, following Dandong and Dalian which were approved in 1992. The Nanjing Wire Works represents the computer/peripherals subsector (120 factories), and the technology planned includes replacement of existing ODS cleaning lines with a semi-aqueous cleaning line for the critical circuit boards, and an aqueous cleaning line for the non-critical boards and peripherals.

PROJECT OF THE GOVERNMENT OF CHINA

ELIMINATION OF CFCS IN CLEANING OPERATIONS AT THE NANJING WIRE WORKS

1. Project Objective

The objective of this project is to phase out the use of CFC-113 and methylchloroform used in the manufacture of computers and peripherals at Nanjing Wire Works. The project will use technology and equipment that can serve to demonstrate successful application of ODS-free technology to the other manufacturers in this subsector

2. Sector Data

Total ODS consumption in China in 1991 was 48,239 tonnes with an ODP (ozone-depleting potential) value of 60,352 tonnes. China has forecast that unconstrained ODS consumption would by the year 2010 result in ODS consumption of 229,318 tonnes with an ODP value of 292,714 tonnes with resulting severe damage to the global ozone layer.

ODS consumption in the solvents sector in 1991 amounted to 4,947 tonnes with a combined ODP value of 4,311 tonnes. This combination reflects the weighted average of a 1.07 ODP value for CFC-113 (91%) and a 0.12 ODP value for methyl chloroform (9%). There are 3,200 medium and small-sized enterprises using ODS-based cleaning processes in China at present. With unconstrained consumption, ODS consumption in this sector by year 2010 would reach 53,571 tonnes, growing at over 14% per annum in the period 1991-2010. It is thus critical that ODS consumption in this sector be reduced as soon as possible. This is technologically feasible since alternative processes exist. The main issue is to determine the few cleaning processes, or alternative technologies, most feasible for the many different factory applications throughout China.

3. Background

A major, high growth area in China is the solvents sector, as described above. Key demonstration projects in each of several major applications, or subsectors, followed by rapid deployment and replication of the demonstrated technology, are deemed necessary for successful completion of the solvents sector overall strategy. Two additional elements which are essential towards achieving cost-effective phase out in the sector consist of

a) A laboratory for evaluating parts cleaning processes for the replication plants, where samples from the factories can be cleaned in various standard processes.

b) A manufacturing line to produce cleaning equipment for the replication in an economical, expeditious manner. (One study tour has already been completed to evaluate the possible candidates for a joint venture in this regard.)

Nanjing is a major city with both railroad and air service connecting it to the other major cities in China. The Nanjing Wire Works was chosen as a key subsector firm from among some 120 computer and peripheral manufacturing firms in China because it features high accuracy and possesses the appropriate complexity in its manufacturing of printed circuit boards (PCB's) and consumption of Ozone Depleting Substances (ODS). Nanjing Wire Works is situated in Dongjingting, Zhongyangmenwai, Nanjing City. It is one of the largest firms in the nation and has been in business for more than 50 years, with current products in the areas of minicomputers, peripherals, printers, video displays and wire carrier communications units. It utilizes upgraded technology and equipment obtained from France, Japan, and the USA. In the area of new product development, it has been averaging 30 new items per year with an impressive track record of awards for excellence among the new products. Its production capability is being expanded to a base of 120,000 printers per year and 100,000 video display units per year. For the past few years, its sales have grown and average of 10%, with pretax earnings exceeding 10%.

4. Project Description

Nanjing Wire Works currently uses primarily CFC-113, with some methyl chloroform, in the manufacture of its product lines, consuming 11t/y of ODP. The company is committed to phase out the use of these ozone depleting substances, and has selected the use of aqueous and semi-aqueous technology for its two batch cleaning lines that are to be replaced. In addition to the equipment to be replaced, instrumentation will be needed to define and establish a quality manufacturing process during startup. This process definition equipment will also be used by other firms during the replication process. Peripheral equipment will consist of a D.I. water generating unit and an aqueous effluent monitoring system to assure product quality requirements are retained and environmental responsibilities are met.

5. Technology Discussion

5.1 Selection

The selection of semi-aqueous technology for the PCB's was based on the desire to assure that the minimum changes are made to the manufacturing process. The use of semi aqueous cleaning technology allows the continued, uninterrupted use of the upstream, solvent based soldering and assembly steps (with rosin based fluxes and paste) and allows the limited engineering resources to be focused on a smooth transition in the cleaning process as well as the change in the effluent streams.

5.2 Production Process

After soldering, the high reliability, complex PCB's will be processed in a semi aqueous cleaner. This allows the same upstream process to be used. It does require, however, the use of DI(deionized) water for rinsing and a dryer section which consumes more energy than the current process. There will be cascade rinsing required for these boards, which is built into the batching cycles. The metal parts and non-critical PCB's will be cleaned in an aqueous batch cleaning system, which also requires DI water, a cascade rinse and an effluent monitoring station.

6. Project Costs

6.1 Total Project Costs Requested from the Multilateral Fund

Equipment		price/cost $
1	semi aqueous cleaner with drying unit	76000
1	DI water cleaner with drying unit	78000
1	DI water generation plant	40000
1	cleanliness tester	22000
1	atom absorption effluent monitor	30000
	spare parts	10000
	subtotal	256000

Materials

ion exchange resin	5000
subtotal	5000

Miscellaneous Costs

equipment installation	
study tour	10000
expert fee	40000
feasibility study/ design	30000
transportation/premium	10000
construction management	10000
contingency items	10000
	30000
subtotal	140000
TOTAL	401000

6.2 Operating Costs

energy
$0.05/kwh*(418000-33000)kwh = 19300/yr

maintenance
12000 new maintenance cost (5%)
8000 replaced eqpt mt. cost 4000/yr

ingredients
15000 new solvent
20000 old solvent -5000/yr

Operating Costs TOTAL 18300/YR

NPV of 4 yr costs 58,000 $US

6.3 Project Costs to be Borne by the Country(RMB)

technical assistance		
experts		23,500
local training		10,000
development,testing for replication		180,000
contractor supervision		150,000
preparation		10,000
building, pipeline conversion		110,000
local equipment		70,000
transport and miscellaneous		140,000
		8,400
TOTAL	RMB	701,900
	$US	124,000

7. Financing Plan

7.1 From Multilateral Fund:

Investment Costs	$401,000
NPV of 4 Yr Operating Costs	58,000
TOTAL REQUESTED FROM THE ML FUND	**$459,000**

7.2 From the Government: $124,000

Total Project Cost **$583,000**

8. Project Implementation

8.1 Management

Project management will be carried out by CEEDI/MEI under the direction of NEPA

8.2 Schedule

	YEAR	**1992**	**1993**	**1994**	**1995**
STEP	**DESCRIPTION**				
1	Feasibility study report and evaluation	x	x		
2	Examination and approval by NEPA and UNDP		xx		
3	survey and technical exchange		xx	xx	
4	study tour		x	x	
5	Contract negotiations			x	
6	Contracts signed			x	
7	Procurement/Construction			x	x
8	Startup and acceptance testing				xx
9	Begin replication				x

9. Project Impact

This project will eliminate the use of at least 11 tonnes of ODS in the first year after startup. Market and growth estimates indicate that this may continue to increase at the rate of about 10% per year. The project will also provide a high quality demonstration site for the training and dissemination of the know-how that will be required to replicate the results at an additional 120 computer manufacturing sites throughout China.

United Nations
Development Programme

World Development

TO: FRANK PINTO

FROM: CLINTON NORRIS
UNDP CONSULTANT

DATE: 13 MAY, 1993

SUBJECT: PROJECT TECHNICAL REVIEW

I have reviewed the Solvent Demonstration Project, "Elimination of CFCs in Cleaning Operations at the Nanjing Wire Works" based on detailed discussions with MEI (Ministry of Electronics Industries), CEEDI (China Electronics Engineering Design Institute), and review of the study report prepared by factory and CEEDI personnel regarding the NanjingFactory project.

Technical Soundness

This demonstration project substitutes aqueous technology for the metal parts and non-critical printed circuit boards that are currently cleaned with a batch ODS solvent cleaner. Semi-aqueous technology (solvent clean/aqueous rinse) is planned for the for the critical printed circuit boards. Because semi-aqueous technology allows the continued use of rosin fluxes and solder pastes, the uninterrupted use of already established upstream technology can be assured. The other, less critical parts should be adequately cleaned via aqueous technology, which requires a change to the use of water soluble fluxes in the circuit board assembly process. Both technologies are now in use and have generally demonstrated at least equivalent performance vs. prior ODS cleaning processes.

Safety

The use of semi aqueous technology employs hydrocarbon substances which have flammability potential. The use of established equipment and processes assures that the appropriate safeguards are designed into the replacement technology. Thus, misting will be controlled or blanketed, depending on the equipment chosen.

Cost Effectiveness

The project addresses cost effectiveness, with continued use of existing upstream assembly processes. This minimizes the cost of changeover and startup testing for solder joint reliability, as well as the need to test long term performance/statistical failure potential for the high reliability boards. The project stipulations that

Cost Effectiveness (contd)
instrumentation be used in the replication process for the subsector, and subsectoral local experts be developed as a result of the study tour, for use in subsequent replication activities.
The estimates are in line with experience in other countries and at $7.6/kg, are in the range of unit abatement costs for solvents, in spite of the fact that this is a demonstration project. Cost effectiveness of the replications within this subsector (computers and peripherals) should be considerably less than this project based on the Chinese plan to use the instrumentation from this project for process set up, and the plan to use locally produced equipment that is based on technology transfer from an established, reputable equipment manufacturer.
This will also address issues related to practical experience.

Environmental

The use of aqueous technology has the potential for the dissolved detergents to complex with the heavy metal components in the removed flux residues. The instrumentation provided in the project will detect if metals are being dissolved in the water waste so that the process settings can be adjusted or the metals removed.
It is the evaluator's understanding that aqueous treatment is available at Nanjing and that the operator that monitors the the water treatment/effluent will also be assigned to operate the DI water system.
Equipment chosen has built in recycle capabilities which will minimize the size of waste streams as well. Semi aqueous solvents are hydrocarbons and thus have VOC potential. While VOCs are not regulated in developing countries, they may be a future concern.

Recommendations

It is recommended that this demonstration project be approved.

Background Information

250-300
30

Demonstration PCB Cleaning Line for ODS Phaseout

in Nanjing Wire Works

China Electronics Engineering Design Institute
(CEEDI)
Beijing, April, 1993

Demonstration PCB Cleaning Line for ODS Phaseout in Nanjing Wire Works

Feasibility study Report

Chief Designer: Wang Xiguang
Vice Chief Engineer: Bao Jinming
Chief Engineer: Wang Zhiliang
Director of CEEDI: Wang Qian

China Electrunics Engineering Design Institute
(CEEDI)
Beijing April, 1993

Prepared by:

Wang Xiguang
Liu Hezi
Guo Weicheng
Bao Fengfeng(form the firm)

Table of Contents

1. Outline

Project brief

1)project title—Demonstration PCB cleaning line for ODS phaseout

2)Implementation agency—Nanjing Wire Works

Director—Pang Junming

3)National ageNcy responsible for managing the project—

Environmental Protection Office, MMEI

Dept. of Science and Technology, MMEI

4)Feasibility study report preparing agency—China Electronics Engineering Design Institute(CEEDI)

1—2 Basis for preparaing the report

1)(1992) No. 104 Document issued by the Dept. of Science and Technology, MMEI,

2)Document signed by the government of PRC for participation in "Vienna Treaty" and the revised "Montreal Protocol".

3) The guideline issued by UNDP consultant group on investment feasibility report for ODS phaseout and work report by UNDP expert group.

1—3 Scope of study

As per the overall arrangement of NEPA and the Environmental Protection Office, MMEI, it's planned to set up a demonstration line for electronics and metal parts cleaning to phaseout ODS with the Dept. of Science and Technology, MMEI being in charge.

This report will cover refurnishing the existing PCB cleaning line, setting up the demonstration line in computer and peripheral industry and converting the utilities correspondingly.

1—4 Project background information and necessity of ODS phaseout.

The ozone layer existing high above the globe serves to protect human from vital UV attack. The severe drop of ozone density would cause variation of the worldwide climate and the ruin of ecological environment, authough ozone accounts for such a small propertion that there is one ozone molecule out of every 100,000 air molecules. Ozone layer is also very thin and easily subjected to distruction. It's been reported that ozone density has been decreased by 3.4～3.6% in average and it's even worse that ozone cavities have been found over the South and North Poles. It's virtuely of vital significance and great urgency to protect ozone layer and the human living environment.

CFCs emission is one of the many causes for ozone layer depletion. CFCs is widely used in electronics nd precision components cleaning for its good penetration, easily dissolving oil dirt and safe operation. But despite all this, CFC is fairly stable and may exist in atomosphere for up to hundreds of years. During its build—up process, it enters the stratosphere through troposphere and creates chloric atoms through photolysis under UV radiation which react with and rapidly deplete ozone. Calculation shows that every one chloric atom would spoil 100,000 ozone molecules. It's needless to say that what grave consequence would be resulted from the quantity use and discharge of CFCs. Humanbeing shares the same globe and the common responsibility to protect its own environment. China is eager to join in the worldwide effort and contribute to ODS phaseout in electronics cleaning industry.

In the national 10—year development plan, high priority has been given to the development of electronics industry. At present, there are about 3,200 firms in electronics industry, among which are about 120 firms for computer and peripherals production. Most of them use ODS for cleaning and drying PCB and peripheral parts resulting in large ODS consumers. Statistics indicates 911t ODS consumed in 1991, and the uncontrolled use will lead to 4979t use and 6t accumulated emission in 2010 along with the development of electronics industry.

China is one of the signatories of the revised Montreal Protocol and has the committment to protect ozone layer and phaseout ODS.

China is also a developing country and has just started the ODS phaseout in electronics industry. It's a great work load to completely eliminate ODS in the 120 firms, which has to be done step by setp and in a planned way.

There are about 120 firms for manutacturng computer system and around 690 firms for communication and broadcasting system. They all use ODS to remove oil, dirt or flux residues remaining on PCB after wave soldering. ODS consumed by all of them is of quite big quantity, a small amount for individual firm though. Nanjing firm produces computer and carrier communication unit. PCB they are using is typical among all the 800 firms. There fore, it's assumed that Nanjing Wire Works is the right choice for setting up the demonstration line.

In view of the large quantity and the urgency of ODS elimination in China. UNDP Executing Committee will provide special funds and technical support for the implementation of the conversion project.

1—5 Main technological and economic imputs

conversion building area	$200m^2$
2)additional support operator	5
3) additional equipment and instrument	10

4)additional installed power capacity	1.75KW
5)additional DI water quantity	4t/h
6)additional city water	10t/h
7)total investment	RMB 3,584,800
in which	USD 492,000
	RMB 736,200
8) incremental cost	RMB 3,584,800
in which for conversion importing	USD 492,000

(equipment, instrument and material, study tour and training)

9) ODS reduction

Total ODS reduction in Nanjing firm will be 10t with C=USD 9,300/t. ODP in completion of the line in 1995(Cvalue for UNDP grant is USD 7,380/t. ODP).

In the computer and peripheral industry:

ODS reduction will reach 790t by 1996 when completion of replication in 120 firms (USD 2,500,000 for replication extra).

1—6 Conclusion

The following conclusions have been made on the basis of technical and economic analysis:

1)It's the common task for the whole world to protect ozone layer and phase out ODS, to which the developed countries have contributed a great deal since mid. 80's.

The chinesse government has attached great importance to ODS phaseout since signing the protocol and listed it in the 10—year development plan. As stipulated in the revised Montreal Protocol, China is also liable to replace ODS in the 3,200 electronics firms. Thus, it's entirely necessary to phase out ODS in electronics (and metal parts) cleaning.

2) Since 120 computer and peripheral firms are spread out all over the country and consume quantity ODS, it's more economic and rational to set up a no—ODS demonstration line and replicate step by step.

3) Nanjing Wire Works is a key firm for manufacturing computer and peripherals, featuring high accuracy and difficulty in processing and ODS consuming. It's the wise choice to set up the demonstration line in Nanjing firm.

4) ODS replacement technology could be introduced from DuPont and ECD, USA.

5) The project would get great support from the government.

6) The economic benefit in the project appears negative.

7) But the social benefit is remarkable in terms of protecting the human living envi-

ronment.

Nanjing firm will completely eliminate ODS of 10t in total from 1995.

Replication in 120 firms (USD 2,500,000 extra) will lead to accumulated ODS reduction of 790t by 1996(Cvalue for UNDP grant is USD 7,380/t. ODP).

The above would justify the necessity and feasibility of this project.

1—7 Some explanations

1) Investment in the project won't make any change in production capacity, product quality and the output value. On the contrary, the product cost will go up, which will result in negative economic returns.

In addition, as project is a demonstration line, some costs will be out of the firm's real need. Due to the above reasons, it's best not to have the investment allocated in the form of loan.

2) The cost for patent and software is not included.

3) The replacement technology has not been studied and the choice not made yet.

4) It's requested that the multilateral funds for this project be available at the 3rd quarter of 1993, otherwise The schedule would be delayed.

5) The prerequisite of replication is the cleaning process lab and cleaner manufacturing line in operation plus USD 2,500, 000.

6) The ODS phaseout projects in electronics (and others) cleaning is a system engineering package consisting of 4 demonstration lines (Dalian, Dandong, Chengdu and Nanjing), one cleaning and recycling process lab and one cleaner manufacturing line, which condition one another. The delay or cancel of any shall hinder the progress of the projects.

2. Information on implementation agency

2—1 Basic information

Nanjing Wire Works is situated in Dongjingting, Zhongyangmenwai, Nanjing City. Nanjing is a major coastal city with air service and railroad transport to all the big cities in the country. The express airliner and vessel to Hongkong provides most convinience for foreign trade and technical exchange. It's also well known for the industries of machinery, electronics, light industry, textile and chemistry, laying a good ground for industrial development.

Nanjing Wire Works is a key firm of the ministry and one of the largest firms of the nation and has a history of more than 50 years, being mainly specialized in manufacturing minicomputer, printer, display and wire carrier communication unit and so on.. With the favourable support of the government in 6th and 7th 5—year plans, the firm underwent some technical conversion and introduced some critical equipment and technology as well as process lines of PCB, printer and minicomputer from Japan, France and USA to noticeably upgrade the technical level and the product quality and has formed a yearly production capacity per shift of 5,000 pcs. of minicomputer, 12,000 pcs. of printer(head), 50,000 pcs. of display, 3,000 terminals of wire carrier communication unit, etc..

The firm is quite powerful in new product development with nearly 30 new items put into production every year. Among all its product, 4 have been awarded the Silver Medal Product, 8 the Excellent Product in MMEI and over 90 the Prize for Scientific and Technological Achievements. The 960 line carrier communication unit and CYD—903 Chinese printer won the first and 2nd Prizes for Scientific and Technological Achievements particularly.

During The 8th 5—year plan, the firm will continue large—scaled technical conversion to build up a production base of 120,000 pcs. of printer a year and an export base of 100,000 pcs. of display, shaping the scale economy.

Main technical and economic condition:

staffs:	5,572
in which, technicians:	1,340
site ground area:	400,000m^2
building area:	101,500m^2
major equipment:	1,256pcs.
electronic instrument:	2,500pcs.
fixed assets:	RMB 134,000.000
net fixed assets:	RMB 76.790,000

Economic returns in 1989—1991 is shown in the following table

year returns	output value (USD)	sales revenue (USD)	profit and tax (USD)
1989	144.240.000	149,120,000	14,700.000
1990	141.400.000	161.780.000	18.130.000
1991	178.100.000	184.900.000	21.520.000

2—2 Present condition of the firm's environmental protection

It's a comprehensive firm. creating quite a few types of contaminant such as boiler fume. effluent and waste gas from surface treatment and PCB processing and effluent, from soldered PCB cleaning process. The firm has done a great deal in environmental protection——putting it into consideration and action in the design, construction and conversion pursuant to the National Environmental Protection law. Here are some examples: Special structure and SX cyclone dust collector were employed in the new boiler house project to allow the the fume discharge to the national rules, USD 650,000 was spent in introducing the complete set of effluent treatment system made in GOEMA, Germany to allow the effluent treated to the national rules. Besides these, the firm has input RMB 150,000 every year for retrofitting and converting the environmental protection facilities. In the years of 1989—1992, the firm was awarded the qualified excellent unit in environmental protection by the municipal government.

On the other hand, enclosed vapor and ultrasonic cleaning and part recycling are in service but ODS is still used for PCB and precision parts cleaning, presenting an urgent need for alternative cleaning prcess.

3. Market analysis

Computer sicence is finding more and more applications at an incredible rate while the product becoming more and more diversified.

Take the firm's product—banking automation equipment as an example for market analysis.

Along with the growth of computer application, the banking operation is tending towards 3 nos—no cash, no cheque and no paper. These years, banking automation has been thought highly by the state and listed as one of the top priority nationwide network information systems.

By the end of 1996, the investment by China People's Bank in this aspect will reach RMB 800,000,000. China Industrial and Commericial Bank has set up the network system basesd on big—and medium—size computer in 23 big cities and distribution—central type local network system based on small computer in over 60 middle and small cities, resulting in 6,000 and more automation points equipped with 56 big— and medium—size computers, 200 small—size computers and 20,000 minicomputers and special terminals. The 8th 5—year plan will see a further development in this field.

The Industrial and Commercial Bank is not the only one that has established the overall objective to implement the integrated banking automation system incorporating settling service, new banking service, comprehensive information service, decision—making support and internal affairs handling by means of up—to—date information processing and automation technologies. In 5 years, about 6,500 automatic operation points will emerge with an investment of RMB 500,000,000 a year, which displays a stable and growing market for banking automation system.

At present, the annual sales of printer and display that are major peripherals of computer hit 30 mil. pcs..

It's predicted that, by the end of the 8th 5—year plan, there will be a demand for 400,000 pcs. of minicomputer system at home market, showing a more than 300,000 pcs. of demand for printer and display. But the sales of both wore 100,000 respectively in 1991.

Nanjing firm has devoted their every effort to serve the user. They have fixed 30,000 pcs. of various banking automation system for the Industrial and Commericial Bank, and supplied 40,000 printers and 30,000 displays to the home market.

It's clearly shown that the firm has a prosperous market for the aforesaid product.

4. Product program, property and configuration and technological characteristics

4—1 Product program (typical products)

1) banking automation equipment	20,000 sets/year
2) Chinese printer	120,000 pcs. /year
3) display	100,000 pcs. /year
4) carrier	10,000 teminals/year

4—2 property (typical products)

1)Zijin 386/33 minicomputer system(key unit for banking automation system)

microprocessor	Intel 80386 33MHZ
coordination processor	Intel 80387, Weitek 3167
cache	32KB SRAM, 25ns
standared memory	2MB, 4MB, 8MB, selectable
ROM BIOS	64KB, buile — in setup, self — retrival, BIOS program
I/O layer extension slot	2 32bit slots, 6 16bit slots and 2 8bit slots
floppy	1.2MB
hard disc	104MB, 204MB
sub—display system	MGA 720×350

2)DPK 3600 printer

printing method	Impact matrix printer
number of needles of printing head	24
printing speed	Chinese h/s: 120cps. letter: 60cps English h/s: 180cps. letter: 90cps
printing character group	Chinese: GB 5007—85 National standard chinese character base English: ISO 8859—1/ECMA 94
copying capactity	5 copies (inclding printing the original)
paper feeding	Chain, friction automatic single page feeding
command collective emulation	LQ—1600K, XL24, DPL 24C
interface	standard: Centronics—type option: RS 232
service life	MTBF: 8000hrs
noise	54dBA

3)Zijin monochrome display

display tube	14"FS monochrome
resolution	720×350
scanning F	horizontal: 31~35KHZ vertical: 49~95KHZ
scaning manner	line by line and interlaced scanning
power supply	220V/50Hz, 115V/60Hz
power loss	<35W
color	single: amber, paper white, green
MTBT	>10,000 hrs

4—3 Configuration and technological characteristics

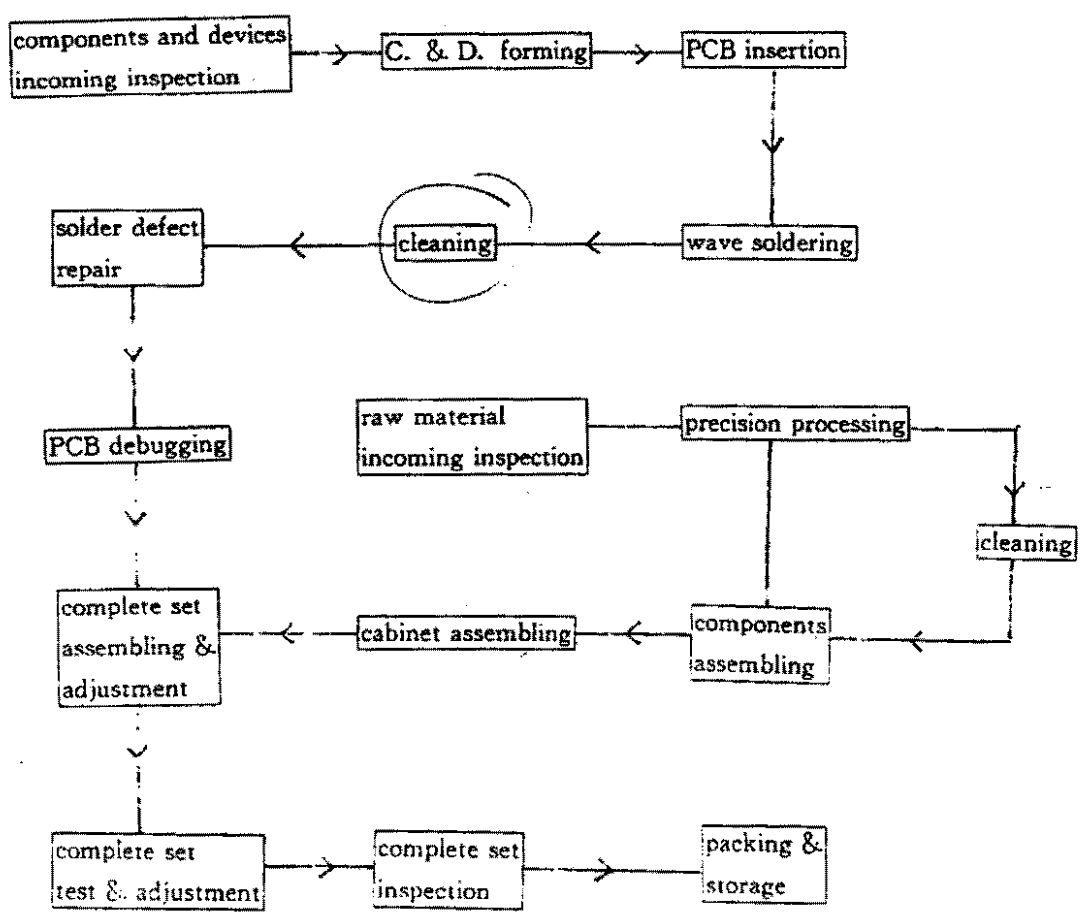
Minicomputer, printer and display are all composed of housing, PCB and mechanical elements, they are different in function and application though.

Housing — plasitc or metal construction through plastic injection and forming or metal maching.

PCB — IC and discrete components or mixed IC SMD and discrete components through insertion and SMT,

mechanical elements — usually are plastic or metal, through precision in jection or machining.

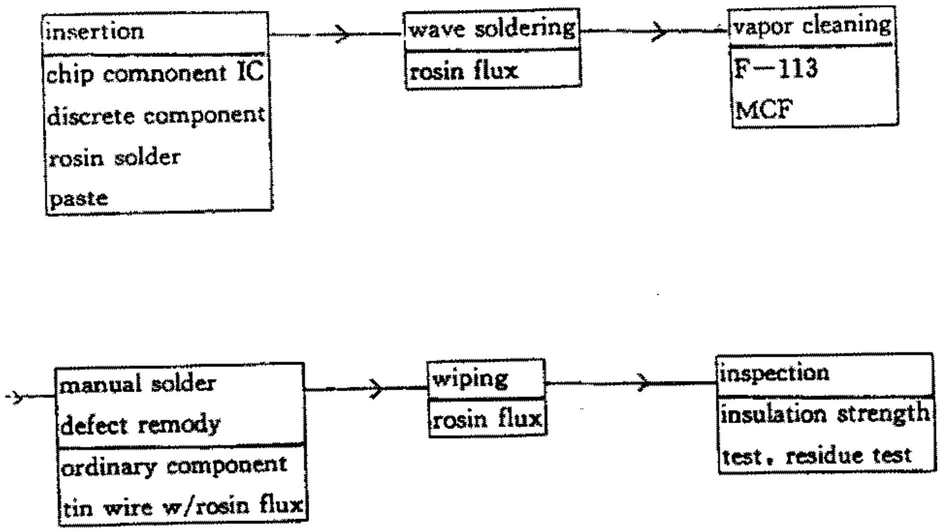
Take the process flow for printer as an example:



5 ODS phaseout plan

5—1 The existing cleaning process with ODS

The process flow is as follows:



PCB with componets SMT and throgh—hole mounted on it is soldered with rosin flux and solder paste and cleaned with F—113 or MCF to remove flux residue and other soils to guarantee the anti—electric strength and insulation stength and upgrade the quality.

PCB used in CPU — heart of computer and peripherals must have features of fine spacing, small hole size and high accuracy and better anti—electric strength, insulation strength and corrosion resistance, which make the cleaning process critical to computer production.

5—2 Introduction of alternative technology—eliminatiny ODS

The choice of PCB cleaning process is closely related to the type of flux and solder used. They have to be compatible, i. e. rosin flux and solder should be cleaned with organic solvent while water soluable flux and solder with water and DI water, which are defined and compared as follows:

1) Water cleaning process

The process is quite mature in through—hole PCB assemblies. It's reported that, in

USA, around 35% of through—hole assemblies employs water cleaning, which is also applicable to SMT assemblies.

Follicable to SMT assemblies.

Following is the process:

Components insertion (water solualbe solder) → wave soldering (water soluable flux) → manual solder defect remidy → cleaning (hot DI water) → drying (hot air) → inspection (insulation strength test, residue test)

Under specified temperature and pressure, city water and DI water effect well to remove water soluable flux and solder residue on PCB. Water soluable flux and solder are commercially available and active enough to be used in soldering materials of poorer solderability. But, it is more corrosive and must be cleaned away quickly and thoroughly to protect PCB and components from damage. Normally, conveyerized process with wave soldering, cleaner and drier completely in—line is employed.

2) solvent cleaning process

Rosin flux and solder paste may be cleaned with organic solvent only. In the world, full F—based composite is a mature ODS alternative option. The available one is Axarel developed by DuPont, USA. Axarel contains surface wetting agent that is not toxic, nor corrosive, no CL in its molecule structure and is of biolysis, which functions to dissolve the rosin residue very well and remove polar and non—polar contaminants.

Axarel is also limited in application. It may dissolve some silicon polymer and synthetic rubber and it has a lower flash point (71℃) and operation must be careful and safe. The cleaning process is not as simple as F—113 for Axarel cleaned PCB must be cleaned with water to avoid the surface wetting agent from remaining on PCB so as to degrade product qualiity.

3) no—clean process

The keypoint for no—clean process is the low solid flux containing no halogen, remaining less residue on PCB that's not corrosive, thus not requiring cleaning after soldering. But, ionized acid contained in this type of flux does not satisfy the current military code. Another approach for noclean process is to solder in inert gas or vacuum to almost entirely isolate O_2 and abolish the full oxidization possibility. In this case only small amount of pretreatment agent is used instead of flux to clear off the original metal oxide layer and minimize residue. The soldering point is so clean after soldering that no ion remains, no cleaning required and the cleanliness and surface resistance are tested to meet the MIL standard.

4)conclusions.

The following table is about the comparision of water cleaning, solvent cleaning and no—clean processes.

		DI water	Axarel	no—clean(solder in N2)
1	price ratio(SF—113)	reasonable or lower	4 times higher	reasonable or higher
2	technology	feasible	good	feasible
3	labor protection	safe, unharmful	inflammable (should be fire and explosion—proof)	safe,unharmful
4	effluent treatment	simple	—	no effluent
5	solvent source	easy	import	—
6	flux source	partly import	local or import	—
7	pretreating solvent source	—	import	—
8	one—time investment	higher	higher	high

Comparision shows that water and semi—aqueous cleaning processes are feasible options for this project to phase out ODS. Axarel functions better than DI water, but it's more expensive and has to be imported while water is technically feasible, of a lower price, easy source and simple treatment and unharmful. No—clean process has no solvent needed, no effluent, and no harm, but the one—time investment is quite high. For computer and carrier product, soldered PCB needs cleaning for controlling the ion contaminants. Therefore, it's better to clean computer PCB with DI water and peripheral parts with semi—aqueous.

5—3 Import of equipment

The existing 2 ODS cleaners have to be replaced as the cleaning solvent and operating condition change.

Depending upon the product features of small batch and large variety, it's intended to select ECD 6307 and ECD 500 batch cleaners made in ECD, USA. For wave soldering in inert gas, there are vacuum chambers at both imput and output ends of the machine to maintain a controlled O_2 amount inside the soldering area. PCB is feeded into the vacuum chamer that is enclosed at once with air sucked out and N_2 filled in to reduce the O_2 concentration to 7ppm. PCB then goes in the fully tight pretreating and soldering area and goes out from the other end.

The equipment is quite complicated in configuration and should be imported from abroad.

Following is the list of equipment and materials to be imported.

	item	Qty	description
	Equipment		
1	solvent cleaner with dryer (EDC 6307)	1	cleaning peripherals
2	DI water producing plant	1	producing DI water for cleaning
3	water cleaner with dryer(ECD 9600)	1	cleaning soldered PCB of computer
4	spare parts		
5	cleanliness tester 600	1	cleanliness testing
6	ultrahigh resistance and micro current tester 300	1	
7	conductivity tester	1	
8	atom absorption photometer 3100	1	measuring lead, tin ion concentration in effluent
9	high/low temperature chamber	1	reliability testing
	subtotal	8	
	materials		
1	water soluable flux	1t	PCB soldering
2	thinner	1t	flux thinning
3	water soluable solder	1t	
4	Axarel	$5m^3$	cleaning
5	ion exchange resin	0.5t	

5—4 Replication of the demonstration line

To make the most economic use of multilateral funds and accelerate the replication of ODS phaseont demonstration line in the entire sector, the following plan has been layed down.

1)The Dept. of Science and Technology, MMEI is responsible for the organijation of overall study tour and the policy making.

2)Set up cleaning process and recycling lab in No. 2 and No. 46 institues, MMEI.

3)Set up cleaner manufacturing line in No. 2 Institute, MMEI.

4) In completion of the Nanjing project, the two institutes will coordinate with the factory to hold training course.

5) US $ 250,000,000 (covering technical assistance fee and unforeseen fee) will be needed for purchasing local made cleaners to replicate the demonstration line in the other 120 firms.

5—5 ODS reduction

ODS reduction is figured out upon the rating of unit product ODS consumption as well as the output of each type of product, which is as follows:

	item	output (piece)	rating of ODS consumption (Kg/piece)	ODS consumption (t)
1	computer	20,000	0.05	1
2	printer	120,000	0.05	6
3	display	100,000	0.02	2
4	carrier	10,000 (terminal)	0.1	1
	total			10

The total ODS reduction will be 10t by completion of the demonstration line in 1995.

6 Building structure and utilities

The converion will take place in Building No. 6120 of the firm. It is a 3 storey building of reinforced concrete frame structure with a column line of $(7+3+7)\times 6m$ and a length of 120m. It's building area is 2050 m^2 and building floor area is 6150m^2 and the floor height is 4.8m.

The insertion process line is located on the 2nd floor, which is of terrazzo flooring, ready—mixed painting wall with double layer glazing and panel. It's a central air—conditioned area.

PCB cleaning process occupies an area of 42 $m^2$and will be 84m^2 after conversion to DI water cleaning process.

6—2 Utilities

The utilities of water, power and gases for insertion line areall in normal operation and have sufficient capacity for the conversion project.

The conversion will reguire the following additional services:

installed power capacity	175KW
city water	10t/h
DI water	4t/h(max.)

And a DI water producing plant (covering an area of $112m^2$)should be imported and installed for the future use.

7 Environmental protection, occupation safety and hygiene, fire protection and energy conservation.

These issues have been taken into full account and provisions put into action and accepted by local competent authorities.

7—1 Environmental protection.

The acid and alkaline effluent and effluent with saponifier from cleaning process will go to the effluent treatment facilities(to be purchased for this project)before discharge to the national rules.

2) Water cleaning process will not create any waste gas nor any harm to the operating circumstance as the noise of cleaner in operation is lower than that specified in relevant regulations.

7—2 Occupation safety and hygiene.

1) Converted or newly built buildings will have emergency exits, lighting and lightning arrester.

2) lighting of 150—300LX will be provided inside the building.

3) All the driving units will have housing or wire guard and equpment and instrument have neutral grounding.

7—3 Fire protectiom.

1) Buildings will be fitted with portable MY4 extinguisher.

2) Building No. 6120 will be equipped with hydrant and water suppply will meet 25t/s requirement.

7—4 Energy conservation.

1) Automatic temperature control will serve the process requirement of some equipment to conserve energy.

2) Pipelines of water, power and gases will have metering gauges mounted inside.

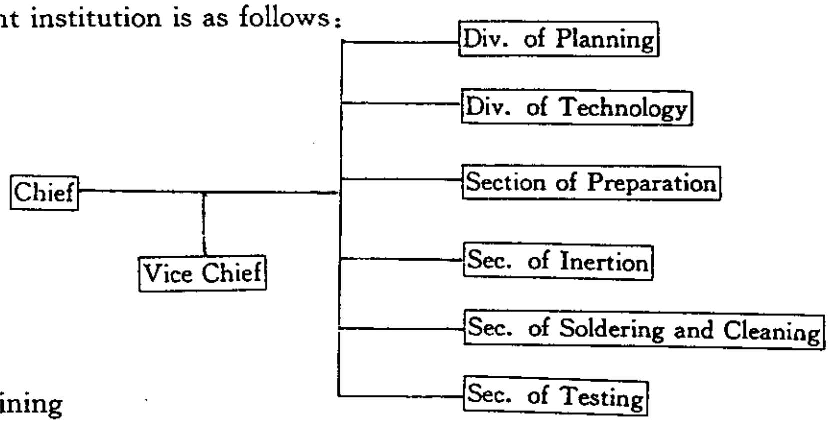
3) Compact fluorescent light will dominate in lighting fixtures in the tine.

8 Organigational institution and training.

8—1 Organizational institution

Nanjing firm adopts the director responsibility system. Under the director's command there are 5 product divisions (containing 6 design centres and 5 assembling departments), 6 specialized processing operation departments and 27 functional divisions.

Water cleaning line will be the business of Insertion Operation Department. This department has a chief and a vice chief, and divisions of planning and technology and some sections such as preparation, inserting, soldering and cleaning and testing. There are in total 101 staff and workers, among them are 19 technicians and 10 for management. The department institution is as follows:



8—2 Training

It's intended to send a group of 6 members for 20 days for study tour abroad so as to speed up the ODS phaseont and introduce mature no—ODS technology in developed countries.

To facilitate the replication of the demonstration line to a great extent, it's also intended to organize fraining courses one after another for 10 days and 30 participants each course with the cooperation of No. 2 institute, MMEI, beginning from the date of the construction of the project till 1996.

9 Implementation schedule;

The Director of Nanjing firm will be in direct charge of this project and a group specially appointed and headed by Jiang Jianhua for Implemetation. The No. 2 (electronics process research) Institute and No. 46(electronic materials research) Institute will closely coordinate with the factory to conduct test and replication work.

This project will be completed in 1. 5—2 years since the approval of the feasibility study report and the implementation schedule.

The implementation schedule is as follws:

	year progress description	1992	1993		1994		1995	
		2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half

1	Feasibility study report preparation and evaluation	—	—					
2	Examination and approval by NEPA and UNDP		—					
3	survey and technical exchange at home			—	—			
4	Study tour aboad 6 member for 21 days			—	—			
5	commercial negotiation				—			
6	contract signing and approval				—	—		
7	contract execution and construction					—	—	
8	Trial run and acceptance test						—	—
9	replication							—

Note :This schedule is on the basis of the fact that UNDP funds will be available at the 3rd quarter of 1993,otherwise,it will have to be postponed accordingly.

10 Incremental cost calculation

10—1 Investment estimate

Nanjing firm is intended to set up a demonstration PCB cleaning line for ODS phase-out with the grant of the Montreal Multilareral Fund . The investment estimate is as follows:

1)the total investment: RMB 3,584,800(including US$492,000)where:

construction	RMB70,000
machine procurement	RMB2,186,400
(covering	US$ 352,000)
installation	RMB 57,900
(covering	US$ 10,000)
other engineering cost and expense	RMB1.270.500
(covering	US$ 130,000)

2)the proportion of fixed assets. 61.57%

3)schedule of investment allocation

The investment allocation will be completed within 24 months from the date of

UNDP signing the project document.

4)some descriptions concerning the investment estimate.

a. The foreign exchange rate is 1USD to RMB 5.79 as issued by the State Foreign Currency Administratiom on Feb 5th, 1993. The imported equipment will be of CIF price and together with the materials for trial run will be exempted from duties and taxes on added value pursuant to certain rules. But the local supplied costs in RMB such as company commission, banking charges and local transport expense and miscellaneoous expense are all included.

b. The local supplied equipment will be priced with reference to the ex—factory price with 6% of transport and miscellaneous expenses.

c. Installation cost will cover the cost for installation and debugging of both imported and local equipment and instrument.

d. Construction cost will cover the cost for transforming the existing building and pipeline.

e. This project will involve refurnishing the cleaning process only, exclusive of the tools or furnitures required, which will be supplied by the firm itself.

f. It's estimated that US$ 50,000 will be needed for study tour abroad and training.

g. The charges for feasibility study report preparation and design will be as stipulated in "The Charging Criteria For Engineering Design"issued by the State Planning Commission in 1984.

h. The preparation expense will be 10% of the total cost.

i. The foreign currency required for this project will be allocated by the Montreal Maltilateral Fund while the RMB by the firm.

10—2. Estimate of operating cost

computer and peripherals are cleaned in vapor cleaning process with F—113 and MCF. The no—ODS replacement technology—water cleaning and semi—aqueous cleaning processes—induced equipment change will bring about the change of fues and energy cost, labor cost and maintenance cost, which is shown in the table attached.

10—3. the estimate of net present value of operating cost

Judging from the table attached, it could be seen that the operating costs before and after conversion for this project are right equal to each other (RMB 139,200). The difference of increased sum and saved sum is "o" and the net present value is "o" too.

10—4. The total sum of incremental cost

The incremental cost is just the total investment as the net present value is "o". The total sum of incremental cost, i. e. total investment is RMB3,584,800 (equals to US

$ 619,100). It's hoped that US$ 492,000 out of the total sum would be grant allocated by the Montreal Multilateral Fund.

10—5. Calculation of "C" value

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

where CC=increased investment RMB 3,584,800

CRF=12%

OC=yearly additional operating cost RMB174,200

OS=yearly saved sum RMB174,200

M. ODP=yearly emission of ODS (In terms of ODP value) 8t

1.07

(i.e. F—113—10t, ODP—0.8, emission—5.1t) MCF ODP 0.12

Therefore, for this proect "C" value is RMB53,700=US$ 9,300

(C value for UNDP grant is US$ 7,380/t · ODP)

11. Financial analysis and economic evaluation

11—1 Conversion's impact on the firm's economic results

The firm's financial returns analysis clearly displays a rise of the annual total cost and the peoduct cost under the circomstances of identical operating cost due to the increase of fixed assets and the relevant increase of depreciation charge and the amortizarion charge that should be counted in the cost.

11—2 Economic evaluation and suggestion

The project aims at ODS phaseout through converting the cleaning process. Conversion won't lead to any new product, any change of technical specifications and property of the existing product, nor the out put rise and upgrading of the product and the sales increase. On the contrary, there will be a notable cut—down in the firm's profit rate and rate of profit and tax. It should be pointed outthat the economic returns come out of the conversion will be negative and should be offset with the orignal profit, which will not economically benefit the firm. Thus, for replication of the demonstration line to eliminate ODS, it's suggested that US$ 492,000 be supported as grant by the Montreal Multilateral Fund.

To reduce ODS caused ozone layer destruction is most essential and imperative. The social results could not be judged only from the economic point of view. It's firmly believed that the conversion is not only feasible but also a must.

Table: Operating cost before and after conversion

	description	before conversion		after conversion		difference increase+ decrease−
		Qty	price (US $)	Qty	price (US $)	
1	F−113	10t	15,000			−15,000
2	Axarel			5t	15,000	+15,000
3	water use			24,000t	6,000	+6,000
4	power consumption	33,000kwh	6,600	418,000kwh	83,600	+77,000
5	labor cost	2 persons	9,600	7persons	33,600	+24,000
6	maintenance cost		8,000		36,000	+28,000
	total		174,200		174,200	0

Table: Investment Estimate

	description	foreign currency (USD)	in terms of RMB	RMB	remarks
	1 building constructin				
	building and pipeline conversion			70,000	
	2 equipment procurement				
	2−1 imported equipment				
1	price (including materials)	342,000	1,980,200		CIF
2	company commission	5,100	29,500		
3	Bank Commission	1,700	9,800		
4	local transport and miscellaneous expense	3,200	18,500		
	subtotal	352,000	2,038,000		
	2−2 local equipmet				
1	price			140,000	
2	transport and miscellaneons expense			8,400	
	subtotal			148,400	

	total for equipment	352,000	2,038,000	148,400	
	3 installation				
1	imported equipment	9,000	52,100		
2	local equipment	1,000	5,800		
	subtotal	10,000	57,900		
	4 other items and expense				
1	study tour abroad	50,000	289,500		
2	technical assistance	30,000	173,700	23,500	
3	expert receiption			10,000	
4	local training			180,000	
5	replicaiton,development and test			150,000	
6	feasibility study and design				
7	contractor supervision	10,000	57,900	10,000	
	subtotal	100,000	57,900	373,500	
	5 preparation	30,000	173,700	110,000	
	6 interest of loan			34,300	
	total	492,000	2,848,600	736,200	

List of Equipment and Instrument

	description	Qty	Price(US $) unit price	total	remark
	foreign source				
1	solvent cleaner with drier(ECD 630)	1		76,000	
2	Water cleaner with drier (ECD 9600)	1		78,000	
3	DI water producing plant	1		40,000	
4	Cleanliness tester	1		22,[illegible]	

5	ultrahigh resistance and micro current tester	1		25,000	
6	conductivity tester	1		6,000	
7	atom absorption photometer	1		30,000	
8	high/low temperature test chamber	1		20,000	
9	spare parts			10,000	
	subtotal	8		307,000	
	local source				
1	effluent treatment facility	1		100,000	
2	PH ion tester	1		40,000	
	subtotal	2		140,000	
	total	10		587,000	

PROJECT COVER SHEET

COUNTRY OR REGION:	China
SECTOR COVERED:	Primary Sector: Solvents
ODS CONSUMPTION IN AFFECTED SECTORS	4311 tonnes of ODP in 1991
PROJECT TITLE:	ELIMINATION OF CFCs IN CLEANING OPERATIONS AT THE CHENGDU QIANFENG RADIO INSTRUMENT FACTORY
PROJECT DURATION:	Three years from funding availability
PROJECT IMPACT:ODS REDUCTION	9 tonnes reduced CFC-113
PROPOSED BUDGET:	Project Expense: US $401,000 Operational Cost @4 YR NPV = US $ 43,700 US $444,700
IMPLEMENTING AGENCY:	UNDP
NATIONAL COORDINATING AGENCY:	NEPA THROUGH MEI

PROJECT SUMMARY

The China Country Programme addresses the rapidly growing solvent sector by employing a strategy of subsectoral demonstration projects, followed by replication. The CHENGDU factory is the fourth demonstration project, following Dandong and Dalian which were approved in 1992. The CHENGDU FACTORY represents the sector associated with the manufacture of electronic instrumentation (180 firms, 20% of the ODS consumption),and the technology planned includes replacement of existing ODS cleaning lines with a semi-aqueous cleaning line for the critical, high reliability, high frequency circuit boards, and an aqueous cleaning line for the non-critical boards and peripherals.

PROJECT OF THE GOVERNMENT OF CHINA

ELIMINATION OF CFCS IN CLEANING OPERATIONS AT THE QIANFENG RADIO INSTRUMENT FACTORY, CHENGDU

1. Project Objective

The objective of this project is to phase out the use of CFC-113 and methylchloroform used in the manufacture of high voltage/low loss printed circuit boards (PCB) and coaxial products, and electronic instrument components at Chengdu Qianfeng Radio Instrument factory. The project will use technology and equipment that can serve to demonstrate successful application of ODS-free technology to the other manufacturers in this subsector

2. Sector Data

Total ODS consumption in China in 1991 was 48,239 tonnes with a ODP (ozone-depleting potential) value of 60,352 tonnes. China has forecast that unconstrained ODS consumption would, by year 2010, result in ODS consumption of 229,318 tonnes with a ODP value of 292,714 tonnes with a resulting severe damage to the global ozone layer.

ODS consumption in the solvents sector in 1991 amounted to 4,947 tonnes with a combined ODP value of 4,311 tonnes. This combination reflects the weighted average of a 1.07 ODP value for CFC-113 (91%) and a 0.12 ODP value for methyl chloroform (9%). There are 3,200 medium and small-sized enterprises using ODS-based cleaning processes in China at present. With unconstrained consumption, ODS consumption in this sector by year 2010 would reach 53,571 tonnes, growing at over 14% per annum over the period 1991-2010. It is thus critical that ODS consumption in this sector be reduced as soon as possible. This is technologically feasible since alternative processes exist. The main issue is to determine the few cleaning processes, or alternative technologies, most feasible for the many different factory applications throughout China.

3. Background

A major, high growth area in China is the solvents sector, as described above. Key demonstration projects in each of several major applications, or subsectors, followed by rapid replication and deployment of the demonstrated technology, is deemed necessary for successful completion of the solvents sector overall strategy. Two additional elements which are essential towards achieving cost effective phase out in the sector consist of:

a) A laboratory for evaluating parts cleaning processes for the replication plants, where samples from the factories can be cleaned in various standard processes, and the appropriate process and equipment specified.

b) A manufacturing line to produce cleaning equipment for the replication in an economical, expeditious manner. (One general study tour has already been completed to evaluate the possible candidates for a joint venture in this regard.)

The Chengdu Qianfeng Radio Instrument Factory was chosen as a key subsector firm from among some 180 factories producing similar product lines in China because it features high quality and high reliability requirements, and possesses the appropriate complexity in its manufacturing of both through-hole and mixed technology printed circuit boards (PCBs). It is located in the northeastern suburbs of Chengdu City, Sichuan Province. Founded in 1958, it manufactures 3 main product lines - signal source(low frequency, high frequency, and ultra high frequency), high reliability products, electronic application products (such as security devices, medical electronics, etc), and consumer based instruments, such as gas and water heater instrumentation. It produces a nominal 320,000 pieces per year. Since it is engaged in circuit board manufacturing as well as soldering/assembly, it also contains effluent treatment facilities, to assure compliance with national and provincial regulations.

4. Project Description

Chengdu Qianfeng Radio Instrument Factory currently uses primarily CFC-113, with some methyl chloroform, in the manufacture of its product lines, consuming 9t/y of ODP. The company is committed to phase out the use of these ozone depleting substances, and has selected the use of aqueous and semi-aqueous technology for its two batch cleaning lines that are to be replaced. In addition to the equipment to be replaced, instrumentation will be needed to define and establish a high reliability, quality manufacturing process. This process definition equipment will also be used by other firms during the replication process. Peripheral equipment will consist of a D.I. water generating unit and an assembly process aqueous effluent monitoring system to assure product quality requirements are retained and environmental responsibilities are met. The factory will absorb the costs of new piping and transformer needs, as well as piping modifications, and some training expenses associated with startup and the replication process. A study tour is built into the project in order to select the exact semi-aqueous process and equipment, and to develop an adequate startup plan which takes advantage of the experiences of others who have adopted this technology, and to prepare some local experts for the training tasks associated with the replication process.

5. Technology Choice Discussion

5.1 Selection

The selection of semi-aqueous technology for the "high rel" PCBs was based on the desire to assure that the minimum changes are made to the manufacturing process. The use of semi-aqueous cleaning technology allows the continued, uninterrupted use of the upstream, solvent based soldering and assembly steps (with rosin based fluxes and paste) and allows the limited engineering resources to be focused on a smooth transition in the cleaning process as well as the change in the effluent streams. In addition, the high frequency applications of the critical circuit boards can put them at greater risk, in an environment conducive to dendritic formation. The semi-aqueous process allows the use of non-aqueous rosin based fluxes and pastes, which reduces that risk.

5.2 Production Process

After soldering, the high reliability, complex PCBs will be processed in a semi-aqueous cleaner. This allows the same upstream process to be used. It does require, however, the use of DI(deionized) water for rinsing and a drying step which consumes more energy than the current process. There will be cascade rinsing steps required for these boards, to be built into the batching cycles. The metal parts and non-critical PCB's will be cleaned in an aqueous batch cleaning system, which also requires DI water, a cascade rinse and an assembly waste effluent monitoring station that was not needed in the ODS solvent cleaning systems which are being replaced by this project.

6. Project Costs

6.1 Total Project Costs Requested from the Multilateral Fund

Equipment		price/cost $
1	semi aqueous cleaner with drying unit	76000
1	DI water cleaner with drying unit	78000
1	DI water generation plant	40000
1	cleanliness tester	22000
1	atom absorption effluent monitor	30000
	spare parts	10000
	subtotal	256000

Materials

ion exchange resin		5000
	subtotal	5000

Miscellaneous Costs

equipment installation		10000
study tour		40000
expert fee		30000
feasibility study/ design		10000
transportation/premium		10000
construction/startup		10000
contingency items		30000
	subtotal	140000
	TOTAL	401000

6.2 Operating Costs

energy

$0.05/kwh*(335000-33000)kwh =	15100/yr

maintenance

$12000 new maintenance cost (5%)	4000/yr
$ 8000 replaced eqpt mt. cost	

ingredients

$ 9000 new solvent	-5300/yr
$14300 old solvent	
Operating Costs TOTAL	13800/YR
NPV of 4 yr costs	43,700 $US

6.3 Project Costs to be Borne by the Country(RMB)

technical assistance		23,500
experts		10,000
local training		180,000
development,testing for replication		100,000
contractor supervision		10,000
preparation		110,000
building, pipeline conversion		50,000
local equipment		200,000
feasibility study/design		10,000
transport and miscellaneous		12,000
	TOTAL	705,500 RMB
		126,000 $US

7. Financing Plan

7.1 From Multilateral Fund:

Investment Costs	$401,000
NPV of 4 Yr Operating Costs	43,700
TOTAL REQUESTED FROM THE ML FUND	**$444,700**

7.2 From the Government: $126,000

Total Project Cost	**$570,700**

8. Project Implementation

8.1 Management

Project management will be carried out by MEI under the direction of NEPA

8.2 Schedule

	YEAR	1992	1993	1994	1995
STEP	DESCRIPTION				
1	Feasibility Study report and evaluation	x	x		
2	Examination and approval by NEPA and UNDP		xx		
3	survey and technical exchange		xx	xx	
4	study tour		x	x	
5	Contract negotiations			x	
6	Contracts let			x	
7	Procurement/Construction			x	x
8	Startup and acceptance testing				xx
9	Begin replication				x

9. Project Impact

This project will eliminate the use of at least 9 tonnes of ODS in the first year after startup. Market and growth estimates indicate that this may continue to increase at the rate of about 14% per year. The project will also provide a high quality demonstration site for the training, dissemination of know-how, and technology transfer to an additional 180 similar manufacturing sites throughout China, which in 1991 consumed 711 tonnes/year of ODS.

United Nations
Development Programme

World Development

TO: FRANK PINTO

FROM: CLINTON NORRIS
UNDP CONSULTANT

DATE: 13 MAY, 1993

SUBJECT: PROJECT TECHNICAL REVIEW

I have reviewed the Solvent Demonstration Project, "Elimination of CFCs in Cleaning Operations at the Chengdu Qianfang Radio Instrument Factory" based on detailed discussions with MEI (Ministry of Electronics Industries), CEEDI (China Electronics Engineering Design Institute), and review of the study report prepared by factory and CEEDI personnel regarding the Chengdu Factory project.

Technical Soundness

This demonstration project substitutes different, but effective non-ODS technology for the current solvent cleaning lines that are in use, i.e., aqueous technology for the non critical parts and semi-aqueous technology (solvent clean/aqueous rinse) for the critical radio parts. It is these critical parts that will be exposed to circumstances that enhance dendrite formation, and the use of semi aqueous cleaning technology minimizes that potential. The other, less critical parts should be adequately cleaned via aqueous technology. Both technologies are now in use and have generally demonstrated at least equivalent performance vs. prior ODS cleaning processes.

Safety

The use of semi aqueous technology employs hydrocarbon substances which have flammability potential. The use of established equipment and processes assures that the appropriate safeguards are designed into the replacement technology. Thus, misting will be controlled or blanketed, depending on the equipment chosen.

Environmental

The use of aqueous technology has the potential for the detergents to complex with the heavy metal components in the removed flux residues. The instrumentation provided in the project will detect if metals are being dissolved in the water waste so thqt the process settings can be adjusted or the metals removed.

Environmental (contd)
It is the evaluator's understanding that aqueous treatment is available at Chengdu due to the circuit board manufacturing at the site.

Equipment chosen has built in recycle capabilities which will minimize the size of waste streams as well. Semi aqueous solvents are hydrocarbons and thus have VOC potential. While VOCs are not regulated in developing countries, they may be a future concern.

Cost Effectiveness

The project addresses cost effectiveness, with stipulations that instrumentation be used in the replication process for the subsector, and subsectoral local experts be developed as a result of the study tour, for use in subsequent replication activities. The estimates are in line with experience in other countries and at $8.8/kg, are in the range of unit abatement costs for solvents, in spite of the fact that this is a demonstration project. Cost effectiveness of the replications should be considerably less based on the Chinese plan to use the instrumentation for process set up and the plan to use locally produced equipment that is based on technology transfer from an established, reputable equipment manufacturer. This will also address the issues related to practical experience.

Recommendations

It is recommended that this demonstration project be approved.

Back ground Information

Demonstration Cleaning Line for ODS Phaseout in Electronic Instrument and Application Product Production in Chengdu Qianfeng Radio Instrument Factory

Feasibility Study Report

Chief Designer: Wang Xiguang
Vice Chief Engineer: Bao Jinming
Chief Engineer: Wang ZhiLiang
Director of CEEDI: Wang Qian

China Electronics Engineering Design Institute
(CEEDI)
Beijing, April, 1995

Prepared by:

Wang Xiguang
Liu He zi
Guo Weicheng
Hu Tingan (of the factory)

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9) ODS reduction

Total ODS reduction would be 8t with C=US$ 13.700/t · ODP in completion and starting operation of the demonstration line. (C value for UNDP grant is US$10.800/t · ODP)

In completion of replication in 180 firms (cost for replication extra), 711t ODS would be reduced by 1996.

1—6 Conclusion

The following conclusions have been made on the basis of technical and economic analysis:

1) It's the common task for the whole world to protect ozone layer and phase out ODS, to which the developed countries have contributed a great deal since mid 80's. The Chinese government has attached great importance to ODS phaseout since signing the protocol and listed it in the national 10—year development plan.

As stipulated in the revised Montreal Protocal, China is liable to replace ODS in the 3,200 electroic firms. It's thus absolutely necessary to phase out ODS in electronics (including metal parts) cleaning.

2) Since 180 instrument firms are spread out all over the country and big ODS users, it's more economic and rational to build up a no—ODS demonstration line and replicate the line step by step.

3) Chengdu factory is typical and featuring critical electric parameters, high cleanliness and large ODS consumption. So, it's the wise decision to set up the demonstration line in Chengdu factory.

4) It's better to introduce mature ODS replacement technology from abroad.

5) The project would get strong support from the government.

6) The economic benefit of this project appears negative.

7) On the other hand, the social benefit of this project will be remarkable in terms of protecting human environment.

Chengdu factory will completely elimnate ODS up to 8t in total from 1994.

US$ 3.87 mil. will be needed for replication in 180 firms and the ODS reduction will be 756t by 1996.

8) C value: US$ 13.700/t ODP (C value for UNDP grant is $10.800/t. ODP)

The above would justify the necessity and feasibility of this demonstration line.

1—7 Some explanstions

1) Investment in this project won't make any change in production capacity, product quality and the output value. On the contrary, the product cost will go up, which will result in negative economic returns. In addition, the project is a demonstration line and some cost will be virtuely out of the factory need. Due to the above reasons, it's best not to allocate the funds (both US$ and RMB) in the form of loan.

2) The costs for patent and software for the project is not included.

3) ODS phase—out schedule will be delayed unless the transitional multilateral funds is allocated by the 3rd quarter of 1993.

4) The prerequisite of the replication is the cleaning process lab and the cleaner manufacturing line in operation plus the US$ 3.87 mil.

5) All the ODS phaseout projects in electronics and others cleaning is a system engineering package consisting of 4 demonstration lines (in Dalian, Dandong, Chengdu and Nanjing), 1 cleaning process and recycling lab and 1 cleaner manufacturing line. They condition one another and the delay or cancel of any of them would hinder the overall process.

2. Information on implementation agency.

2—1 Basic information

Chengdu Qianfeng Radio Instrument Factory is located in the Northeastern suburb of Chengdu City, Sichuan Province. It's 3.5kms away from the city centre. The factory site is quite plain and well layout. It has sufficient supply of water, power and gases as well as the convinience of highway, railroad and air transportation and communication as well.

The factory was founded in 1958 and has so far had 3 major categories of product—electronic instrument product, electronic application product and consumer product with gas appliance in domination.

Typical instrument product—— signal source (containing LF, HF and UHF standard signal generator, synthesizer, frequency sweeping source and special source for communication, broadcasting and television) serving the use in areas of radar, communication, electronic countermeasure, navigation, broadcasting and television; signal analyzer (including frequency spectrometer, modulation meter, phase noise meter, distortion meter, stereo decoder); network analyzer; RF voltmeter (including voltage standard and test receiver); attenuator; DC/AC regulated power supply and various parameter measuring meter.

Electronic application product—— ESD control, security device, consumer power supply and electronic medical implement.

Consumer product——gas water heater, electric water heater, cooking oven and gas cooker. Each category of product has its own R&D centre. Besides and based on the above product, the factory has devoted great effort to develop intelligent tester and electromagnetic compatible tester for mobile service, broadcasting and televsion, extend electronics technical appplication and furthur diversify the product of the 3 categories. In addition, the factory has successfully combined the technology and trade for even better developing and upgrading their product to follow the principle of enlivening the operation at home and increasing export abroad.

The factory now has:

——staffs: 3,26[illegible]

in which workers: 1, 475

technicians: 970 (senior-level: 115 engineer-level: 341)

——site ground area: 177. 300m^2

in which building area: 106. 200m^2

——floor area: 166. 700m^2

——key equipment: 876 pcs.

instrument: 1237 pcs.

——installed electricity capacity: 1200KW

——￥ fixed assets: 60, 078, 000

net: ￥34. 476, 600

——industrial value of output:

in 1991 (present value) ￥85, 780, 000

profit: ￥5. 566, 000

2—2 Present condition of the factory's environmental protection

Environment protection has been given great attention to and was fully considered in conjunction with the engineering design, construction and production to the National Environmental Protection law.

1) effluent——effluent from plating process and acid and alkaline cleaning process is well treated in the effluent treatment plant.

2) dust and waste gas——dust collector, exhaust hood and scrubber are used for treatment of dust and waste gas.

3) noise——noise insulating wall, door and window were mounted in the noise generating room, and noise suppressor and flexible connection in the piple.

All the facilities in the factory have 100% service rate, 99% operation rate and 95% rate of fineness.

The factory has its own monitoring center to keep the treated waste discharge in conformity with the national and provincial regulations. But, at present, CFC—113 and MCF are still in use in PCB assemblies cleaning to remove excessive flux. Local exhaust serves to ensure the operators health, but the discharge to the atmosphere acts to deplete the ozone layer and ruin the living environment of the humanbeing.

3. Market analysis

The rapid development of mobile service and television industry and the steep increase of the equipment in these two areas have provided a huge market for the related testers and instrument.

3—1 The annual sales of electronic testing instrument and those in it for communication, broadcasting and television these years in the major developed countries are shown in the following table:

year / items	1985	1986	1987	1988	1989	1990
electronic testing instrument (in US $ mil.)	7619	7729	7947	8607	9929	10265
in it the instrument for communication & broad — casting (in US $ mil.)	2536	2576	2649	2869	3309	3422

(The sales in USA, Japan, Germany, UK, France and Italy account for around 99% of the total).

The table indicates a ratio of 1/3 of the testing instrument for communication, broadcasting and television over the total electronic testing instrument with a yearly sales being 2.5 to 3.4 billion and a 6% rate of stable increment.

3—2 The potential home market is rather large since the percentage of testing instrument for communucation, broadcasting and TV over total electronic instrument is only 20%, which is far below the proportion (over 30%) in the world.

3—3 Communication, broadcasting and TV are the key development sectors in the national 8th 5—year plan, which will impose marked impact on the other sectors of national economy as well as the people's life in both material and culture and will open a wider market for the testing instrument. In the recent years, the market demand for such instrument has come up to RMB 350—400 mil. each year (in which only RMB 150—190 mil. of local supplied instrument) with a market sharing of 43—49%.

3—4 Judging from the experts' estimate, the annual market demand for the testing instrument for the above—mentioned sectors will be about 100 mil. RMB in the 8th 5—year plan. It's obvious that the current local supply is far behind that number, for mobile service in particular. For instance, there are 1 mil. pcs. of mobile service units in service now and will be 2 mil. pcs. in 1995. That will require a number of 400 pcs testing instrument for R $ D and production.

3—5 As the communication, broadcasting, TV and information industries growing fast and various electronic appliance entering household, the electromagnetic—interference induced abnormal operation of the appliances has turned to be a common problem. It's attracted much attention in the world and rules and creteria have been issued for control and restrain of such electromagnetic pollution. It's not allowable to produce, import or export the product that does not meet the rules or criteria. In China, it's been not long before the national EMC standard was established with reference to CISPR and MIL and came into force.

There will be an increasing demand for testing instrument (There is almost none for the time being) for the purpose of implementation of EMC standard and the inspection of export product. Chengdu factory's frequency spectrometer and the preselector could functionally satisfy the market demand.

3—6 Great effort may bring about a sharing in international market for the testing instrument for communication. broadcasting and TV. In the past few years. the factory has produced more than 10. 000 pcs. of 13 types of product for export including signal generator. frequency spectrometer and parameter tester to Poland. Cuba and Romania. power supply for all types of radio set to Germany and domestic communication security system to Australia. Singapore. Vietnam. Pakistan and Hongkong. It should be noticed that country like USA is both a big intrument exporter and importer as well.

The USA market statistics on electronic testing instrument in 1987 and 1988 are shown in the table below:

	total sales of electronic testing instrument (in US $ mil.)	home sales	export	improt	home market sharing
1987	5411	1033	4378	2129	32.7%
1988	6166	1163	4983	2188	34.7%

The table displays such a fact that in USA. the export is twice the import of electronic testing instrument while the home market sharing is rather low (below 35%). It's apparent that USA has exercised such a strategy as to dominate the high—grade market while open the medium—and low—grade market. It's known that there is a certain market shared by the instrument of higher performance and price ratio made in Japan. the Netherlands. Canada. South Korea. Taiwan and Singapore. Hopefully some medium—or low—grade instrument made in China could enter the market of USA or Japan so long as the products are greatly improved in performance. reliability and appearance.

3—7 The medical service sector has seen more and more utilization of electronic medical implement in all sizes of hospitals and a bigger market as a result. Take the bed—side monitor as an example. About tens of thousands of monitors will be needed in the 8th 5—year plan. As estimated in the guideline on the development of new medical product. there was and will be a demand of 800 pcs. in 1991. 1. 590 in 1992 and 2. 300 in 1993 at an increasing rate of 30% per year. Chengdu factory is one of the producers of such medical implement.

3—8 With regard to application product such as gas water heater. it uses natural gas. LPG and methane as fuels and features high efficiency. energy—saving. quick heating of water. safe and reliable and simple operation. It's been well received as soon as it's put up for sale. The factory supplied the whole country 1. 5 mil pcs. in 1990 and 2 mil. pcs. in 1991 and more may be anticipated.

In a word. the factory has been and is doing its utmost to diversify and upgrade its product to serve well varions industrial sectors and all regions throughout the country. It has formed a yearly production capacity of 8, 000 pcs. of electronic application product and 300, 000 pcs. of gas heater series and won extensive market and excellent credit and increased its sales every year.

4 — Product programme, property and configuration and technological characteristics

4 — 1 Product programme

1) electronic instrument

a. signal source	560 pcs.
b. signal analyzer	670 pcs.
c. parameter tester	910 pcs.
d. others (regulated power supply)	6150 pcs.

2) electronic application product

a. ESD control	1, 500 pcs.
b. security device	20, 000 pcs. (sets)
c. electronic medical implement	910 pcs.
d. gas appliances	261, 000 pcs.

4 — 2 Product property

1) electronic instrument

a. signal source — LF distortion signal source, multiwave function source, ultrapure phase lock standard source below 1 GHZ and synthetic signal source below 2 GHZ, synthetic intelligent TV standard signal source and standard and FW. stereo image signal generator and frequency sweeping signal source.

b. signal analyzer — frequency spectrometer below 2 GHZ, modulation meter below 1 GHZ, distortion analyzer, high — grade intelligent frequency spectrometer, preselector for EMI inspection and frequency spectrometer below 4. 4GHZ.

c. parameter tester — pointer and digital HF voltmeter, go — power meter, test receiver, LCR meter, vector voltmeter, RF voltage calibration unit, stationary wave tester, insulation R tester, voice surface wave filter, tester and color TV tester.

d. attenuator — step attenuator with multichannel, variable attenuation and step rate, various accuracy and step rate, various accaracy and impedance, fixed and programmable attenuator.

e. microwave device — tandem network, directional coupler, microwave coaxial switch, coaxial filter impedance converter, directional detector, precision receptacle and converter and precision coaxial loading.

f. DC/AC regulated power supply — DC radio station PS, DC regulated PS, contravariant PS, NCAC regulated PS, switching AC regulated PS and clean PS.

2) electronic application product

a. ESD control — table panel and floor mat, wrist tape, vacuum ceaner, ionizer, component carrier, cassette, wrist tape monitor, PCB shelf, voltmeter and plastic bag for ESD control purpose.

b. security device — alarm flash light. police rod. interior security communication system. multiplex wireless alarm system.

c. electronic medical implement — pulse short wave treating unit. heart function monitor. white blood cell sorting counter. CO_2 lazer treating unit. multichannel feedback treating unit. nerve network balance treating unit. single channel automatic electrocardiograph and hot matrix printer. etc..

d. others — aeroplane inspection data collection system. weighing display. antennafier. 4.5″ B/W TV and radio. multipoint temperature sensor and instrument for petrolium industry.

3) consumer product

a. gas water heater — 5 l water heater. fully automatic water heater series. large flow rate water heater. volumetric central water heater.

b. electric water heater series.

c. gas appliance — heating unit. cooker. oven and cooker with oven.

The above three categories of product support each other and all depend upon electronic technology. All the product incorporate PCB and/or high voltage and low loss components. HF circuit. HF MW cavity components and precision components/assemblies requiring strict and thorough cleaning for critical quality and reliability specifications.

Following are two examples defining the performance of two typical types of product — QF 1052 standard signal generator and JST (Y.R.) 5—QFM 14B gas water heater.

QF 1052 standard signal generator provides CF. FM and AM signals and receive stereo modulation as well. It is composed of the following elements — RF. phase lock. output attenuation. modulation and power supply and control functioning to generate CF. FM and AM signal and receive stereo modulation.

Phase lock technology is applied for higher frequency stability and accuracy. and key — operated LED NIXIE tube displays frequency output level. modulation status setting and frequency channel switching. A 256×4 bit static RAM is used for digital information storage and combination storage of frequency. output level and modulation status (32 groups of data).

In case of power outage. a built—in Cd—Ni cell could supply the power and preserve data for more than one month.

QF 1052 is mainly used for FM. AM radio set. mobile radio station or some receiver. It's main specifications are as follows:

CW frequercy　　0.3—170 MHZ frequency stability
$\pm$ (preset value $\times 5 \times 10^{-6} + 30$HZ) /15min.

CW output: 0.11μV—89mv. source impedance: 50Ω

AM characteristics: 0—80%: inner modulating F: 1KHZ
outer modulating F: 20HZ—10KHZ

FM characteristics: 0—99KHZ: inner modulating F: 1KHZ outer modulating F: 20HZ—100KHZ

frequency and output presetting

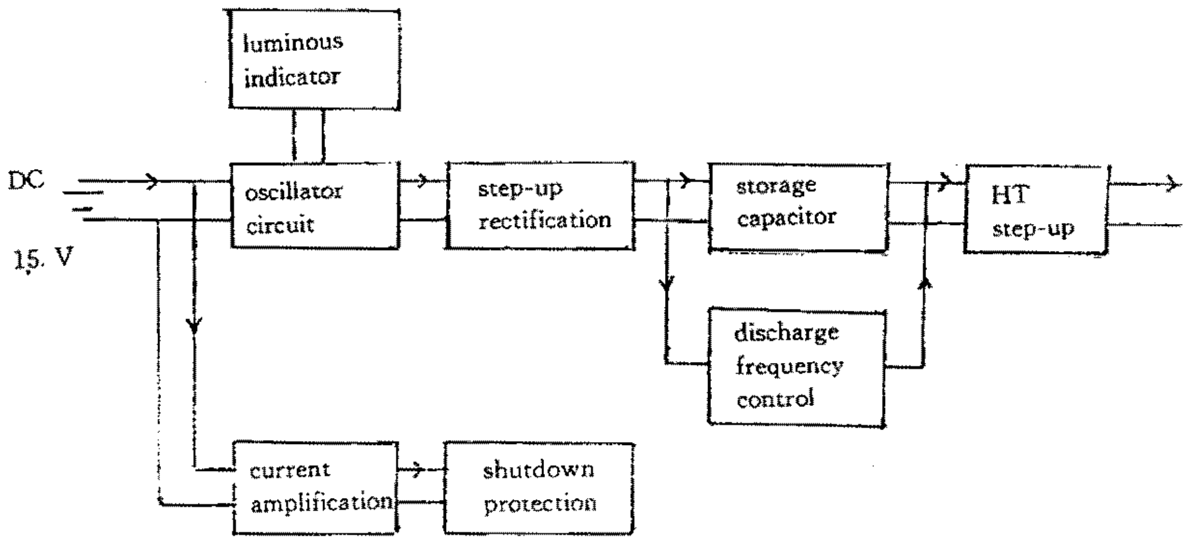
safety: insulation R> 2MΩ

leak current < 5mA

teat voltage: 1. 5KV

JST (Y. R.) 5—QFM 14B gas water heater functions to heat water with natural gas or city gas, firing guickly and fully to provide big volume of hot water. It's electric pulse contincously ignite with $o_2$free pretection and its automatic control is a dense PCB.

The operation principle is as follows:



Applying 1. 5V DC to the circuit to enable the oscillator circuit. At the same time when luminous circuit in operation the storage capacitor comes into service after step—up. The discharge frequency control circuit starts up the secondary step—up to over 10 KV high tension. breaking through 4. 5mm air space to generate spark for ignition. Meanwhile. the quick start current provides amplified PS current to open the solenoid for shut down protection to make up the inertia of thermal couple.

The main specifications.

Operating Voltage: DC 1—1. 5V

(or discharge distance≥10KV

or discharge distance≥4. 5mm)

HT discharge frequency: ≥3 times/s

quick start current time delay: ≥10s (current cuts down to 100mA at 20mΩ)

4—3 Configuration and technology characteristics

Standard signal generator incorporates the following major components:

P. C. L. IC PCB

output display
power supply
switch. key and HF connecor
All fixed on the instrument shell. base plate. panel or shelf.

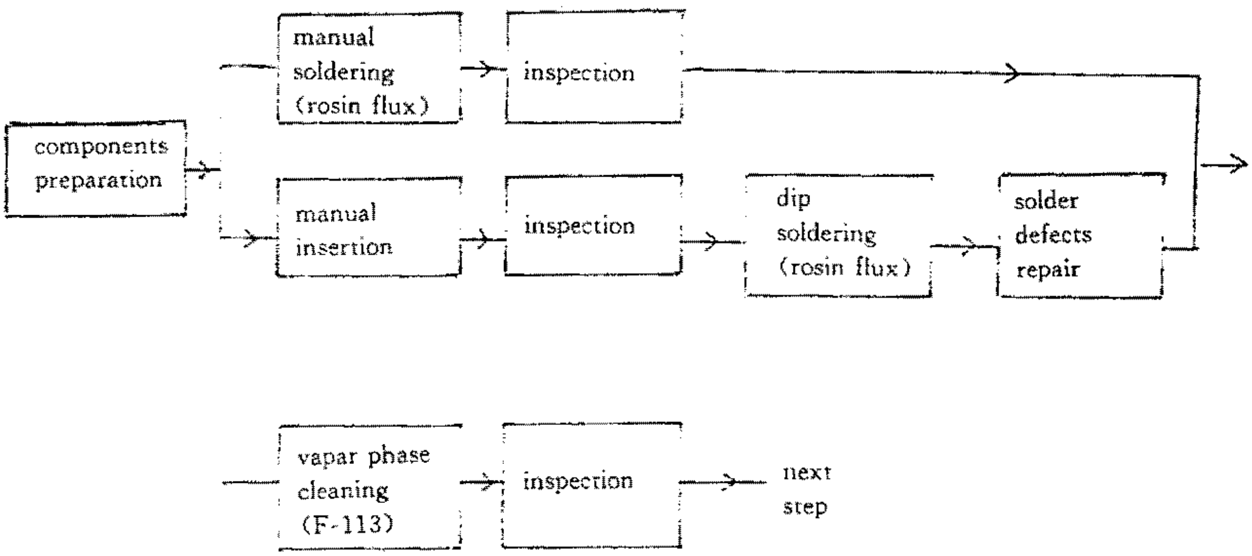
Most of the electronic instrument works in the channels ranging from HF. VHF to MW. PCB assemblies should have a low loss; Quite a number of mixer PCBs has strict requirement of assembly and very low loss. Many products have an inner operating voltage of 1—20. 000 V with low loss and high insulation R. Some PCBs use gold plated wire while some components gold pin.

Assemblying. soldering and cleaning are crtical processes to all the above products. Lots of PCB assemblies should be assemblied using rosin solder and flux and also lots of PCBs soldered with water soluable flux and solder paste. The latter are mainly for application product and consumer product. of which the yearly output is nearly 300. 000 pcs..

5 ODS phase—out plan

5—1 The existing cleaning process with ODS

Following is the process of PCB soldering and cleaning:



The components are soldered on the through—hole type or through—hole and SMT type PCBs with rosin flux and solder paste and cleaned with F—113 to remove flux residue and other soil to guarantee the anticlectric strength. insulation strength and the least leak current specified for quality product.

Cleaning process is most critical to the production of electronic instrument. application product and controls as most PCB assemblies for them are operating in HF. VHF and MW at HT. and should be very clean and dry for electric parameters and accuracies.

5—2 Introduction of alternative technology—eliminating ODS

The choice of cleaning solvent is closely dependant on the type of flux and solder used. Rosin or water soluable flux may be cleaned by water with saponifier +organic solution and water+DI water respectively or by the combination of both to very effectively remove soil remaining on PCB.

There are two alternative cleaning processes that are applicalle to Chengdu factory.

1) Water cleaning process

The process is quite mature in through—hole PCB assemblies cleaning except for military product. It's reported that, in USA, water cleaning procss is employed for 36% or so of through—hole assemblies and also applicable to SMT assemblies.

The process flow is as follows:

components insertion on PCB→wave soldering (water soluable flux) →manual solderung (ordinary components) →cleaning (hot water, DI water) →drying→inspection

At specified temperature and pressure, city water snd DI water (resistivity is 10MΩ—cm) effect to remove water soluable flux and solder residue on PCB. Therefore water and DI water is a feasible option to replace CFC—113.

It's reported by a company, USA, that their water soluable flux, is easily removed to MIL—P—28809 and the used water exhibits neutural, allowing for direct disposal without PH control or very simple treatment as required.

2) Semi—aqueous cleaning process (water with saponifier or Axarel)

PCB with rosin flux and solder paste residue may be cleaned with saponifier or Axarel first and water then in the following process:

Component insertion on PCB→wave soldering (rosin flux rosin solder wire) →manual soldering (rosin flux, rosin solder wire) →cleaning (hot water, DI water) →drying→inspection

Water and saponifier cleaning process usually consists of 3 steps—cleaning, water rinsing snd drying.

In the cleaning step, soils like grease, lubricant and rosin react with alkali—saponifier—PH value of 10.5—11.8—and generate soluable soap. Normally, 10% of rosin remains unsaponified and may be most effectively removed in the water rinsing step with water spraying at high pressure and/or high density. The clean PCB will be dried in the last step.

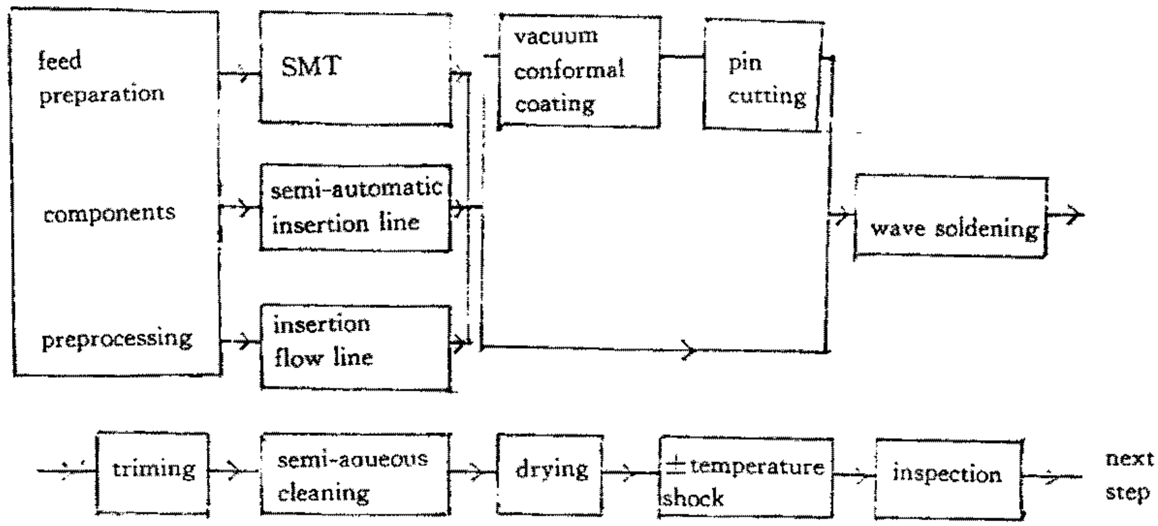
It's assumed that the semi—aqueous and water cleaning process is a good choice of ODS replacement technology as it's technically feasible, cost—effective, human and environment friendly and simple supply and effluent treatmett.

The factory will be fitted with two cleaning lines upon product specifications and production requirement—one semi—aqueous (water and saponifior) automatic cleaning line for PCB assemblies of electronic instrument soldered with rosin flux and solder paste and one DI water cleaning line for PCB assemblies of applicaton product soldered with water soluable flux and solder paste.

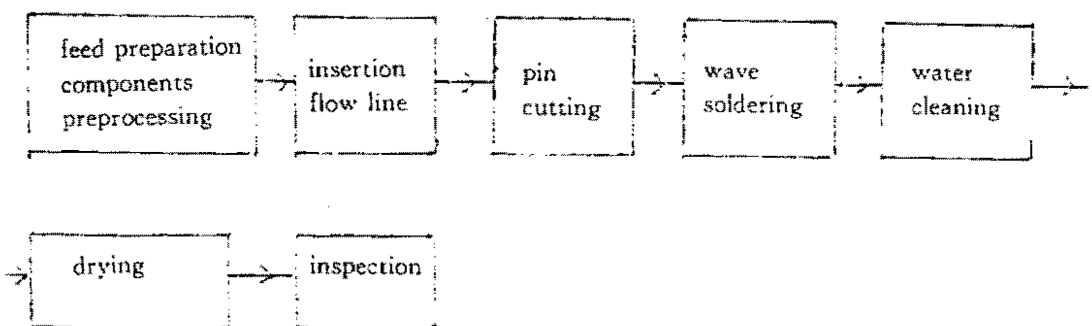
Setting up the two cleaning lines involves the purchase of DI water cleaner as well as DI water producing plant and measurement and inspection instrument.

The cleaning process for other parts should be taken into account too.

instrument product



application product



The production process flow chart will be as follows when no—ODS cleaning process in operation: 5—3 Import of equipment

The existing F—113 cleaner has to be replaced as the cleaning solvent and operating condition change. The list of equipment and materials required for the no—ODS process is shown below:

List of Equipment and Materials
for ODS phaseout

	item	Qty	description
	equipment		
1	semi — aqueous conveyorized cleaner H—500	1	for instrument product-cleaning line
2	DI water cleaner w/drying oven (ECD 9600, 9050)	1	for application and consumer product cleaning line
3	DI water producing plant	1	for instrument product cleaning line
4	cleanliness tester	1	
5	conductivity tester	1	cleanign effect
6	ultra high resistance and micro current tester	1	test
7	solderability tester	1	
8	atom absorption photometer	1	
9	spare parts		
	subtotal	8	
	material		
1	water soluable flux	0. 5t	PCB soldering
2	thinner	0. 5t	flux dilution
3	water soluable paste, solder tin wire	0. 5t	PCB soldering
4	Axarel	$5m^3$	
5	ion exchange resin	0. 5t	

Depending upon the production features of small batch and big variety, ECD 9600, 6307 and 500 batch cleaners may be the best choices for both cleaning lines.

5—4 To make The most economic use of multilateral funds and accelerate the replication of ODS phaseout demonstration line in the entire sector, the following plan has been layed down.

1) The Dept. of Science and Technology, MMEI is responsible for the policy making and the organization of comprehensive study and investigation.

2) Set up cleaning process and recycling lab in No. 2 and No. 46 institutes. MMEI

3) Set up cleaner manufacturing line in No. 2 institute. MMEI.

4) In completion of the Chengdu project, the two institutes shall coordinate with the factory to hold training course.

5) US $ 3. 87mil. (covering technical assistance fee and unforeseen fee) will be needed for procuring local-made cleaners to replicate the demonstration line in 180 firms.

5—5 ODS reduction

The output of electronic instrument and automatic control for application product were 2216 pcs. and 217, 540 pcs. in 1991 respectively.

cleaning solvent consumption per piece of product was 0. 05 kg for the former and 0. 02kg for the latter. In 1994 when the completion and operation of the demonstration line, the output will reach 8290 pcs. and 296, 100 pcs. while the ODS reduction 6335. 5Kg of F-113 and 1658 kg of MCF respectively. The replication in 180 firms will bring about 711t ODS reduction.

6. Building, structure and utilities

6—1 Building structure

Two sets of cleaning system will be placed separately in instrument assembling area and application product productinon area.

1) No. 35 Building-for production of electronic instrument

It's a 5 storey building of reinforced concrete frame structure with a column line of $(7+3+7)\times 6$ and a length of 84m. Its building area is $1512m^2$, building bloor area is $6992m^2$, and the floor hight 4. 5m.

The assembling is located on the 2nd floor, which is a rectangular area of terrazzo floor, 1m high south and north wall with steel framed glazing over it. In it, PCB cleaning process occupies an area of $84m^2$.

2) No. 1 Building-for production of application product

It's a 3 storey building of E shape with reinforced concrete structure. The area is 138m long and 17m wide and has a building area of $3667m^2$, a building floor area of 11, $069m^2$ and floor hight 4. 5m.

The assembling area occupies $991m^2$ on the 3rd floor. That's a rectangular area of terrazzo floor and steel framed glazing and PCB cleaning area is $50m^2$.

The refurnishing items in this project

a. set up PCB cleaning line.

In the assembling area, build glass partition to isolate assembling line from wave soldering and cleaning processes to ease temperature control and noise control.

c. place DI water producing plant right adjacent to the assembling area.

d. fit cabinet AHU and exhaust duct, water supply and drain pipeline.

6—2 Utilities

The supply of electricity, water and gases for the instrument product assembling area are all in normal service.

a. No. 1 and No. 3 terminal substations supply power to satisfy the production need in assembling area.

b. The total water quantity consumed for production, domestic use and fire protection is 360 m^3/day being supplied by the water system inside the factory.

c. The compressed air of up to $6kg/mm^2$ pressure is supplied from The central station in the factory.

d. No. 35 and No. 1 Buildings are equipped with heating and refregeration system and instrument debugging and metering area with cabinet AHU for temperature control.

e. Telephone and fire protection systems are fitted in both buildings.

The refurnishing cleaning lines will require an additional max. DI water consumption of 2. 67t/h that shall be supplied from the DI water plant attached to water cleaning system; an additional installed power capacity 2 x 80kw. which needs an extra 240KVA transformer to be installed in No. 35 Building (There is no existing one) due to the fact that the existing two substations have no spare capacity for future use . Some rearragement and modification of HT feed line will also be necessary.

There will be an additional max. 5. 0t/h effluent to be disposed up to the National law.

7. Environmental protection, occupation safety and hygiene, fire protection and energy conservation.

These issues have been in full consideration and put into service during the design, constuction and operation and accepted by local competent authorities:

7—1 Environmental protection

The acid and alkaline effluent from DI water plant for this project will go to the central sewage disposal facilities for treatment to PH 6—9 before direct discharge, and so does the effluent of high PH (10—11) from the saponifier and water cleaning process.

7—2 Occupation safety and hygiene

1) There are emergency exits at both ends of the two buildings, aisles for dispersion, emergency lighting and lightning arrester.

2) For the operators health, lighting ranging from 150 to 300LX is provided upon operation requirement.

3) All power consumed equipment has reliable neutral grounding system.

4. All the driving units have housing, cover or wire guard.

7—3 Fire protection

1) Both buildings have fire sections constructed upon "Fire Protection Code" and two exits for dispersion in case of emeragency.

2) Each floor is fitted with hydrant and portable dry powder extinguisher.

3) Water supply pipeline and fire engines will provide water of 25l/s for putting down fire outside the building.

7—4 Energy conservation

1) Temperature control irons are used in automatic control assembling area .

2) High efficient lighting fixtures (mostly fluorescent ones) are used.

3) Measuring Meters are provided in the supply line of power, water and gases.

8. Organizational institution and training

8—1 Organizational institution

Chengdu factory performs the director responsibility system. The 4 design and research centers. 19 divisions and departments and 12 production work shops are all under the leadership of the director.

The Chief Engineer is in direct charge of ODS phaseout project and the daily activities are dealed with by the Chief Engineer Office.

"The ODS phaseout project implementation group" will be established as the project gets granted officially.

8—2 Training

In order to introduce no-ODS technology mature and available abroad to speed up ODS phaseout in the cleaning process of automatic controls of electronic instrument and application product, it's planned to send a group of 6 members for 30 days study tour abroad.

And to make the project play an utmost role of demonstration to facilitate the replication work, it's also planned to organize training courses for the 180 firms for 15 days and 30 persons each time with the support of No. 2 institute from the time of construction of the demonstration line till the year of 1996.

9. Implementation schedule

Under the Director's leadership, HuTingan, head of the project implementation group will be responsible for the daily control and planning work.

No. 2 (Electronic Process Research) institute and No. 46 (Electronic Matertal Research) Institute will coordinate with the factory in test and replication.

The project is scheduled to be completed in 2 years. The schedule is shown in the following table:

	Year progress description	1992	1993		1994		1995	
		2nd half	1st half	2nd half	1st half	lnd half	1st half	2nd half
1	feasibility study report preparation and evaluation							
2	examination and approval by NEPA and UNDP							
3	survey and technical exchange at home							
4	study tour abroad 6 members for 21 days							

	Year progress description	1992	1993		1994		1995	
		2nd half	1st half	2nd half	1st half	1nd half	1st half	2nd half
5	commercial negotiation				—			
6	contract signing and aproval				—	—		
7	contract excution and construction					—	—	
8	trail run and acceptance test						—	—
9	replication							—

Note: This schedule is on the basis of the fact that UNDP funds will be available at the 3rd quarter of 1993, otherwise, it will have to be postponed accordingly.

10. Incremental cost calculation

10—1 Investment estimate

Chengdu factory is intended to set up a demonstration PCB cleaning line for ODS phaseout with the Montreal multilateral funds. The investment estimate is as follows.

1) The total investment: RMB 3, 500, 300 (including US $ 479, 000) where

construction	RMB	50, 000
machine procurement	RMB	2, 475, 900
(covering	US $	391, 000)
installation	RMB	45, 300

other engineering cost and expenseRMB928, 100

(covering US $ 80, 000)

Note: RMB 726, 800 to be provided locally accounts to US $ 125, 500.

2) the proportion of fixed assets: 65.83%

3) schedule of investment allocation.

The investment allocation will be completed within 24 months from the date of signing the project document by UNDP.

4) some descriptions concerning the investment estimate:

a. The foreign exchange rate is 1 USD to RMB 5.79 as issued by the State Foreign Currency Administration on Feb. 5th. 1993.

The imported equipment will be of CIF price and together with the materials for trial run will be exempted from duties and taxes on added value pursuant to certain rules. But the local provided costs in RMB such as company commission , banking charges and local transport expense and miscellaneons expense are all included.

b. The local supplied equipment will be priced with reference to ex-factory price with 6% of fransport expense and miscellaneous expense.

c. Installation cost will cover the cost for installation and debugging of both improted and local equipment and instrument.

d. construstruction cost will cover the cost for transtorming the existing building and pipeline.

e. This project will involve refurnishing the cleaning process only, exclusive of the tools or furnitures required, which will be supplied by the factory itself.

f. It's estimated US $ 35, 000 will be needed for study tour abroad and training.

g. The charges for feasibility study report preparation and design will be as stipulated in "The charging Criteria for Engineering Design" issued by the state planning Commission in 1984.

h. The preparation expense will be 6% of the total cost.

i. The foreign currency required for this project wil be allocated by the Montreal Maltilateral Fund while the RMB by the factory.

10—2 Estimate of operating cost

The no-ODS replacement technology-water cleaning and semi-aqueous cheaning processes-induced equipment change will bring about the change of such operating cost as fuels and energy cost, labor cost and maintenance cost, which is shown in the table attached.

10-3 The estimate of net present value of operating cost

Judging from the table attached, it could be seen that the operating costs before and after conversion of this project are right equal to each other (RMB 139. 200).

The difference of increased sum and saved sum is "O" and the net present value is "O" too.

10—4 The total sum of incremental cost

The incremental cost is just the total investment as the net present value is "O'. The total sum of incremental cost. i. e. total investment is RMB 3. 500. 300 (that equals to US $ 604. 500).

It's sincerely hoped that US $ 475. [illegible]00 out of the total sum would be grant allocated by the Montreal Multilateral Fund.

10—5 Calculation of "C" value

$$C = \frac{CC \cdot CRF + (OC\text{-}OS)}{M \cdot ODP}$$

where. CC = increasted investment RMB 3. 500. 300 (USD being equal to RMB 2. 773. 500 will be UNDP support)

CRF=12%

OC=yearly additional operating cost RMB 139. 200

OS=yearly saved sum RMB 139. 200

M·ODP=yearly emission of ODS (in terms of ODP value) 5. 3t

(i. e. F-113-6. 34t, ODP-0. 8, emission-5. 1t)

(MCF-1. 66t. ODP-0. 1, emission -0. 2t)

Therefore, for this project, "C" value is RMB 79. 300=US $ 13. 700. ("C" value for UNDP funds is US $ 10. 800)

11 Financial analysis and economic evaluation

11—1 Conversion's impact on the firm's economic results.

The firm's financial returns analysis clearly displays a rise of the annual total cost and the product cost under the circomstances of identical operating costs due to the increase of fixed assets and the relevant increase of depreciation charge and the amortization charge that should be counted in the cost.

11—2 Economic evaluation and suggestion

The project aims at ODS phaseout through converting the cleaning process. Conversion won't lead to any new product, any change of technical specifications and property of the existing product, nor the output rise and upgrading of the product and the sales increase. On the contrary, there will be a notable cut-down in the firm's profit rate and rate of profit and tax.

It should be pointed out that the economic returns come out of the conversion will be negative and should be offset with the original profit, which will not economically benefit the firm. Thus, for replication of the demonstration line to eliminate ODS, it's suggested the US $ 479. 000 out of the total incremental cost be supported as grant by the Montreal Multilateral Fund.

To reduce ODS caused ozone layer destruction is most essential and imperative. The social results could not be judged only from the economic point of vies. It's firmly believed that the conversion is not only feasible but also a must.

Table: Operating Cost before and after Conversion

	description	before conversion		after conversion		difference decrease − increase +
		qty	price (US $)	qty	price (US $)	
1	F-113	6. 34t	95. 100			-95. 100
2	MCF	1. 66t	19. 900			-19. 900
3	Axarel			3t	9. 000	+9. 000
4	water use			2. 4t	6. 000	+6. 000
5	power consumption	33. 000 KWh	6. 600	335. 000	67. 000	+60. 400
6	labor cost	2 persons	9. 600	6persons	28. 800	+19. 200
7	maintenance cost		8. 000 139. 200		28. 400 139. 200	+20. 400 0

Table: Investment Estimate

	description	foreign currency (USD)	In terms of RMB	RMB	remarks
	1. building construction				
	building and pipeline conversion			50. 000	
	2 equipment procurement				
	2−1 imported equipment				
1	price (including materials)	381. 000	2. 206. 000		CIF
2	commission (Company)	5. 700	33. 000		
3	commission (Bank)	1. 900	11. 000		
4	local transport and miscellaneous expense	2. 400	13. 900		
	subtotal	391. 000	2. 263. 900		
	2−2 local equipment				
1	price			200. 000	
2	transport and miscellaneons cost			12. 000	
	subtotal			212. 000	

	description	foreign currency (USD)	In terms of RMB	RMB	remarks
	total for equipment	391. 000	2. 263. 900	212. 000	
	3. installation				
1	imported equpment	7. 100	91. 100		
2	local equipment	900	5. 200		
	subtotal	8. 000	46. 300		
	4. other items and expenses				
1	study tour abroad	35. 000	202. 700		
2	technical assistance	10. 000	57. 900	23. 500	
3	expert receiption			10. 000	
4	local training			180. 000	
5	replication, development and test			100. 000	
6	feasibility study and design	10. 000	57. 900	10. 000	
7	contractor supervision	10. 000	57. 900	10. 000	
	subtotal	65. 000	376. 400	323. 500	
	5. preparation	15. 000	86. 900	110. 000	
	6. interest of loan			31. 300	
	total	479. 000	2. 773. 500	726. 800	

List of Equipment and instrument

	description	qty	price (USD)		remark
			unit price	total	
	foreign source				
1	water cleaner with drier (ECD 9600, 9050 series)	1		78, 000	
2	DI water producing plant	1		40, 000	
3	semi-aqueous conveyorized cleaner H—500	1		120, 000	
4	spare parts			10, 000	
5	cleanliness tester	1		22. 000	
6	conductivity tester	1		6. 000	
7	ultrahigh resistance and micro current tester	1		25. 000	
8	solderability tester	1		15. 000	
9	atom absorption photometer	1		30. 000	
	subtotal	8		346. 000	
	local source				
1	air handling unit (AHU)	2		100. 000	
2	electric transformer (3. 5KVA energy conserving type)	1		50. 000	
3	effluent treatment facility	1		50. 000	
	subtotal	4		200. 000	
	total			546. 000	

PROJECT COVER SHEET

COUNTRY:	China
PROJECT TITLE:	Strategy and Action Program for the Elimination of CFCs in the Manufacture of Foams
SECTOR COVERED:	Foamed Plastics
ODS USE IN SECTOR:	17,773 tons CFCs (17,773 tons ODP, 1991)
PROJECT IMPACT:	Preparation of a detailed action and monitoring plan for the elimination of the use of CFCs in foams (all categories). The action plan is a condition for an orderly, cost effective, ODS phaseout
PROPOSED BUDGET:	USD 325,000
EXECUTING AGENCY:	National Environmental Protection Agency (NEPA)
IMPLEMENTING AGENCY:	Ministry of Light Industry (MLI) UNDP (assisting)

PROJECT SUMMARY

MLI is leading a coalition of ministries in the implementation of the phaseout of CFCs in foams in China; the largest use sector of ODS (36.8%) with the highest ODP (29.4%).

ODS phaseout technologies are evolving at a fast pace, and the Chinese industry is currently somewhat lagging in the knowledge of the newest developments. In addition, the government possesses insufficient knowledge of the particulars of this industry, i.e. amount of facilities, equipment used, applications etc.

This project serves to update knowledge in both areas and to maintain updated information in the future. In addition, the industry will be made aware of the need to phaseout CFCs in greater dept than so far. Thus the base will be laid for the preparation of a detailed action plan for an orderly, fast and relative cost effective phaseout of the use of CFCs in the foam industry in China.

The acquisition of these data and formulation of such a plan will require a substantial amount of time. To avoid any unnecessary delay in implementation, a separate plan for accelerated phaseout will be submitted for selected companies that have sufficient data and technical background to participate in such a program.

PROJECT OF THE GOVERNMENT OF CHINA

PREPARATION PROGRAM FOR THE ELIMINATION OF THE USE OF CFCS IN THE MANUFACTURE OF FOAMS

1. PROJECT OBJECTIVE

The objective of this project is (1) to collect information needed to prepare for a complete phaseout of the use of CFCs in foamed plastics in the Chinese industry, (2) to prepare a strategy and (3) to prepare a detailed action plan for such a phaseout, based on the information collected.

2. SECTOR BACKGROUND

The Chinese foam industry consumed in 1991 17,773 tons CFCs (ref.: Country Programme). CFC-11 was the dominant substance, followed by CFC-12. No other ODS was used in statistical significant amounts, although some MCF may be used in glue applications. Furthermore some MCF and CFC-113 may be used in mold release agents. More detailed information is provided in Table 1:

(sub)category	tons ODS	type ODS
Extruded Polystyrene/ethylene	2,173	CFC-12
Flexible Polyurethane	2,000	CFC-11
Rigid Polyurethane	13,600	
Pipe Insulation	600	CFC-11
Sprayed PUR	600	CFC-11
Appliance Foams	5,000	CFC-11
PUF Panels	7,400	CFC-11
TOTAL	17,773	

Table 1. ODS consumption in the foam sector (1991)

The information is not in all categories complete reliable, as reports from township enterprises are considered incomplete at best. Government and industry are committed to sharply reduce, and ultimately eliminate CFC utilization. MLI is responsible for the phaseout coordination in all foam categories. Ministerial responsibility is divided into two areas:

- o Non refrigerating foams,
- o Refrigerating foams.

There are other ministries are involved in the refrigeration foams, i.c.:

- o Ministry of Chemical Industry (MCI),
- o Ministry of Commerce (MOC),
- o Ministry of Aerospace Industry (MAI),
- o Ministry of Machinery and Electronics Industry (MMEI)[1],

Complete phaseout for non-refrigeration foams is targeted for the year 2000. Refrigerating foams are expected to be CFC free from the year 2005.

The sector accounts for **at least** 200 production facilities. Because information on smaller township facilities is incomplete one can assume this figure to be very conservative. Estimates reach as high as up to 500 individual production units (see table 2). Many companies have combined capabilities, or even multiple capabilities in a sub-category[2].

(sub)category	production (t)	plants(l)	plants(h)
Extruded PS/PE	13,000	30	50
Flexible PUF	50,000	50	100
Rigid PUF	100,000	118	340
Pipe Insulation	4,000	8	20
Sprayed PUF	4,000	50	200
Appliance Foams	40,000	40	70
PUF Panels	52,000	20	50

Table 2: Annual Estimated Production and Production Facilities. (l=low estimate; h=high estimate)

[1] The Chinese Government is currently restructuring some of its Ministries. The list of Ministries and Associations involved may therefore change. This list will be updated as soon as new information is available.

[2] Tianjin Polyurethane Plastics Factory, for instance, has three flexible PUF manufacturing units, one PUF panel unit and one unit for PUF pipe insulation, in addition to a polyol blending facility.

The use of foams for domestic refrigeration is expected to increase during 1991-1995 by 8 %/y, and after 1995 by 3%/y. For other foams, a growth rate of 6 %/y is forecasted.

3. PROJECT DESCRIPTION

The international contacts of the Chinese technical community have substantially improved over the last years, and many study missions have added to its technical knowledge. However, ODS replacement technology is developing at an accelerated rate, and existing provisions are still insufficient to guarantee the rapid technology dissemination that is required to maintain updated in a timely fashion.

The technology of choice for reduced CFC or for CFC elimination in foam is depending on many factors, such as

- o Foam Type
- o Application
- o Manufacturing Equipment
- o Plant Setting
- o Availability of Raw Materials

The ability to make the right choice for a particular facility requires therefore knowledge of the available matured CFC-free/reduced-CFC technologies and--because of the rapid developments in this area--a constant update of this knowledge in a timely fashion, in addition to intimate knowledge of facility data.

From current information, the conclusion can already be made that the sector contains a significant overcapacity. Although this is inherent to the manufacture of foams (transportation costs rather than production costs/production capacity dominate the cost structure), consolidation may be required in individual cases to economically justify ODS phaseout projects. This, again, can only be decided from detailed knowledge of the sector.

The current Chinese industrial structure with large numbers of rather independent township enterprises and emerging private facilities, makes it very difficult to establish reliable industry information from existing statistics. Such information is critical and should be gained prior to--or be a part of--the formulation of a detailed phaseout action plan.

For instance, the amount of manufacturing facilities in the flexible PUF area is estimated between 50 and 100. This may double or halve the projected phaseout costs. In addition, process, equipment and application determine the individual phaseout costs.

These can range from $0 to $500,000 per production unit[3].

This project is aimed to provide government and industry with the necessary knowledge by means of:

- o The improvement of literature dissemination,
- o Attendance of relevant seminars by qualified individuals,
- o The conduction of an industry survey with the purpose to gain the knowledge necessary to conduct a successful phaseout program[4]. Such information should include
    - o Equipment specifications,
    - o Formulation specifications,
    - o Applications/productspecifications,
    - o Material usage (total ODS).

The project is to be completed with the formulation of a phaseout plan for the foam sector that addresses the particulars of process, applications, equipment, plant settings, capacity adjustments etc. as well as the monitoring mechanism on the actual phaseout progress.

Individual segments of the program are described in more detail in annex-2.
It is expected that the funds invested in this project will lead to savings in much larger amounts in actual phaseout costs, as well in stricter control of the progress made in this phaseout.

A drawback of the plan is that it might delay the submittal of phaseout projects even for companies that are known MLI, are able to disclose relevant data on very short notice and are technically capable to implement ODP phaseout with a minimum of outside support. For those companies, an accellerated phaseout program will be offered under separate cover[5].

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[3] Many facilities have multiple production units. This figure should not be misunderstood as applicable to an entire facility.

[4] Such a survey is already proposed by MLI for the non refrigeration foams (see annex 1). However, many facilities manufacture refrigeration and non-refrigeration foams, and it would be cost effective to survey the entire industry in one program.

[5] Such a proposal is in the mean time submitted through the World Bank.

4. PROJECT COSTS

The following is a summary of the expected costs related to the activities mentioned in the project description.

o Subscription to additional literature	USD 10,000
o Attendance of conferences/seminars	USD 60,000
o Conduction of an industry survey	USD 200,000
o Preparation of a itemized phaseout strategy and action plan	USD 25,000
o Contingency and rounding	USD 30,000
TOTAL	USD 325,000

Supporting documentation is provided in Annex-2.

5. FINANCING PLAN

Recipient requests a grant to the amount as budgeted.

6. IMPLEMENTATION

MLI, with assistance of UNDP will oversee the implementation of this project. Communication and concurrence with other implementing agencies, such as the World Bank, is critical and will be integrated in the process of implementation. It is expected that the project can lead to a proposed application specific action plan within six months after approval.
Literature and seminar attendance--needed to update technical knowledge on a continuous base-- are included for a period of four years. After that, industry and government will have to carry these costs on their own.

It should be pointed out that this project should not delay the submittal of selected phaseout projects. Many government owned facilities have already provided sufficient information to warrant such a submittal. A separate workshop and implementation program is proposed for companies that will participate in this accelerated phaseout program.

7. PROJECT IMPACT

This project will have no **direct** impact on the use of CFCs. It will, however, allow the formulation of an application and technology specific phaseout strategy and action plan for the

Chinese Foam Sector, and so with indirectly contribute to the phaseout of annually about 18,000 tons of CFCs (base 1991). It also may have a significant cost mitigation effect, as it allows to identify the most applicable and economic phaseout costs for individual facilities, including the option to consolidation in an effort to avoid unnecessary excess capacity. Finally, it will allow to adequately monitor the actual phaseout progress in this sector.

8. ANNEXES

Annex-1: Proposed survey of the non-refrigeration foams industry

Annex-2: Detailed outline of proposed activities and related costs

FOAMS/UNCH0301.CLI
4-24-93/REV 01

Annex 1

1. Name of project:

Investigation on Present Situation of Foam Plastics in China

2. Category:

Conversion/Support

3. Unit of implementation:

Plastics and Leather Office ,Ministry of Light Industry

China Plastics Processing Industry Association

4. Department in charge:

Ministry of Light Industry

5. Meaning and purpose:

At present,there are foam plastics of three categories made in China using CFCs as blowing agent. They are mainly: flexible polyurethane foam, rigid polyurethane foam as well as extruded polyethylene,polystyrene foam.(This project does not include foam used for refrigerator, freezer and cold storage.) Most of the production enterprises of these products are of small and medium sized with large quantity and wide distribution. Especially the township enterprises take a big proportion and are distributed nationwide. For example,at present there are more than 100 polyurethane foam factories in China , of which the township small factories take about 50 %. There are about 20 rigid polyurethane foam factories, of which the township small factories take about 30 %. There are about 50 extruded polyethylene, polystyrene foam factories, of which the township small factories take about 30 %. These factories are distributed in more than 20 provinces and municipalities in China. The township factories concentrate mainly in following provinces and municipalities: Guangdong, Fujian, Shandong, Jiangsu, Shanghai, Zhejiang, Tienjin, Beijing, Liaoning, Hubei,Hebei,etc. Due to more varieties of foam produced and different raw materials, equipment and technologies used, the amount of CFCs used by each production factory is quite different.Furthermore,there are less connections between township small factories and administrative department of trades, so no statistic data are available. Therefore, it is necessary at present to clarify the status of use of CFCs of each factory in China by investigation. Based on the investigation, corresponding experts can then be called together to carry out research and analysis for topics. A written investigation report has to be made as basis for selection of technology and equipment of CFCs sustitution and for phaseout of CFCs, so that the realization of the national phaseout plan of ozone depleting substances in China can be guaranteed.

6.Content of investigation:

To investigate the production status of products of three categories(flexible polyurethane foam, rigid polyurethane foam, extruded polyethylene, polystyrene foam) using CFCs as blowing agent, including number and distribution of factories, type of equipment, technology, production capacity, output of foam in near 3 years and consumption of CFCs as well as factory's environment conditions, etc.

7. Plan of action:

1). To establish 8 panels of experts(4 for flexible foam, 2 for rigid foam, 2 for extruded PE,PSfoam). Each panel is composed of 5 persons. The member of panel are the corresponding experts from China Plastics Processing Industry Association and main factories as well as Plastics Research Institute.

2). According to the content of investigation and regional division of labour, the panel of experts will carry out investigation in production enterprises over whole China and make written report for each investigated factory separately.

3). To organize seminars on phaseout of CFCs. Based on the investigation, seminars of products of three categories are to be convened separately. The main contents are as follows:

-- To propagate the influence of the destruction of atmospheric ozone layer by CFCs on human living environment.

-- To give presentation on present situation of the development of ozone layer protection work undertaken by various countries in the world and the national phaseout plan of CFCs as well as to circulate the national ozone policies .

-- According to the studies in foreign countries and different information documents to give presentation on different technological routes and advanced equipment regarding phaseout of CFCs of the products of three categories.

-- To study the advanced and practicable technological routes and implementation methods to be adopted in combining the concrete situation of production factory in China, in order to reach the goal of phaseout of CFCs.

4). To complete investigation report by the working panels of experts after investigation and holding seminars. To put the phaseout plan of 8064 t ODS till 2000 in effect.

8. Working schedule:

Investigation:	06.1993--12.1993
Seminar to be held:	01.1994--03.1994
Report to be put forward:	04.1994--06.1994

9. Budget:

1). Expert subsidies (~~40 persons~~, 12 months) — US $ 16,000

2). Travel expense (including traffic expense for ~~40 persons~~ and accommodation subsidies for ~~40 persons~~, 2 months) — US $ 76,000

3). Administrative expense (printing, static copier, typewriters) — US $ 10,000

4). Seminar expense
- Flexible PU foam ~~50 persons~~, 2 times — US $ 16,000
- Rigid PU foam ~~30 persons~~, 1 time: PE/PS — US $ 10,000
- Extruded polyolefin foam ~~30 persons~~, 2 times — US $ 20,000

5). Unpredictable cost — US $ 15,000

Total — US $163,000

76
16 } 26 x 2 = 52 x 0.75 = 39
10 Contingency
16 } 46 x 2 = 92 - 20 = 72
16
20
150,000
total 172 + cont = 200,000

ANNEX-2

CHINA FOAM UMBRELLA PROJECT

1) SUBSCRIPTION ON ADDITIONAL LITERATURE

The dissemination of technical literature in the foam sector in China is delayed, incomplete and not broad enough. There is a need to improve the information system at a minimum for a group of designated national experts. It is proposed to provide a group of five national sector experts with literature in their specific area for a time of four years. It is assumed that an annual amount of USD 500 per expert will be sufficient.

USD 500 x 5 experts x 4 years = USD 10,000

2) ATTENDANCE OF CONFERENCES AND SEMINARS

In line with the arguments brought under 1) it is felt that the attendance of (sub)sector specific conferences and seminars is required to keep the national experts up to date in their knowledge. It is proposed to provide the previous mentioned group of five national sector experts for four years with the financial means to attend conferences such as

- o The annual conference of the polyurethane division of the SPI (USA),
- o The bi-annual Polyurethane World Conference.

It is assumed that an annual amount of USD 3,000 per expert will be sufficient.

USD 3,000 x 5 experts x 4 years = USD 60,000

3) CONDUCTION OF AN INDUSTRY SURVEY

The existing Chinese information system for the foam sector is unreliable and incomplete. A big proportion of the enterprises is owned locally. Information on these generally small factories is lacking, but needed to implement a successful ODS phaseout program. To approach these enterprises, a survey will be needed. Such a survey is proposed by MLI for three categories (annex-1). Such a survey is, however, also needed for the remaining categories--except perhaps the appliance industry--and it is more cost effective to survey the entire sector at the same time. The proposed survey is budgeted on USD 150,000, from which 50% consists of travel. it is assumed that these travel costs will be essentially the same for a sector survey. Proportional reduction in administrative expenses and survey personnel are also feasible, and estimated to be at least 25% (USD 6,500). Seminar expenses, while related to the amount of survey personnel, can be further reduced by more and proper written instructions and adequate supervision (estimated savings USD 20,000). In summary, a consolidated survey should be feasible for not more than USD 200,000.

4) PREPARATION OF A COMPREHENSIVE ODS PHASEOUT STRATEGY AND ACTION PLAN

Representatives of the ministries, five national experts and three international experts-- the last two groups identical to the individuals that implemented the accelerated phaseout plan for selected enterprises--will design this plan in a two day seminar, coinciding with a regular visit of the international experts. The seminar costs are budgeted at USD 25,000 consisting of:

o	Foreign experts	USD 5,000
o	National experts	USD 1,500
o	Ministries (MLI,MOC,MMEI,MAI)	USD 2,500
o	Translation, printing/copying	USD 10,000
o	Accommodations	USD 1,000
o	Miscellaneous	USD 5,000
	TOTAL	USD 25,000

Including about 10% contingency, the project costs are estimated at

USD 325,000

PROJECT COVER SHEET

COUNTRY:	Peoples Republic of China
PROJECT TITLE:	Revising design standards for cold storage.
SECTORS COVERED:	Foamed Plastics; Refrigeration/AC
ODS USE IN SECTOR: (1991)	Foam Sector: 17,773 t CFC (= ODP). Refrigeration/AC Sector: 12,869 t CFC (= ODP). Subsector (insulation panels and boards): 7,400 t CFC; the corresponding refrigeration subsector accounts for 7,480 t CFC.
PROJECT IMPACT:	Institutional project; the project is a precondition for a successful implementation of ODS-free technology in cold storage.
PROPOSED BUDGET:	USD 200,000 MLF Grant; RMB 850,000 Government of China.
EXECUTING AGENCY:	National Environmental Protection Agency (NEPA), via the Ministry of Internal Trade (MIT)
IMPLEMENTING AGENCY:	UNDP

PROJECT SUMMARY

The implementation of ODS-free technology in cold storage facilities requires changes of both storage rooms and the refrigeration machinery.

The purpose of the project is to revise the existing standards after collection of information on standard setting in other countries, and reviewing the available ODS-free technology for the sector.

The standard setting includes measurements on existing and prototype cold storages in order to ensure that they will be applicable to Chinese conditions. It will include energy standards as well as provisions on allowed (disallowed) ODS-content.

PROJECT OF THE GOVERNMENT OF CHINA

REVISING DESIGN STANDARDS FOR COLD STORAGE

1. PROJECT OBJECTIVE

The objective of the project is to revise the standards for cold storages in order to regulate and facilitate the implementation of ODS-free technologies in this field. The revision will include both standards for the cold storage rooms and the refrigeration machinery which is normally used in this sector.

The standard setting will be based on existing regulations developed by countries which already have included considerations on ODS-free or reduced ODS technologies.

The project covers all kinds of cold storage i.c. both cold storages for the industrial and the commercial sectors. Cold storage in the industrial sector covers mostly storage rooms in the food industry (dairies, slaughterhouses, breweries, frozen food industries etc.). Cold storage in the commercial sector mostly implies storage rooms in supermarkets and retail shops for food and beverages (butchers, greengrocers etc.).

The project does not include standard setting for mobile cold storages (i.c. trucks, vessels etc.) and domestic refrigeration.

2. SECTOR BACKGROUND

Ozone Depleting Substances (ODS) are used in the manufacture of insulation panels and boards for cold storage rooms, as well as in the refrigeration equipment which controls the temperature in the cold storage rooms.

2.1. Insulation

There are approx. 50 Chinese companies producing polyurethane foam (PUF) panels and boards with a total production of 52,000 tonnes of PUF (ref. China country programme, Jan. 1993), consuming 7,400 t CFC-11 (7,400 t ODP) (1991). The growth rate for this sector is estimated at about 6 % p.a.(see also Annex 1).

2.2. Refrigeration

The total consumption of ODS for cold storage refrigerants in China amounts to about 7,480 t, mainly CFC-12 (1991).
New installations count for 1,500 t or 20 % of this amount, while refilling requires about 5,980 t or 80 %. These figures

derived from the China Country Programme differ from those given in other reports. This project will as a side effect, derive better figures for the sector.

The following standards relating to cold storage, are currently in place:

- "Cold storage designing standards"
- "High architectural designing codes"
- "Standards for cold storage and air conditioning systems in supermarkets and department stores"

These standards will have to be revised in order to implement ODS-free and reduced ODS technologies. The project must at the same time ensure acceptable energy standards.

3. PROJECT DESCRIPTION

A number of ministries and institutions will be involved in the formulation and review of revised standards. The results of this project therefore require review and concurrence from these institutions (see section 6).

The project will consist of the following phases:

1. Survey on existing cold storage facilities.
2. Collection and review of standards from other countries.
3. Drafting of revised standards for CS in China.
4. Carry out of measurements to evaluate the standards.
5. Amending of the standards and subsequent review by relevant institutions.
6. Publishing and dissemination of standards codes.
7. Reporting

The proposed activities are described in more detail in Annex 2.

It is anticipated to carry out the project with one or more sponsor countries that have already put revised standards into operation.

4. PROJECT COST

The following is a summary of the expected costs related to the activities mentioned in the previous section:

Activities	Government contribution	UNDP contribution
Phase 1: -National experts	RMB 40.000	
Phase 2: -National experts -International exp	RMB 20.000	USD 21,000
Phase 3: -National experts	RMB 40,000	
Phase 4: -Staff, measurem. -Equipment	RMB 50,000 RMB 500,000	USD 20,000 USD 121,000
Phase 5: -National experts -International exp	RMB 80,000	USD 8,000
Phase 6: -National experts -Others (publication etc.)	RMB 10,000 RMB 100,000	USD 10,000
Phase 7: -National experts	RMB 10,000	
Miscellaneous		USD 20,000
Total	RMB 850,000	USD 200,000

Annex 3 contains a more detailed budget.

5. FINANCING PLAN

The recipient requests a grant to the amount of USD 200,000. The contribution of the Government of China will be RMB 850,000.

6. IMPLEMENTATION

The Ministry of Internal Trade (MIT) has been authorized by a group of ministries and NEPA to undertake standard setting in this area.

MIT will implement the project under the guidance of UNDP and NEPA. The project will be carried out by MIT's Design Institute (DIMC) in cooperation with national and international experts.

The project will be supervised by a Steering Committee composed of representatives from NEPA, MIT, UNDP, DIMC and other relevant institutions and organisations.

The duration of the project is expected to be about 24 months. DIMC will report to the Steering Committee every sixth month.

PROJECT IMPACT

The project will have no direct impact on the use of ODS. It will, however, formulate the standards for phasing out ODS in two sub-sectors: (1) insulation materials and (2) refrigeration for cold storage. These two sub-sectors represent ODS consumption on about 7,400 t CFC-11 and about 7,480 t CFC-12 respectively. In all about 14,000 t ODP (1991).

Annex 1

THE CHINESE FOAM INDUSTRY

--SECTOR BACKGROUND--

In 1991 the Chinese foam industry consumed 17,773 tons of CFCs (ref. Country Programme for the Phaseout of ODS under the Montreal Protocol). CFC-11 was the dominant substance, followed by CFC-12. No other ODS were used in statistically significant amounts, although some MCF may be used in glue applications. Some MCF and CFC-113 may be used as a mold release agent.

Production is divided between larger state owned enterprises and smaller township or private enterprises. Production and process information from state enterprises is well documented. However information on the rest of the industry is less reliable.

More detailed information is provided in Table 1:

(sub)category	tons ODS	type ODS
Extruded Polystyrene/ethylene	2,173	CFC-12
Flexible Polyurethane	2,000	CFC-11
Rigid Polyurethane	13,600	
Pipe Insulation	600	CFC-11
Sprayed PUR	600	CFC-11
Appliance Foams	5,000	CFC-11
PUF Panels	7,400	CFC-11
TOTAL	17,773	

Table 1. ODS consumption in the foam sector (selected industry data, 1991)

Government and industry are committed to sharply reduce, and ultimately eliminate CFC utilization. MLI is responsible for the phaseout coordination of all foam categories. In addition, other ministries are involved in the refrigeration foams, such as the:

- Ministry of Chemical Industry,
- Ministry of Internal Trade,
- Ministry of Aerospace Industry,
- Ministry of Machinery Industry,

Complete phaseout for non-refrigerating foams is targeted for the year 2000. Refrigerating foams are expected to be CFC free from the year 2005.

The sector involves at least 208 production facilities. Because the information on smaller township facilities is incomplete this figure is assumed to be very conservative. Estimates reach as high as up to 340 individual production units (see table 2). Many companies have combined capabilities, or even multiple capabilities in one category[1].

(sub)category	production (t)	plants(l)	plants(h)
Extruded PS/PE	13,000	30	50
Flexible PUF	50,000	50	100
Rigid PUF	100,000		190
Pipe Insulation	4,000	10	20
Sprayed PUF	4,000	50	200
Appliance Foams	40,000	40	70
PUF Panels	52,000	20	50

Table 2. Estimated number of foam production unit ("l" = low estimate; "h" = high estimate)

The use of foams for domestic refrigeration is expected to increase annually during 1991-1995 by 8 %, and after 1995 by 3%. For other foams, an annual growth rate of 6 % is forecasted.

Beijing, April 21, 1993
Bert Veenendaal

[1] Tianjin Polyurethane plastics Factory for instance has two flexible foam lines, one panel line and facilities for spray foam.

Annex 2

PROJECT DESCRIPTION

The project will consist of the following phases and activities:

Phase 1: Survey

The project will start with a definition of the areas to be covered by the revised standards, variables to be included and of related standards.

The parameters which should be taken into consideration with regard to insulation are among others:

- Recommended room temperatures
- Insulation capability (thermal conductivity) of construction materials
- Mechanical properties of the materials (compressive strength, product stability etc.)
- Dimensions of standard panels and boards
- Fire resistance
- Cleaning

Parameters which should be taken into consideration with regard to refrigeration are among others:

- Use of refrigerant (ODP-value etc.)
- Energy consumtion of machinery
- Operation and maintenance of refrigeration devices

Subsequently a survey of the exsiting cold storages and estimates of the need for new cold storage facilities in the coming 10 year period will be carried out.

The survey will provide an overview of to which kinds of cold storage facilities the revised standard should apply.

Phase 2: Information on foreign standards

This phase will consist of the collection of information on which standards exist in other countries with high standards for cold storage facilities.

A number of developed countries might be relevant in this connection, for example Denmark and Canada. The Danish EPA has been contacted in order to evaluate the possibilities of using the Danish standards. A preliminary positive answer regarding possible cooperation has been received.

Phase 3: Draft standards

Based on the above mentioned information, a first draft of the revised standards will be formulated. The draft will be discussed by the relevant institutions and organisations in order to draft a new version.

Phase 4: Measurements

In order to assess the applicability of the drafted standards, a number of cold storage facilities will be constructed and tested with regard to the proposed standards codes.

This will require purchase of devices (insulation panels/-boards, and refrigeration equipment) based on ODS-free or reduced ODS technology.

The cold storage units will be installed in three different regions of China in order to evaluate the applicability of the facilities under various conditions.

When the cold storage units are installed, they will be tested with regard to parameters which are covered by the standards.

Phase 5: Amending standards

The draft standards will be amended according to the test results obtained in the previous phase. The revised standards will then be submitted to the relevant committees for discussion and approval.

Phase 6: Dissemination

The approved standard codes will then be published and a plan for the dissemination of the standards will be set up. The standards will be disseminated to the central and local authorities which will be responsible for the implemetation and control of the standards.

Phase 7: Reporting

The project will be completed by drafting a report on the expected effect of the standards and the need for follow-up activities.

Annex 3

DETAILED BUDGET
FOR PROJECT ON
REVISING DESIGN STANDARDS FOR COLD STORAGE

The phase numbers refer to the project description in section 3 of the project document and the detailed project description in annex 2.

The exchange rate of USD/RMB has been set to: 1 USD = 5,66 RMB.

PHASE 1: Survey on existing cold storage facilities in China and estimates of futural needs

1.1. National experts (3 persons):

133 days of 300 RMB (i.c. travel): RMB 40,000

PHASE 2: Collection and review of standards from other countries

2.1. International experts (2-3 persons):

15 days of USD 790:	USD	12,000
Travel expenses	USD	9,000

2.2. National experts (3 persons):

65 days of 300 RMB (i.c. travel): RMB 20,000

PHASE 3: Drafting of revised standards for cold storage in China

3.1. National experts (4 persons):

100 days of 400 RMB (i.c. travel): RMB 40,000

PHASE 4: Measurements on new cold storage facilities in order to evaluate the new standards

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4.1. Purchase of equipment, produced according to new standards: Insulation panels, refrigeration equipment and installation for cold storage facilities in three regions:

	USD 121,000	RMB 500,000

4.2. Measurements (12 persons):

408 days of 400 RMB (i.c. travel):	USD 20,000	RMB 50,000

PHASE 5: Amending of standards and subsequent review of relevant institutions

---

5.1. National experts (20 persons):

160 days of 500 RMB (i.c.travel/DSA):		RMB 80,000

5.2. International expert (1 person):

6 days of USD 790	USD 5,000	
Travel expences:	USD 3,000	

PHASE 6: Publishing and dissemination of new standard codes

6.1. National experts (4 persons):

33 days of 300 RMB:		RMB 10,000
6.2. Publication etc.:	USD 10,000	RMB 100,000

PHASE 7: Reporting

7.1. National expert (3 person):

33 days of 300 RMB:		**RMB 10,000**
Miscellaneous:	**USD 20,000**	
Total project costs	**USD 200,000**	**RMB 850,000**

PROJECT COVER SHEET

COUNTRY:	Peoples Republic of China
PROJECT TITLE:	Testing of vacuum insulation panels for domestic refrigerators and freezers
SECTOR COVERED:	Foamed Plastics
ODS USE IN SECTOR:	Foam sector (1991): 17,773 t CFC (= ODP). Subsector (appliance insulation foam): 5,000 t CFC (= ODP). Estimated annual increase 8 % until 1995; after 1995 3 % p.a.
PROJECT IMPACT:	The project contains the potential of reducing the use of ODS for this purpose on a long term basis, and reducing the energy consumption substantially
PROPOSED BUDGET:	USD 50,000
EXECUTING AGENCY:	National Environmental Protection agency (NEPA), via Ministry of Machinery Industry (MMI)
IMPLEMENTING AGENCY:	UNDP

PROJECT SUMMARY

A number of research institutes all over the world are developing insulation panels for domestic refrigerators and freezers, using vacuum technology as a partial replacement of plastic foams. The panels seem promising with regard to the reduction of the use of ODS and with regard to the energy consumption from domestic refrigeration.

The Guangzhou Electric Apparatus Research Institute has developed a new type of vacuum insulation panel. In order to assess the feasibility of the panels, a number of tests of the insulation capability have to be carried out. The objective of this project is to carry out such tests on the panels.

PROJECT OF THE GOVERNMENT OF CHINA

TESTING OF VACUUM INSULATION PANELS FOR DOMESTIC REFRIGERATORS AND FREEZERS

1. PROJECT OBJECTIVE

The objective of the project is to carry out measurements on recently developed vacuum insulation panels for proposed use in domestic refrigerators and freezers as a substitute of plastic foam insulation.

2. SECTOR BACKGROUND

Several research institutes all over the world (especially in France, Japan, USA etc.) are developing insulation panels for refrigerators and freezers, using vacuum technology instead of plastic foams as now.

The technology is promising in the sense of insulation capability and ozone layer protection. No ODS is needed.

The Guangzhou Electric Apparatus Research Institute (GEARI) under the Ministry of Machinery Industry (MMI) has developed a new type of powder vacuum panel which seems rather promising.

However, a range of technical measurements are needed in order to assess its performance and to test the feasibility for use in refrigerators and freezers.

There are in all 70 production lines for domestic refrigerators and freezers in China with a production capacity on 12 million units (1991). The CFC-11 consumption for the insulation foam is approx. 5,000 t per year (1991).

The annual increase of the production, and hence the consumption of CFC-11, is expected to be 8 % p.a. until 1995 and 3 % p.a. thereafter.

A more detailed description of the foam sector is attached (Annex 1).

3. PROJECT DESCRIPTION

The main objective of the project is to carry out a number of physical and chemical measurements on vacuum panels that have been developed by GEARI. The status of the relevant measurements is descriped in the attached Presentation Paper (Annex 2).

The project will include comparison of the perfomance of these panels with other, similar, panels. Furthermore the project will include considerations of the applicability to the existing designs and production processes for refrigerators in China.

The project can be divided into the following phases:

1. Collection of information on testing standards
2. Testing of panels
3. Evaluation of test results and conclusions
4. Reporting

The different phases include the following activities:

Phase 1: Collection of data on testing standards

The testing consists of both physical and chemical tests. The physical tests include both thermal and mechanical tests.

In order to ensure that the tests carried out in this project include all relevant parameters, and that the test results can be compared to results generated from other similar tests of vacuum panels, there will be a preliminairy collection of test procedures from those institutes which have tested the other panels.

The data collection will also include technical specification of the other types of vacuum panels.

The testing should be carried out on various applications of the panels. This phase will therefore also include considerations of:
- Size and thickness of panels
- Filler and barrier (enclosure) materials
- Adhesives and other materials used in the refrigerator cabinets

This phase will end up with a specified plan for the testing of the panels. Most of the tests will be carried out by GEARI, but other relevant institutes will be included for specific tests. The testing plan will be discussed with these institutes before the next phase is started.

Phase 2: Testing of panels

This phase consists of the testing of the panels. The thermal testing will include measuring of the thermal conductivity under different temperatures, with different panel thicknesses and with different powder and barrier materials.

The mechanical tests will include mechanical strength measurements. Also in this cases different kinds of panels will be tested.

The chemical tests include measurements of the influence on the panel surfaces of different chemicals, among others the adhesives or other chemicals which the panels will be affected by during the manufacture and under operation.

The chemical tests include accelerated tests in order to evaluate long term effects.

Phase 3: Evaluation of test results and conclusions

In this phase all the collected measurement data will be used for calculation of relevant parameters. Furthermore, the data will be used for consideration of the applicability of the panels in refrigerators and in the existing production facilities in the Chinese refrigeratior industry.

This phase also includes comparison of data of these panels with the data of panels developed by other institutes.

Phase 4: Reporting

This phase will include preparation of a report with all the findings of the tests. The report will be published and discussed with representatives of relevant research institutes and industries, e.g. from France, Japan, USA, Denmark and China itself, and presented at international seminars.

4. PROJECT COSTS

The total project cost will amount USD 50,000. The budget can be summarized as follows:

- Materials, equipment etc.:	USD 15,000
- Testing at other institutes:	USD 10,000
- Travel expenses:	USD 5,000
- Fees:	USD 10,000
- Seminar cost:	USD 10,000
- Total project cost:	**USD 50.000**

The project costs are specified in annex 3.

5. FINANCIAL PLAN

The recipient requests a grant to the amount as budgeted.

6. IMPLEMENTATION

MMI with assistance of NEPA will oversee the implementation of this project. It is expected that the project can lead to a better understanding of the possibilities of the performance and applicability of vacuum insulation panel as a substitute for foam plastic insulation.

7. PROJECT IMPACT

This project will ~~have no direct impact on the use of ODS. However, it will~~ contribute to the development of a very promising technology which will have the potential of eliminating the use of CFCs and HCFCs for insulation foam in refrigerators. It also ~~implies the~~ possibilities of reducing the energy consumtion for domestic refrigeration substantially and reducing the emission of greenhouse gases.

Annex 1

THE CHINESE FOAM INDUSTRY

--SECTOR BACKGROUND--

In 1991 the Chinese foam industry consumed 17,773 tons of CFCs (ref. Country Programme for the Phaseout of ODS under the Montreal Protocol). CFC-11 was the dominant substance, followed by CFC-12. No other ODS were used in statistically significant amounts, although some MCF may be used in glue applications. Some MCF and CFC-113 may be used as a mold release agent.

Production is divided between larger state owned enterprises and smaller township or private enterprises. Production and process information from state enterprises is well documented. However information on the rest of the industry is less reliable.

More detailed information is provided in Table 1:

(sub)category	tons ODS	type ODS
Extruded Polystyrene/ethylene	2,173	CFC-12
Flexible Polyurethane	2,000	CFC-11
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Pipe Insulation	600	CFC-11
Sprayed PUR	600	CFC-11
Appliance Foams	5,000	CFC-11
PUF Panels	7,400	CFC-11
TOTAL	17,773	

Table 1. ODS consumption in the foam sector (selected industry data, 1991)

Government and industry are committed to sharply reduce, and ultimately eliminate CFC utilization. MLI is responsible for the phaseout coordination of all foam categories. In addition, other ministries are involved in the refrigeration foams, such as the:

- Ministry of Chemical Industry,
- Ministry of Internal Trade,
- Ministry of Aerospace Industry,
- Ministry of Machinery Industry,

Complete phaseout for non-refrigerating foams is targeted for the year 2000. Refrigerating foams are expected to be CFC free from the year 2005.

The sector involves at least 208 production facilities. Because the information on smaller township facilities is incomplete this figure is assumed to be very conservative. Estimates reach as high as up to 340 individual production units (see table 2). Many companies have combined capabilities, or even multiple capabilities in one category[1].

(sub)category	production (t)	plants(l)	plants(h)
Extruded PS/PE	13,000	30	50
Flexible PUF	50,000	50	100
Rigid PUF	100,000		190
Pipe Insulation	4,000	10	20
Sprayed PUF	4,000	50	200
Appliance Foams	40,000	40	70
PUF Panels	52,000	20	50

Table 2. Estimated number of foam production unit ("l" = low estimate; "h" = high estimate)

The use of foams for domestic refrigeration is expected to increase annually during 1991-1995 by 8 %, and after 1995 by 3%. For other foams, an annual growth rate of 6 % is forecasted.

Beijing, April 21, 1993
Bert Veenendaal

[1] Tianjin Polyurethane plastics Factory for instance has two flexible foam lines, one panel line and facilities for spray foam.

ANNEX 2

Study Report on Powder Vacuum Insulation Panel

1. Introduction

With the development of refrigerator industry, China has consequently increased its production of rigid polyurethane foamed plastics(RPUF) for the last decade of years. Adverse studies aim to improve the insulation rate and reduce the weight of RPUF manifest that its thermal conductivity, which usually has 0.020-0.024w/mk, is very close to the theoretical value, 0.0182w/mk. Its density also drops to 32+-2kg/m3. So it will be hardly possible to improve the technology of refrigeration and save money and energy through further efforts to raise the insulation rate and keep low density of RPUF with CFC-11(F-11) as its blowing agent.

And what is more important is scientists, after ten years of observation and research, prove that CFCs cause severe depletion on the ozone layer and accelerate the speed of warmhouse phenomenon of the Earth. They destroy and bring disastrous effects to the environment which human beings cannot survive without. To replace them becomes the overwhelming task of environmental protection.
F-11, the blowing agent of RPUF, is one of the limited CFCs. Statistics shows that in 1987 the world's total output of refrigerator is 58,676,000 sets, using up 8,600 tons of CFC-12 and 60,000 tons of CFC-11. In 1988, China manufacturers produced 7,398,600 sets. Consumption of CFC-12 is 2,000 tons. Eight thousand tons of CFC-11 are used as insulation materials, which take up 17 percents of total consumption of CFC in China. It is a priority to seek alternatives of CFC-11 as insulation material.

For the last two years many countries have made great efforts to replace CFC-11. One method is to use combined poly-ethereal agents. It contains 50-percent water replacement of CFC-11. British ICI Company and German's Bayer Company, for example, have put this method into practice in many European nations and regions. The ICI Co. who introduces its technology to China's Beijing Snowflake Refrigerator Factory and Bayer to Qingdao Refrigerator Factory, make successful experiments in the East. China's Twilight Chemical Research Institute and the 501st Institute of the Ministry of Aerospace and Aeronautics have achieved satisfactory results in this field and planned to put into use in three years.

The research of appliance of CFC-11 alternatives is undertaken at the same time. German's Kali-Chemie Co. use HCFC-123 and HCFC-141b as blowing agent in RPUF foaming experiment to compare the formula and quality of RPUF. Several research centers in China make similar experiment and discover that by using HCFC-123 and HCFC-141b, the insulation rate of RPUF drops to some degree. And HCFC-123 does not fix well to the lining material ABS inside a refrigerator; while HCFC-141b is unfortunately inflammable. To solve these problems it still take a long period of time changing the formula of RPUF and the internal lining material.

Some researchers develop an insulation panel without ODS. This panel, called the Powder Vacuum Insulation Panel, will completely replace CFC and has a rate of insulation three times as high as RPUF. Panasonic Freezer Refrigeration Company began to make PVIP in 80s and they have minimized its thermal conductivity to 0.007w/mk. In 1985 a special panel combining RPUF and PVIP was made to substitute for the insulation panel of refrigeration room. For example, Panasonic NR-314TG refrigerator, which uses this new panel, has 120L of volume, 30% bigger than usual refrigerators and 50.3% raise in capacity. That is a significant progress in the technology of refrigeration.

In consequence, researches on the connecting rigid foam plastic vacuum insulation panel were undertaken. This panel has same insulation rate as

PVIP. U.S. and German have achieved similar thermal conductivity of PVIP to Japan. Another research lately done in U.S. involves stainless steel. In China, Xi'an Pomegranate Technology Co. LTD. and Shaanxi Refrigerator Factory have jointly accomplishzed 0.006-0.0.0093w/mk with PVIP.

PVIP has a fine quality of insulation and doesn't contain any kind of CFCs. But it is regarded as an ideal alternative of CFCs in the long term. In March-October, 1991, my institute undertook a preliminary research of CFC replacement.

2.The Theory of PVIP

An insulator usually have one of the three modes of thermal conductivity: conductivity, radiative conductivity or convective conductivity. Its superficial thermal conductivity(λ)includes the thermal conductivity of its internal vapor(λ_g),of its solid contact(λ_s)and radiative conductivity, convective conductivity of vapor(λ_c).As formula (1) shows:

$$\lambda = \lambda_g + \lambda_s + \lambda_r + \lambda_c$$

PVIP is a kind of panel with extracted vacuum after being filled by powder insulators. The panel could make a vacuum of 1 pa (10^{-2} mmHg).

Under general circumstances an insulator conducts heat by air. And this mode of conductivity will take up over 50% of its total conductivity. The density of the insulator has little influence on the conductivity. The vapor inside PVIP is extremely sparse and the molecules of the vapor have least chances to come into each other. The conductivity of vapor i.e. λ_g is reduced to such a degree that it can be neglected. And the extreme sparseness of cellular powders can also be neglected. Therefore, the thermal conductivity of PVIP λ_o is mainly determined by λ_s and λ_r. But the proportion of these two factors are small. So λ_o will be much lower than λ. Formula (2) shows their relation:

$$\lambda_o = \lambda_{go} + \lambda_{so} + \lambda_{jo} + \lambda_{ro} + \lambda_{co}$$

here λ_{co} is extremely saml and can be neglected. So formula (2) transfers to formula (3):

$$\lambda_o = \lambda_{go} + \lambda_{so} + \lambda_{jo} + \lambda_{rc}$$

From formula (3), we'll find λ_o of PVIP is determined by λ_g, λ_{so}, λ_{jo} and λ_{rc}. Formula (4) explains the λ_g of PVIP vapor:

$$\lambda_{go} = \lambda_{g1} \frac{L_v}{L_v + L}$$

here: λ_{g1} stands for λ_g of vapor of 1 barometric pressure,
Lv for distance between vapor,
L for average free movement of vapor molecules.

Formula (5) shows L value:

$$L = \frac{2.33 \times 10^{-20} T}{P \sigma^2}$$

here: T stands for temperature (k),
P for pressure (mmHg),
σ for semi-radius of vapor molecules (cm).

L is inverse to vapor pressure when T and σ is stable. When the vaccuum degree goes up (i.e. the pressure is lower), the L value goes up while λgo drops. As L >> Lv (over fifty times), the TC value of λgo decreases to a level that it can be overlooked. Consequently the quality of the insulation is determined by F, i.e. the solid volume of powder, which affects the value of λso, λjo and λro. The TC value of solid powder matrix is bigger than that of the air. As F goes up, λso goes up too. As the powder grains make less contacts, the powder has a great heat resistance. F goes up, λjo goes down. Formula (6) calculates the value of λro:

$$\lambda ro = 4L\mu n^2 d \xi T^3$$

Here: n refers to refraction index of the air
d to radiation constant
ξ to blackness of fillers
T to temperature
L to range betwenn the grains.

When the other parameters are set, λro is proportionate to L, i.e. λro is inverse to F.

According to the above theory, a PVIP can be made through researches in these aspects.

3. Research on PVIP

3.1 Research on the Powder

The quality of powder is most influential factor in making PVIP. These premises determine whether a kind of powder can be used or not:

a. very small TC and λjo value;
b. under the condition of a low vaccuum degree, the range between grains is so small that λco can be overlooked;
c. endurance of the outside air pressure, so as to keep the plastic film container apart;
d. light weight;
e. easy to get dry;
f. rich resource to keep its price low.

The best choice is the expansive perlite powder (EPP). However, the varied density of powder, the thickness of liner, the size of grains and the content of impurity will have direct effects on the TC value of PVIP. Experiments on PVIP from various sources show that the TC value of PVIP goes up with the increasing panel density in a certain range and drops when the granularity gets lower. See:

Diagram 1: TC Value of PVIP with Densities

Sample No.	Density (kg/m3)	Vaccuum Degree(pa)	TC(w/mk)
911019-A	300	0	0.0198
911019-B	250	0.1	0.0171
911019-C	200	0.1	0.0165
911019-D	150	0.5	0.0172

Diagram 2: TC Value of PVIP with Granularity

Sample No	Powder Granularity	Panel(kg/m3) Density	VD(pa)	TC(w/mk)
9190-2	coasre grain: fine = 2:1	160	<1	0.0226
9190-3	coarse	160	<1	0.0273
9190-5	coarse	250	<=2	0.0329
9190-6	fine	250	<=2	0.0160

Those data show that to achieve the best value of density between the granular ranges and the panel and of powder and granular sizes, we must do much more experiments.

3.2 Research on Materials of Powder Vaccuum Container
Keep the vaccuum degree of panel steady. These are the required characteristics for the materials:

1) well-maintenance of vaccuum and low gas and air permeability;
2) low solid TC value of the container;
3) mechanical strength for 1 bar;
4) easy sealing, simple craft and suitable for quantity production;
5) light weight.

The best choice at present is PET-Al-PE compiled film. But experiments show it causes 3-5% increase of TC value. See:

Diag 5: TC Value of PVIP with Packings

Sam No	Vaccuum Degree(pa)	TC(w/mk) kraft paper bag PET-Al-PE	kraft paper bag
9010-17-1	101325	0.0556	0.0541
9010-17-2	101325	0.0771	0.0411
9010-17-3	101325	0.0519	0.0505

The reason: TC value of aluminium(230w/mk) is 1,000 times bigger than that of plastic film. Data show when the thickness of Al layer is 0.5μm, there is almost no effect. But TC value rises when it is 7μm. See below:

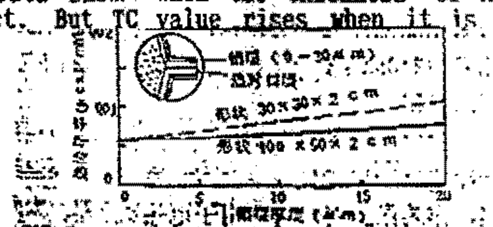

图 1.

The thickness of Al layer used in present frige is 9-12μm. So TC value rises. We'll have systematic research in this aspect to make the best radiation rate of Al layer in certain thickness so that the TC value is proper.

3.3 Research on Vaccuum Extraction

This technology is critical in determining the perfect insulation rate of

PVIP. Resistance of the extraction is high and the process will take a comparatively long time. So the accessory, the timing and the panel temperature of extraction system must carefully designed. Diagram 6 discloses the relationship between timing and TC value of panel.

Diag 6: TC Value of PVIP with Extraction Time

Sam No	Density(kg/m3)	TC value ext 2/3hr 1pa	ext 4hs 200pa	ext 6hs 1pa	comments
8912-29	160	0.0485	0.0255		
9190-2	160			0.0226	use viscose to stick powder

3.4 Research on Formulation and Craft of PVIP

The gas and humidity will permeate the film of the vaccuum container when a PVIP for a long duration. Vaccuum pressure in PVIP will gradually rise and insulation rate drop. Adding gas absorbing agent(GOA) will prolong the life of PVIP. GOA has these characteristics:

1) large capability of absorbing gas and low balance pressure intensity,
2) stable quality and regenerative,
3) high intensity.

The additive is determined by PVIP duration, permeatiblity of gas and humidity in vaccuum container materials, emission rate of powder material gas, absorbing speed and quatity of the agent.

Also, to reduce the effects that radiative conductivity makes to the TC value of the panel, proper types and amount of metal powder will be added in PVIP. We had used water-soluble resin as viscose to make the material into a panel of proper intensity and specifications. The result, however, is that its driness and vaccuum degree are affected. See:

Diag 7: TC Value of PVIP with Panel-making Crafts

Sam No	Density (kg/m3)	Vaccuum Degree(pa)	TC (w/mk) Panel of powder	Of powder with viscose
9010-2	192	1		0.0362
9190-1	207	1	0.0186	

Diag 8: TC Value of PVIP with Viscose

Sam No	Density (kg/m3)	Vaccuum Degree(pa)	TC (w/mk) Powder panel paper bag PET-Al-PE	Powder panel
9140-1	123	1	0.0533	
		101325		0.0513
9140-3	86	1	0.0471	
		101325		0.0448

Further research should be made on the location of gas absorber and metal powder in the panel and the size of the panel.

4. Research on Application of PVIP

It doesn't require any CFC substances to make a PVIP. Therefore, it can replace RPUF insulation material currently used in refrigerators. It is significant for protection of ozone layer, environment that mankind rely on, and will create remarkable social benefits. Its super TC has tackled the problems derived from freezer enlargement such as volume increase, occupying large space, and higher energy consumption. The TC rate of PVIP is 0.007w/mk. Its insulation performance is three times of the current RPUF. The application of PVIP and RPUF compound as refrigerator insulation can not only improve a refrigerator's insulation properties, achieve energy efficiency, improve refrigerator volume, but also reduce 50% of CFC-11 consumption. Current CFC-11 substitution research work proves that the TC value of RPUF with HCFC-123 or HCFC-141b as foaming agent is greater than current RPUF. Adoption of PVIP-RPUF combination will completely replace CFC-11, its insulation performance is identical with existing RPUF. See diagram 9 for details. Therefore, PVIP is a new prospective insulation material used in refrigerator.

Diag 9 TC of PVIP, RPUF and their Compound

Sam No	Density(kg/m3)	TC(w/mk)
HCFC-141b	33	0.0242
1019B	250	0.0165
HCFC141b + 1019B	/	0.0215
HCFC-123	33.8	0.0236
9282	110	0.0162
HCFC123 + 9282	/	0.0227

As people are concerned about the feasibility of actual application of PVIP in refrigerators. Some of the views on this issue presented here are for reference.

1) Long-term Effect of PVIP

Since formulation, technology, vacuum container material, thermo-sealing technology, and vacuum extraction technology can guarantee the vacuum of PVIP and keep vacuum for long time. When used in refrigerator, it can be compounded with RPUF. In this way, RPUF can not only keep the panel from any damage but slow the permeation of the air and humidity - so it'll be more durable.

2) Costs of PVIP

Present researches promise low cost of materials but difficult craft and technology. The total cost is roughly the same as or slightly higer than that of RPUF but lower than that of RPUF with HCFC-123 or HCFC-141b blowing agents. The refrigerator manufacturers will find it quite acceptable.

3) No big change will be made on the present foaming line when PVIP is applied in refrigerators. The only amendment is to add a process in the line to make PVIP into the setup of refrigerators. However, we are in this research right now.

4) A refrigerator with PVIP will be heavier than that with RPUF due to its density which is six times bigger than that of RPUF. But if we make some improvement on its moving sturcture and at same time tell the customers the importance of environmental protection, it won't be a big problem.

5. Conclusion

1) All in all, it is critical to start the research on PVIP.
2) Preliminary study on PVIP has achieved 0.016w/mk TC and 160kg/m3 of density. It provides a serial of critical points which we have to come across in future research, to wit:

a. making expansive perlite powder and best choice with grains' size and range;
b. materials for making powder vacuum container;
c. technology for thermal sealing;
d. accessories for the vacuum extraction system and research on its related technology;
e. research on PVIP formulation, technology.

In future research work, if these issues can be studied more systematically, anticipated objectives can be achieved.

3) Based on the preliminary research work, our idea for the next step is: while PVIP research is being undertaken, the research work should also be made on connected foaming rigid plastic vacuum insulation panel with CFC-11 free foaming agent. Through research, first-class PVIP with comprehensive performance will be selected from vacuum panel made by different kinds of vacuum container material or fillings. Research on RPUF and PVIP compounds technology as refrigerator insulation layer should also be conducted. Objectives such as insulation material used in refrigerators completely free of CFC-11 and insulation technology improvement will be accomplished.

4) Due to large amount and difficulty of research work of the project, it is necessary to have supports in terms that this technology involved many fields of research, manpower, materials and financial aid. I believe, under the auspices of concerned authorities, the research work of the project will be accomplished definitely, creating benefits for the society.

Annex 3

--PROJECT COSTS--

--DETAILED BUDGET--

1. Materials, equipment and apparatus:

1.1. Materials testing:

- Vacuum container performance tests:	USD	3,000
- Perlite powder perfomance test:	USD	3,000
- Absorbent performance tests:	USD	1,000

1.2. Equipments and apparatus:

- Film permeability rate measurer:	USD	1,000
- Vacuum board forming mould:	USD	2,000
- Vacuum container sealing machine:	USD	2,000
- Vacuum pump system:	USD	3,000
Total, materials and equipment:	USD	15,000

2. Testing etc. other institutes:

- Sample and prototype manufacture:	USD	6,000
- Sample and prototype tests:	USD	4,000
Total, testing etc.:	USD	10,000

3. Travel expences:

- Collection of information on other panels:	USD	5,000

4. Seminar costs:

- Discussion of test results with other institutes:	USD	10,000

5. Staff expenditures:

- 1 senior engineer:	USD	4,600
- 2 engineers of USD 2,700:	USD	5,400
Total, staff:	USD	10,000

Total project costs: **USD 50,000**

PROJECT OUTLINE

COUNTRY	:	CHINA
SECTOR COVERED	:	Primary Sector: Halon
SECTORAL ODS CONSUMPTION	:	Halon 1211: 4.000 Tons/year Halon 1301: 50 Tons/year
PROJECT TITLE	:	Implementation of the Halon Phase-out Plan for China: Current Situation, Revision of National Codes and Education and Training
PROJECT DURATION	:	Three years
PROJECT IMPACT	:	No direct impact (relevant for the phase out of 16.500 tons ODP)
PROPOSED BUDGET	:	US$480,000
IMPLEMENTING AGENCY	:	UNDP
NATIONAL COORDINATING AGENCY	:	National Environmental Protection Agency (NEPA) through Ministry of Public Security (MPS)

PROJECT DESCRIPTION

To achieve the goals set in the Chinese phase out plan for halons and to ensure full implementation throughout the country, the following activities are required:

Based on information to be collected on the present use of halons, the necessary changes, including revision of national codes and standards and drafting and adoption of new standards for handling of halons will be carried out.

In order to change the existing practices of halons use and implement revised codes and standards, the appropriate education and training will be carried out through national and regional seminars and training courses.

As the project concerns all Fire Bureaux in the provinces, all halon agents and equipment manufacturers, design organs and end users, the project will be implemented by the Fire Bureau of MPS.

The specific technical work will be carried out by the Tianjin Fire Research Institute and an information and technical center will be established at this institute.

The Fire Bureaux at regional levels will assist in the collection of information, implementation of the phase-out programme and education and training.

A pool of experts from all sectors will be engaged in halon alternatives research, revision of codes and standard, related tests and training.

At specific stages, the MPS will ensure coordination and cooperation with other Ministries concerning issuing administrative guidelines and technical codes according to demand, for example, implementation of the national programme to phase out CFCs and Halons; formulating customs policy to raise the import tax on halons and equipment; formulating tax policy to raise the cost of halon agents and halon based fire equipments; and giving preferential tariff to halon alternatives.

PROJECT COVER SHEET

COUNTRY:	The Peoples Republic of China
PROJECT TITLE:	IMPLEMENTATION OF THE HALON PHASE-OUT PLAN FOR CHINA: Current situation, Revision of national codes and education and training
SECTOR COVERED:	HALON SECTOR
ODS CONSUMPTION IN THE SECTOR:	HALON 1211: 4.000 Tons/year (ODP=3) HALON 1301: 50 Tons/year (ODP=10)
CONSUMPTION WEIGHTED WITH ODP FACTOR:	12.500 tons ODP
PROJECT DURATION:	3 years
PROJECT IMPACT:	No direct impact (relevant for the phase out of 16.500 tons ODP)
TOTAL PROJECT COST:	US$ 480.000 RMB 550.000
PROPOSED ODS GRANT:	US$ 480.000
IMPLEMENTING AGENCY:	UNDP
NATIONAL COORDINATING AGENCY:	National Environmental Protection Agency through the Ministry of Public Security

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UNIDO

1. PROJECT OBJECTIVES:

The aim of the project is to reduce the use of halons through change of requirements and change of existing and well established practices. The project is one of the key preconditions for the limitation and phase out of halons in China. Its implementation is closely linked to other projects financed by the World Bank, UNDP and UNEP and is a prerequisite for the succesful implementation of these projects.

Halon is presently extensively used for fire protection in China. Since the beginning of 1970, halons have been presented as a clear and very efficient fire extinguishing medium.

This project has three objectives. The first is to investigate the present use of halons in order to eliminate unecessary use in the shortest time by issuing guidelines or regulations when needed and to identify areas where it is more difficult to find alternatives and where further investigation is needed. The second objective is to change a number of codes and standards which directly or indirectly require or lead to the use of halons. The third objective is to implement the changes at the national, regional and local levels through education and training sessions.

2. SECTOR BACKGROUND:

China's halon consumption is presently 12.600 tons ODP, or more than 25% of the total CFC and halon consumption in China if the weighted ODP value of the ODS consumed in China is considered. At present only 60% of the total existing production capacity of halon 1211 is utilized. (ODP factors used: Halon 1211 = 3, Halon 1301 = 10).

Approximately 3.500 tons of halon 1211 and 10 tons of 1301 are produced annually in China by 13 to 18 factories, of which only 5 have a production of more than 300 tons yearly. An additional 5-700 tons of halon 1211 and 50 tons of 1301 is imported from developed countries annually (all figures for 1991).

2645 tons of halon 1211 are used for the production of approximately 1.2 million portable halon fire extinguishers produced annually by 80 factories in China. 355 tons of halon 1211 and 45 tons of halon 1301 are used for fixed installations, with halon 1211 installations produced by 25 factories.

600 tons of halon 1211 and 5 tons of halon 1301 are used by 900 servicing and maintenance companies in China.

Due to the recent rapid economic development in China, a large number of halon 1301 fire extinguishing systems have been imported and installed. Those systems are not included in the above figures, as they have been imported as "fire fighting equipment" and not as halons. They however will have an influence on the amount of halon 1301 used for service and maintenance in the future.

The Fire Bureau, Ministry of Public Security (MPS) is responsible for fire prevention, fire safety, fire fighting and licencing of the production of fire equipment, including halons, in China. It is also responsible for the national phase out program for the halon sector. The Provincial Fire Bureau authorities directly administer, monitor and control manufacturers and service and maintenance workshops in each province.

Through regulatory change and change of established practices for the use of halons, licencing of the production of halon based fire equipment and responsibility for phase out of halons in China, the MPS plays a major role in the sector. A phase out programme is under preparation to implement the country programme for this sector.

3. PROJECT DESCRIPTION

As the project concerns all Fire Bureaux in the provinces, all halon agents and equipment manufacturers, design organs and end users, the project will be implemented by the Fire Bureau of MPS.

The specific technical work will be carried out by the Tianjin Fire Research Institute and an information and technical center will be established at this institute.

The Fire Bureaux at regional levels will assist in the collection of information, implementation of the phase-out programme and education and training.

A pool of experts from all sectors will be engaged in halon alternatives research, revision of codes and standards, related tests and training.

At specific stages, the MPS will ensure coordination and cooperation with other Ministries concerning issuing administrative guidelines and technical codes according to demand, for example, implementation of the national programme to phase out CFCs and Halons; formulating customs policy to raise the import tax on halons and equipment; formulating tax policy to raise the cost of halon agents and halon based fire equipments; and giving preferential tariffs to halon alternatives.

3.1 Investigation of current situation

In order to stop the use of halons for non-essential and non- critical uses as quickly as possible, the MPS will allocate more manpower to collection of information nation-wide and to evaluation of the information gathered. This information should cover production of halons, production of halon-based fire fighting equipment and actual use of halons. For the latter, the emphasis will be on servicing and maintenance workshops (for evaluating the possible establishment of a national recycling and banking system) and fixed halon fire extinguishing systems (for evaluating the future need for halon 1301).

Due to the size of the country and regional differences, the collection of information requires the developement of a common reporting system and forms. The establishment of a database is foreseen and will be coordinated with NEPA and MCI.

The database will be located at the Tianjin Fire Research Institute and the information will come from four areas: the North, North-east, South-east and South. The information on fixed halon installations will be utilized for identification of essential uses and alternatives for each type of use. Especially for halon 1301 where China has limited production compared to the need for servicing and maintenance, it will facilitate the transfer of halon 1301 from less critical to more critical uses in the future.

3.2 Change of national codes, standards and guidelines.

The following codes, standards and guidelines will be revised. The list might be extended as a result of information collected and new international developments:

Revison of codes:

* Fire Protection in Building Design
* Fire Protection in Tall Civil Building Design
* Fire Protection in Underground Engineering Design
* Fire Protection in Underground Engineering Design

Revision of existing national standards:

* The general technical specification of portable extinguishers
* Halon 1211 portable extinguishers

Formulating new standards:

* Guidelines for limiting Halon use and protecting the ozone layer.
* The Seal Requirements and Testing Methods of Leakage in Halon Equipment
* Standard requirements for limiting halon emmision during production, servicing and handling of halons and halon extinguishers and systems.

3.3 Education and training

In order to implement the phase-out programme and the change of standards and existing approaches, education and training of fire safety management staff is required in the following fields and organizations, i.e. Regional Design, MPS Regional Fire Authorities, Design Engineers, Fire Equipment Manufactures, Service and Maintenance Workshops, Safety Officers from governmental and joint venture enterprises and other major users of halons.

As part of the programme, the necessary text books and other material will be prepared by the MPS. Video and other audio-visual material will be made avaiable from the demonstration of alternatives to halons.

For the execution of the education and training programme, China will be divided into 6 regions. Training courses will be conducted at the national, regional and local levels based on the educational materials prepared by the MPS.

3.4 Information and consultancy center

A national centre for information and consultancy will be set up at the Tianjin Fire Research Center. This centre will also serve as an Office under the China National Halon Phase Out Committee, set up by MPS. The centre will also provide information for the implementation of the halon phase-out programme and provide technical assistance for activities involving halon consumption control and application of non-halon technologies.

The proposed work on introduction of alternatives to halons and transfer of non-halon fire protection technology will also be coordinated by Tianjin Fire Research Institute. This will make it possible to ensure cooperation and rapid implementation of activities leading to direct phase-out.

3.5 Time Schedule

The total project duration is 3 years. The various activities described above will be carried out in parallel.

Sub-projects	1st year	2nd year	3rd year
Investigation of current situation and establishment of data base, determination of essential and non-essential end-user	■■■■	■■■■	
Necessary examine tests and model engineering project	■■■■	■■■■	
Formulating of new/revision of existing Standards and Codes	■■■■	■■■■	■■■■
National education and training (the budget also includes organization of an international conference in China and attending international conferences)	■■■■	■■■■	■■■■
Set up an information and consultation Centre for limiting halon use in China	■■■■	■■■■	■■■■

For the revision of Codes and Standards, the following detailed time schedule has been prepared.

Codes and Standards	1st year	2nd year	3rd year
Revising "The Code of Fire Protection in Building Design"			
Revising "The Code of Fire Protection in Tall Civil Building Design"			
Revising "The Code of Fire Protection in Underground Engineering Design"			
Revising "The Code of Design on Engineering Allocated in Industrial and Civil Building"			
Revising "The General Technical Condition of Portable Extinguishers"			
Revising "Halon 1211 Portable Extinguishers"			
Formulating "The Signs of Limiting Halon Use and Protecting the Ozone-layer"			
Formulating "The Seal Requirements and Testing Methods of Leakage in Halon Storage Equipment			

4. PROJECT COST:

The total budget for the project is US$ 480,000 and RMB 550,000

Sub-projects	Total	
	UNDP US $	Domestic RMB
Investigation of current situation and establishment of data base, determination of essential non-essential end-user	170,000	150,000
Necessary examine tests and model engineering project	30,000	200,000
Formulating and revising Standards and Codes	130,000	60,000
National education and training programme	100,000	70,000
Set up an information and consultation station for limiting halon use in China	50,000	70,000
Total	480,000	550,000

5. FINANCE PLAN

Requsted finansial support from the Montreal Protocol through UNDP:	US$ 480,000
Financed by Fire Bureau, MPS:	RMB: 550,000

6. ANNEXES:

Annex 1: Time schedule for the project

Annex 2: Detailed budgets for the activities included.

Table 1: Annual Budget

Sub-projects	Total		1993		1994		1995	
	UNDP US $	Domestic RMB	UNDP US $	Domestic RMB	UNDP US $	Domestic RMB	UNDP US $	Domestic RMB
Investigation of current situation and establishment of data base, determination of essential and non-essential end-user	170,000	150,000	100,000	75,000	70,000	75,000		
Necessary examine tests and model engineering project	30,000	200,000	20,000	100,000	10,000	100,000		
Formulating of new/revision of existing Standards and Codes	130,000	60,000	30,000	20,000	60,000	20,000	40,000	20,000
National education and training (the budget also includes organization of an international conference in China and attending international conferences)	100,000	70,000	20,000	20,000	30,000	30,000	50,000	20,000
Set up an information and consultation Centre for limiting halon use in China	50,000	70,000	20,000	20,000	15,000	20,000	15,000	30,000
Total	480,000	550,000	190,000	235,000	185,000	245,000	105,000	70,000

Table 2: **Budget for investigation of current situation, establishment of data base and determination of essential and non-essential end-user**

Item	Activities	Budget		Description
		UNDP funds US $	Domestic funds RMB	
1.	Cost for training investigators (training 100 investigators)	20,000	10,000	
2.	Cost for labour	40,000	30,000	
3.	Information collection and travel cost (in China)	15,000	20,000	
4.	Software and type in data	10,000	10,000	
5.	Computers and printer (5 sets)	20,000	10,000	*
6.	Cost for data update	25,000	50,000	
7.	Attending international conference (4 persons)	20,000	10,000	
8.	Domestic conference (200 persons)	20,000	10,000	
9.	Total	170,000	150,000	

* Dispose for 4 administration areas such as North, North-East, South-East and South areas.

Table 3: Budget for necessary tests and model engineering project

Item	Activities	Budget		Description
		UNDP funds US $	Domestic funds RMB	
1.	Cost for updating test equipment	30,000	40,000	*
2.	Cost for purchasing test goods		30,000	**
3.	Cost for consumption material and after treatment		15,000	***
4.	Cost for model engineering project		100,000	****
5.	Cost for labour		10,000	*
6.	Information		5,000	
7.	Total	30,000	200,000	

* Supplement or update equipment in existing labs.
** Such as computers, electronic instruments, books, etc. for fire test.
*** Such as fuel for test and clear test ground, etc.
**** Including cost for model project selection, testing and other additional cost, etc.

Table 4: Budget for formulating and revising Standards and Codes

Item	Activities	Budget		Description
		UNDP funds US $	Domestic funds RMB	
1.	Information	40,000		
2.	Travel cost	10,000	20,000	
3.	Forum for soliciting opinions	20,000	10,000	
4.	Meeting for examination and approval	20,000	10,000	
5.	Labour	40,000	20,000	
6.	Total	130,000	60,000	

Table 5: Budget for education and training

Item	Activities	Budget		Description
		UNDP funds US $	Domestic funds RMB	
1.	Training cost for implementation of new and revised standards and codes	50,000	35,000	
2.	Training and education cost for limiting halon use to fire service, manufacture, design and end-user in relevant ministries and provinces	50,000	35,000	
3.	Total	100,000	70,000	

Table 6: Budget for information and consultation centre for limiting halon use in China

Item	Activities	Budget		Description
		UNDP funds US $	Domestic funds RMB	
1.	Cost for equipment and instruments	20,000	20,000	*
2.	Cost for information collection		10,000	
3.	Cost for operation and personnel	30,000	40,000	
4.	Total	50,000	70,000	

* Including computers, duplicator, fax and communication equipment.

PROJECT COVER SHEET

COUNTRY:	The Peoples Republic of China
PROJECT TITLE:	IMPLEMENTATION OF THE PHASE OUT PLAN FOR CHINA: Transfer of technology on alternatives to halon fire protection systems
SECTOR COVERED:	HALON SECTOR
ODS CONSUMPTION IN THE SECTOR:	HALON 1211: 4.000 Tons/year (ODP=3) HALON 1301: 50 Tons/year (ODP=10)
CONSUMPTION WEIGHTED WITH ODP FACTOR:	12.500 tons ODP
PROJECT DURATION:	3 years
PROJECT IMPACT:	No direct impact (relevant for the phase out of 12.500 tons ODP)
TOTAL PROJECT COST:	US$ 350.000 RMB: 510.000
PROPOSED ODS GRANT:	US$ 350,000
IMPLEMENTING AGENCY:	UNDP
NATIONAL COORDINATING AGENCY:	National Environmental Protection Agency through the Ministry of Public Security

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PROJECT SUMMARY

To achieve the goals set in the Chinese phase-out plan for halons, and in accordance with the Chinese Country programme, the following activities are required:

In order to utilize alternative fire protection systems presently operating in a number of countries for replacement of halons and to examine their performance and capability against a number of typical applications in China, prototypes of such systems will be installed and tested at Tianjin Fire Research Institute.

The following systems will be covered by this project: Fast Response Sprinkler Systems, Low Pressure CO2 Fire Extinguishing System, Nitrogen/Argon Fire Extinguishing Systems and Fine Water Mist Systems. The necessary education and training will be carried out through national and regional seminars and training courses.

1. PROJECT OBJECTIVES:

The purpose of this project is to transfer technology by introducing and demonstrating a number of fire extinguishing systems which are used elsewhere as alternatives to halon fire extinguishing systems.

At present, China imports over 85% of halon 1301 from developed countries for fixed fire extinguishing systems. Due to the rapid economic development in China, the number of new halon systems installed is increasing rapidly. This means also that the dependency on imported halon 1301 is growing. It is therefore important that alternatives to halons are introduced as soon as possible, as it will no longer be possible to import halon 1301 in the future.

The project will also allow China to set up the necessary specifications and requirements for such systems utilizing the extensive research and development that has been carried out in USA and other countries. It will also allow China to import or produce the new systems.

2. SECTOR BACKGROUND:

China's halon consumption is presently 12.600 tons ODP, or more than 25% of the total CFC and halon consumption in China if the weighted ODP value of the ODS consumed in China is considered. At present only 60% of the total existing production capacity of halon 1211 is utilized. (ODP factor used: Halon 1211 = 3, Halon 1301 = 10).

Approximately 3.500 tons of halon 1211 and 10 tons of 1301 are produced annually in China by 13 to 18 factories, of which only 5 have a production of more than 300 tons yearly. An additional 5-700 tons of halon 1211 and 50 tons of 1301 is imported from developed countries annually (all figures for 1991).

2645 tons of halon 1211 are used for the production of approximately 1.2 million portable halon fire extinguishers produced annually by 80 factories in China. 355 tons of halon 1211 and 45 tons of halon 1301 are used for fixed installations, with halon 1211 installations produced by 25 factories.

600 tons of halon 1211 and 5 tons of halon 1301 are used by 900 servicing and maintenance companies in China.

Due to the recent rapid economic development in China, a large number of halon 1301 fire extinguishing systems have been imported and installed. Those systems are not included in the above figures, as they have been imported as "fire fighting equipment" and not as halons. They however will have an influence on the amount of halon 1301 used for service and maintenance in the future.

The Fire Bureau, Ministry of Public Security (MPS) is responsible for fire prevention, fire safety, fire fighting and licencing of the production of fire equipment, including halons, in China. It is also responsible for the national phase out program for the halon sector. The Provincial Fire Bureau authorities directly administer, monitor and control manufacturing and service and maintenance workshops in each province.

Through regulatory change and change of established practices for the use of halons, licencing of the production of halon based fire equipment and responsibility for phase out of halons in China, the MPS plays a major role in the sector. A phase out programme is under preparation to implement the country programme for this sector.

3. PROJECT DESCRIPTION:

In order to establish the necessary technical conditions for the transfer of technology covering alternatives to halon fire extinguishing systems, the project's main goal is to evaluate a number of alternatives to fixed halon fire extinguishing systems and their performance against typical uses for halon fire extinguishing system in China. The project will cover the following systems:

* Fast response sprinkler and circulating on-off systems (control valve).
* Water spray systems
* Low pressure CO_2 systems
* Mixed gases systems

Those systems are currently used instead of halon systems for protection of typical areas such as control rooms, computer rooms, stand-by generator rooms, engine and machinery rooms, storage of flammable liquids etc.

The project will be carried out by the Tianjin Fire Research Institute. The Institute is the main testing centre for fire extinguishing systems and has considerable experience in this field. The various systems identified for this project will be imported and installed in the fire test hall belonging to the Institute.

Tests will be carried out on each of these systems in order to obtain necessary information to understand and use existing standards and installation rules. If necessary, modifications will be made to meet Chinese conditions.

The Tianjin Fire Research Institute will establish four working groups, each consisting of four to six persons and responsible for one of following types of systems:

* Fast response sprinkler and circulating on-off (control valve)
* Water spray systems
* Low pressure CO_2 fire extinguishing systems
* Mixed gases (N_2, CO_2, Ar) systems

The project plan includes the following elements:

a) Identification of types of areas protected by halon fire extinguishing systems in China
b) Technical survey and collection of information on work carried out already
c) Installation of new systems
d) Test programme, including missions by foreign experts for technical assistance
e) Implementation, including set up of test procedures and specification of typical areas of application for each system.

The following time schedule has been established for the project:

4. TIME SCHEDULE:

Each of the four sub-projects will be carried out in parallel by the working groups.

For each of the sub-projects the following tentative time schedule has been established.

	Year 1	Year 2	Year 3
Collection of information			
Import and installation of demonstration systems			
Test set up and demonstration test			
Identification of field of uses			
Reporting			

5. PROJECT COST:

The overall budget includes the following inputs:

		Budget UNDP Fund USD	Budget Domestic Fund RMB
1.	Technical information collection	20,000	20,000
2.	Technology introduction* (import and installation)	225,000	190,000
3.	Set up of test procedure and demonstration test	60,000	180,000
4.	Identification and specification of field of uses	45,000	80,000
5.	Labor cost		40,000
	Total	350,000	510,000

A detailed budget for each of the sub-programmes is given in Annex 1.

* This budget includes technical assistance.

5. FINANCE PLAN:

Financed by the MLF:	US$	350,000
Financed by MPS:	RMB	510,000

6. PROJECT IMPLEMENTATION

The project involves critical preparatory work for substituting halon systems. When the project is completed, test procedures will have been established and the necessary technical background developed. Installation of new halon fire extinguishing systems will be banned. Only for applications where none of those alternatives and other already used alternatives are applicable, halon systems can be installed.

Annex 1, p1

1. Fast response sprinkler systems and on-off systems

		Budget	
		UNDP Fund USD	Domestic Fund RMB
1.	Technical information collection	5.000	5.000
2.	Technology introduction (import and installation)	60.000	60.000
3.	Set up of test procedure demonstration test and misc.	15.000	30.000
4.	Identification and specification of field of uses	15.000	30.000
5.	Labor cost		10.000
	Total	95.000	145.000

2. Water spray system

		Budget	
		UNDP Fund USD	Domestic Fund RMB
1.	Technical information collection	5.000	5.000
2.	Technology introduction (import and installation)	50.000	50.000
3.	Set up of test procedure demonstration test and misc.	15.000	50.000
4.	Identification and specification of field of uses	10.000	20.000
5.	Labor cost		10.000
	Total	80.000	135.000

Annex 2, p2

3. Low pressure CO_2 fire extinguishing systems

		Budget	
		UNDP Fund USD	Domestic Fund RMB
1.	Technical information collection	5.000	5.000
2.	Technology introduction (import and installation)	50.000	50.000
3.	Set up of test procedure demonstration test and misc.	15.000	50.000
4.	Identification and specification of field of uses	10.000	20.000
5.	Labor cost		10.000
	Total	80.000	135.000

4. Mixed gases (N_2, CO_2, Ar) fire extinguishing systems

		Budget	
		UNDP Fund USD	Domestic Fund RMB
1	Technical information collection	5.000	5.000
2.	Technology introduction (import and installation)	50.000	40.000
3.	Set up of test procedure demonstration test and misc.	15.000	50.000
4.	Identification and specification of field of uses	15.000	20.000
5.	Labor cost		10.000
	Total	85.000	125.000

MONTREAL PROTOCOL

TRAINING and TECHNOLOGY DISSEMINATION

PROJECT COVER SHEET

COUNTRY:	Ecuador
PROJECT TITLE:	Training and Technology Dissemination
ODS CONSUMPTION:	570 t (1992 estimate)
PROJECT DURATION:	1 YEAR
TOTAL PROJECT COSTS:	US$ 250,000
PROPOSED GRANT:	US$ 150,000
LOCAL CONTRIBUTION:	In kind: office space
NATIONAL EXECUTING AGENCY:	Ministry of Industries
IMPLEMENTING AGENCY:	UNDP
APPRAISAL DATE:	March 1993

ECUADOR

MONTREAL PROTOCOL

Training and Technological Dissemination

BACKGROUND

1. Ecuador ratified the Montreal Protocol (MP) on Substances that Deplete the Ozone Layer on April 30, 1990. In March 1991 the country began preparation of its Country Program (CP) for implementing the Protocol with the assistance of the World Bank and the U.S. EPA. The CP was submitted to and approved by the Executive Committee during its March 1992 meeting. Under the Protocol, Ecuador is required to phase out production and consumption of CFCs, halons, and carbon tetrachloride by the year 2010 and methyl chloroform by the year 2015. However, in line with the country's overall commitment for environmental protection, the CP proposes to accelerate phasing out the substances controlled under the MP to the year 2000, thus waiving the grace period which Ecuador is permitted as a Party operating under Article 5 of the Protocol.

2. Ecuador imports all of the ODSs to meet domestic needs and depends on external sources for innovations in existing technology. In 1990 the country consumed approximately 723 metric tons of CFCs, halons, methyl chloroform, and carbon tetrachloride. Weighted by the ozone depleting potential (ODP) of each substance total consumption in 1990 amounted to 742 t. Of this total, consumption of CFCs accounted for 94 percent (694 t) and was distributed in five end uses: aerosols 464 t (67 percent), refrigeration 134 t (19 percent), foams 58 t (8 percent), air conditioning 19 t (3 percent), and miscellaneous uses 19 t (3 percent). In addition, 45 t of halons were used as fire extinguishing agents, 1 t of methyl chloroform for solvent cleaning, and 2 t of carbon tetrachloride for miscellaneous applications. Since 1990 there has been a reduction of CFC use in the aerosol sector because some manufacturers introduced carbon dioxide (CO_2) as a substitute propellant in response to ozone depletion concerns. However, CO_2 is effective in only a few products and is not a long term replacement for CFCs. Total use of CFCs in the aerosol sector in 1992 is estimated at about 290 t. Thus, total 1992 use for all sectors is estimated at 568 t.

3. The CP includes an action plan which comprises two phases. The first phase covers the period January 1993 through December 1995 and entails the following activities: i) establishment of the legal, institutional, and policy framework; ii)introduction of technological improvements to reduce use of 316 t of ODSs in the sectors dealing with aerosols (290 t) and with rigid foams (26 t); and iii) implementation of a training and information dissemination component to be executed by UNDP. The second phase includes reduction in all remaining industries (flexible foams, refrigeration, air conditioning, and solvents) leading to additional annual reductions of 252 t of ODSs, thus, completing a total phase out by the year 2000.

4. **Institutional Capacity.** There is no institution in Ecuador dealing with the use of substances that deteriorate the ozone layer. Presently there is no central official entity responsible for overall environmental protection. Issues dealing with pollution problems in general are usually dealt on a project by project basis by pertinent sectoral ministries. However, not all sectors are covered since only the ministries of Health, Energy, and Public Works have

established environmental units within their organizational structure. The main constraints preventing other ministries from active participation in solving their sectoral environmental issues are inadequate budgetary allocation and lack of trained staff in environmental protection and impact assessment.

5. To comply with the stipulations of the Protocol and the activities proposed in the CP, GOE designated the Ministry of Industries, Commerce, and Fisheries (MICIP) by to be the leading implementing and coordinating entity (Presidential Decree signed on April 28, 1992). For this purpose MICIP authorities has decided to establish under the Industries Directorate a small unit to be responsible for implementing the activities proposed in the CP (MPPU). Three professionals and one support staff have already been designated for this unit. However, MICIP has no previous experience with MP technical and administrative issues, thus, a training program is needed for the unit's staff. Moreover, during project preparation it has been evident that industries working with ODSs have little access to up-to-date information dealing technological alternatives to reduce use of these substances. Thus, dissemination of information to private sector industries and ultimately to the final consumers would be imperative for successful implementation of the CP.

The Project

6. Objectives. The main objective of the project would be to organize training activities for the MPPU's staff, for members of other public entities interested in elimination of ODSs such as the Ministry of Health and local municipalities, for representatives of pertinent industries and for the public in general.

7. Features of the Training and Dissemination Program. Training activities would consist of a series of conferences, seminars and workshops to be held in the three main cities (Quito, Guayaquil, and Cuenca) where most industries using ODSs are located. Because of lack of local expertise, external specialists would be recruited for events dealing with technical aspects of the phaseout program. The logistic organization of these events would be contracted out to experienced local private firms. The program would be supplemented with the preparation of printed material, and with films and videos. It has been envisaged that the entire process of design, production and implementation of the program would be completed in about one year.

8. Executing Agency. The project would be executed by MICIP's MPPU under the coordination and guidance of the UNDP office in Quito. An operational agreement between the two entities has already been approved. A training coordinator has been jointly designated and one of the MPPU's staff would act as counterpart to the coordinator on a part-time basis. Both would report directly to the Director of Industries (DI) who would act as counterpart to UNDP's project officer. Training strategy and needs would be identified jointly by the coordinator and members of the MPPU and approved by DI and UNDP's project officer.

9. Justification. Because of MICIP's lack of previous experience in MP operating principles and guidelines, the success of the technological conversion sub projects, and the efficient use of grant funds would depend to a large extent on the ability and capacity of MICIP to provide technical assistance to enterprises interested in participating in the Government's program to phase out ODSs.

10. Project Beneficiaries. In the immediate and medium term the main beneficiaries would be MICIP's MPPU's staff and officials of other pertinent public sector entities, members of private sector industries interested in participating in the CP's first and second phase, and ultimately the public in general.

11. Training Coordinator Functions. The main functions would be the identification of training needs, identification, selection, and recruitment of technical experts for training events, selection and contracting of firms to be responsible for the organization and execution of training events and for the preparation of printed and electronic dissemination material, for evaluation of the effectiveness of training activities, and for reporting progress to executing agencies and to the ExCom.

12. Project Costs and Budget. Training estimate costs shown in the CP (US$100,000) were under estimated because of insufficient data available at the time of initial program formulation. However, during project preparation a detailed revision of the proposed program, carried out jointly by UNDP and the Bank, revealed that actual total cost required to design and implement a training and technological dissemination program would be $250,000. This amount represents the entire incremental cost for which a grant is requested. Table 1 attached shows detailed budget costs of the proposed program.

Table 1

ECUADOR

MONTREAL PROTOCOL

PHASE 1

TRAINING AND TECHNOLOGY DISSEMINATION

Total Estimated Cost
(US$)

Item		Unit Cost	Total
Refrigeration Expert	(fees and travel expenses)	10,000	10,000
Aerosols Expert	(" " ")	10,000	10,000
Foams Expert	(" " ")	10,000	10,000
Secretary	(salary one year)	4,000	4,000
Training Coordinator	(salary one year)	10,400	10,400
Translations		5,000	5,000
Internal travel		8,000	8,000
	Sub total	57,400	57,400
Service Contracts:			
Organization of seminars/workshops (6)		6,000	36,000
Preparation and Presentation of Audio/visual dissemination programs (4)		32,000	128,000
Equipment Purchase:			
Word Processor, printer, projector		6,600	6,600
Equipment Maintenanace		5,500	5,500
Materials for Seminars		9.500	9,500
Internal/External communications		7,000	7,000
	Sub total	66,600	192,600
	TOTAL	124,000	250,000

PROJECT COVER SHEET

COUNTRY:	Malaysia
PROJECT TITLE:	Elimination of CFC-12 in the manufacture of extruded polystyrene foam sheet at Jumaya Industries
SECTOR COVERED:	Foamed Plastics
ODS USE IN SECTOR:	600 CFCs (722 tons ODS) in 1991
PROJECT IMPACT:	150 TONS CFC-12 per year, based on 1991 consumption
PROPOSED BUDGET:	USD 254,000
IMPLEMENTING AGENCY:	UNDP
COORDINATING AGENCY:	Malaysia Department of Environment (DOE)

PROJECT SUMMARY

Jumaya Industries SDN BHD ("Jumaya") is one of Malaysia's three manufacturers of extruded polystyrene foam sheet (EPS). Its products are aimed at the food service market. The company is a private sector enterprize.

CFC-12 was until recently used in the production process. Under this project, Jumaya will eliminate the use of CFCs in this process through replacement by initially liquified petroleum gas (LPG), followed--as soon as locally available--butane, resulting in an annual reduction of 150 tons ODS, based on 1991 consumption. The project contains safety features to address the hazards generated by the use of a flammable substance.

The company expects no significant change in the incremental operating costs. LPG--an interim solution until butane will be available-- would theoretically lead to significant savings, but causes process and quality problems that negate the effect of the lower material costs. A price for butane could not be established as this product is currently not offered in Malaysia. Based on the international market price (about USD 1.50/kg), no or insignificant incremental costs are expected.

PROJECT OF THE GOVERNMENT OF MALAYSIA

ELIMINATION OF CFCs IN THE MANUFACTURE OF EXTRUDED POLYSTYRENE FOAM SHEET AT JUMAYA INDUSTRIES SDN BDH.

1. PROJECT OBJECTIVE

The objective of this project is to phase out the use of CFCs in the manufacture of extruded polystyrene foam sheet (EPS) at Jumaya Industries SDN BDH ("Jumaya").

2. SECTOR BACKGROUND

The CFC consumption in the foam sector in Malaysia is estimated to have reached at least 600t in 1991. This is about 8% of the total ODS and 7% of the Malaysian ODP generation. CFC-11 (polyurethane foams) and CFC-12 (polystyrene and polyethylene foam sheet) are the dominant substances in this sector, with much smaller usage of MCF, CFC-114 and CFC-115.

3. ENTERPRIZE BACKGROUND

Jumaya Industries was established in October 1989 by Juraya Enterprises. It operates a production facility for extruded polystyrene foam sheet (EPS) in Johore, Malaysia. Similar facilities are operating in China and Indonesia, in joint venture with local enterprises. EPS is predominantly used in products for the food industry, such as meat trays, lunch boxes, egg trays, etc. The company utilizes in Johore two modern extruders from Nakamura, Japan. Production in 1991 was about 1000 t EPS.

4. PROJECT DESCRIPTION

Jumaya utilized in 1991 about 150 t CFC-12 in the manufacture of EPS foam sheet. The companies board committed in May 1992 to phase out the use of CFCs, identifying butane as the replacement of choice. Butane technology is available through original equipment manufacturers. In general, it is possible to adapt existing equipment for this purpose. In addition to equipment changes, safety related modifications in the production environment have to be implemented, to mitigate fire and exposure hazards from the use of butane. Finally, extensive production and safety training is needed to guarantee a smooth and safe operation and to conform to the strict fire safety standards in Malaysia.

The company submitted a project proposal in October 1992 to the DOE. The project faced one problem: butane is currently not available in the Malaysian market. The company decided not to wait, but to start-up utilizing LPG, available in the local market as a mixture of predominantly C-3 (28%) and C-4 (71%). Processing and the resulting quality is however insufficient, and the company remains attempting to source a butane supplier.

5. TECHNOLOGY

5.1 SELECTION

There are several options to replace CFCs in the production of EPS foam sheet, such as:

- o Nitrogen gas,
- o CO_2 gas,
- o Hydrocarbons,
- o "Berstorff" technology (nitrogen and alcohol),
- o HCFC-22,
- o HCFC-142b,
- o HFC-134a,
- o HFC-152a,
- o Liquified petroleum gases (LPG).

A summary of these technologies, their potentials and their limitations is provided in annex-A. Butane is selected by the company as an alternative that is:

- o Proven technology in processing and product performance,
- o Environmentally acceptable,
- o Low in toxicity,
- o Adaptable to the existing equipment,
- o Cost effective.

Butane is not locally available, and the company therefore decided to utilize LPG, expecting similar results and lower costs. The problems in processing and quality are however significant and the product is not universally accepted in the food industry. It is therefore anticipated to turn to butane as soon as a producer can be located. With other companies in Malaysia and Indonesia facing the same needs, future local availability of butane is expected.

A draw back of LPG and butane is the high flammability, requiring stringent safety precautions.

Users of LPG (and for that matter butane) are subject to stringent fire regulations, including the appointment and training of company safety experts for every shift. The emission of LPG and butane is not regulated in Malaysia, nor are restrictions expected in the foreseeable future.

5.2 PRODUCTION PROCESS

The use of LPG or butane will require substantial changes in the production process and storage facilities.

Required equipment modifications and additions may include:

- Storage
  - Separate, explosion proof storage of the butane tank.

- Feeding systems
  - More injection systems for additives,
  - Replacement of the foamant metering pump and injection system,
  - New gaskets and seals.
  - New pressure gauges

- Extrusion system
  - Replacement or modification of the screw,
  - Replacement or modification of the extrusion die.

- Electrical systems
  - Installation of spark arresters,
  - Sealing of electrical control cabinets,
  - Explosion proof motors and switches.

- Auxiliary safety devices
  - A ventilation system to prevent the accumulation of hydrocarbon vapors,
  - Monitoring and alarm systems for hydrocarbon vapors,
  - Extra fire extinguishers.

Production and aging areas are to be separated from other working areas and to be sprinklered or otherwise protected against fire hazards.

production and maintenance personnel has to be trained in the safe handling of hydrocarbons, in addition to production training.

Start-up trials will be necessary to adjust for foamant volume and permeability.

Jumaya was able to source a manufacturer from Taiwan ("New One Machinery Co Ltd") that offers an extraordinary competitive modification package for any machine brand (Jumaya operates Nakamura equipment). The price offered is only about one third of that offered by the original manufacturer and comparable European/US manufacturers. Jumaya checked the quality of the results achieved by this company at previously modified plants, and they appeared to operate satisfactory. "New One Machinery" was therefore selected, in conjunction with local suppliers for tanks and safety equipment. An extensive monitoring program on hydrocarbon gas concentrations around all critical equipment is foreseen, and some contingency money is earmarked for any adjustment to be made (i.e. additional explosion proof motors).

The production process is already separated from other working areas. Additional space is rented to accommodate a separate an enlarged aging area. Hydrocarbon gas and temperature alarm systems will be installed through the whole plant. The tank area is sprinklered, however, no sprinkler could be installed in the production building, based on the local water supply (too low pressure). Instead large fire extinguishers will be staged at all critical places, portable fire extinguishers will be placed at every entrance and thorough initial and follow up fire safety training will be implemented. Production and maintenance personnel are also trained in the safe handling of hydrocarbons, in addition to production training.

Start-up trials are made to adjust for the different foamant volume and permeability. The start-up was supervised by supplier personnel[1].

6. PROJECT COSTS

6.1 Total Project Costs

The following is a summary of the expected and experienced costs of investment and related activities (the numerical identification system originates from UNDP's Office of Project Services, and is utilized to facilitate later procurement):

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[1] The thorough preparation and comparative low costs of modification--even if adjusted for local labor costs and favorable facility conditions--has generated high interest at UNDP. The company has agreed to share a photo documentation that was made during the installation and training. The consequences of a successful completion of this project could be significant lower cost estimates for future projects. Also, Jumaya did **not** pay for know-how, a significant budget item in previous projects. This confirms UNDP,s opinion that the hydrocarbon technology is no proprietary technology, and, given sufficient competition, should not induce know-how costs.

ITEM	DESCRIPTION	SUBTOTAL (USD)	TOTAL (USD)
2100	**Storage Tanks**		**17,658**
	Purchase	10,506	
	Testing	1,751	
	Installation	5,401	
2100	**Equipment Modification**		**116,707**
	Machine 1	68,517	
	Machine 2	42,108	
	Installation	6,082	
2100	**Fire Safety Systems**		**59,546**
3200	**Training**		**16,000**
	Abroad	6,000	
	In House	10,000	
5300	**Permits**		**6,000**
5306	**Contingency and Rounding**		**38,089**
9906	**TOTAL**		**254,000**

Supporting documentation is provided in annex-B and -C.

6.2 OPERATING COSTS

The price of LPG is considerable lower than CFC-12:

CFC-12	USD 2.09
LPG	USD 0.36

These prices reflect the status at October 1992, date of project submission, and are documented in annex-D. Prices fluctuate significantly, and are slightly different for individual companies. Butane is currently not available in the Malaysian market. International price level is about USD 1.50/kg.

The use of hydrocarbons requires addition of an anti-shrinkage and a static-dissipative agent. Costs are assumed at USD 30/ton resin, or--given a resin use of 1,000 tons for 1991--USD 0.20 per kg blowing agent. 1 : 1.2 replacement in the case of LPG and 1 : 1 replacement in the case of butane is assumed. This amounts to an expected annual decrease in material costs of:

USD 259,500 for LPG, or
USD 88,500 for butane.

This has to be held against higher costs in maintenance, rent, insurance, safety monitoring and ongoing safety training. These costs are estimated on USD 112,467/y and specified in annex-D.

Assuming butane to be the ultimate choice of replacement and the currently intangible effects of LPG on processing, quality and sales, no recurring costs nor benefits in this project are projected.

6.3 UNIT ABATEMENT COST

a)	ODS Reduction Project Costs	**USD 254,000**
b)	Annual Incremental Costs	**USD -,-**
c)	Project Useful Life	**7 years**
d)	ODS reduction/y	**kg 150,000**
	Unit Abatement Costs [(a/c + b)/d]	**USD/kg/y 0.24**

.34 x

7. FINANCING PLAN

The company requests the reimbursement of the complete project costs estimated on

USD 254,000

8. PROJECT IMPLEMENTATION

8.1 MANAGEMENT

The project is already substantially implemented by the company. UNDP-OPS will oversee the completion of this project, UNDP-ENR will provide technical assistance.

8.2 SCHEDULE

Implementation schedule started with Jumaya Board approval of the installation of CFC-free technology (May 1992), and will end after monitoring has confirmed that at no place on the machine or in the working area unsafe levels of hydrocarbons can be detected.

TASK	TIME FOR COMPLETION					
	Q2	Q3	Q4	Q1	Q2	Q3
1. Preparation						
Board Approval	x					
Visit Vendor		x				
Order Confirmation		x				
2. Installation						
Arrival, Customs			x			
Machine Modifications			x	x x		
Tank Installation				x		
Safety Devices				x x	x	x
3. Start-up, Training						
Machine Start-up				x	x	
Safety Training				x	x	x

8.3 PROCUREMENT

The company has procured the project. UNDP's Office for Project Services (OPS) will review this procurement. OPS expects at the about the same time to procure three identical projects, resulting in procedural and cost efficiencies. OPS will be assisted by the local UNDP office as well as DOE, and receive technical assistance from UNDP-ENS.

9. PROJECT IMPACT

This project will eliminate the use of at least 150 tons of CFCs in the first year of implementation. Market and company growth indicates that this may increase by 5-10% annually in subsequent years. The project employs commercially and environmentally acceptable technology.

10. ANNEXES

Annex A: Overview of CFC Phase out Technologies in the Manufacture of Polystyrene and Polyolefine Foams
Annex B: Detailed budget proposals
Annex C: Price documentation
Annex D: Detailed calculation of recurring costs

ANNEX-A

CFC REPLACEMENT IN THE MANUFACTURE OF POLYSTYRENE AND POLYOLEFINE FOAMS

CFCs in polyurethane foams function generally only as auxiliary blowing agents. This is not the case in polystyrene (PS), polyethylene (PE) or polypropylene (PP) foams. These foams use solely physical blowing agents. Criteria for such blowing agents are:

- solubility in the resin,
- worker safety (flammability, toxicity),
- consumer safety (toxicity),
- thermal and chemical stability,
- diffusivity,
- environmental impact.

CFC-11, CFC-12, CFC-114 and hydrocarbons have been traditionally used as blowing agents (1), with CFC-12 being in most cases the agent of choice. Significant non (thermal) insulation varieties of these foams include:

- extruded sheet,
- extruded plank,
- moldable beads.

A wide variety of options have been proposed so far to replace CFCs in PE/PP and PS foams. They can be categorized as follows:

- Atmospheric gases,
- Hydrocarbons,
- HCFCs, and
- HFCs.

1. ATMOSPHERIC GASES

Nitrogen Gas

Inert, nontoxic and noncombustible, but asphyxiant. The use is burdened by a low solubility in the resin and a relatively high density of the end product. New resin developments may make the use of nitrogen a more viable option in the future.

The Berstroff Technology is based on a mixture of nitrogen and alcohol. This technology exhibits undefined risks in toxicity and fire. The resulting product has also a higher density. So far as known, it has only been applied in extruded PS sheet.

Carbon dioxide gas

An asphyxiant, high energy consuming and moderately toxic gas. Carbon dioxide is a reportedly proven technology in polystyrene foam sheet (2). The poor solubility in polyolefine resins restricts the use in PE/PP foams at this time. Certain uses of CO_2 in extruded PS sheet are patented, and require licensing.

2. Hydrocarbons

<u>N-pentane, butane, isopentane and isobutane</u> are proven replacements, in polystyrene and polyolefine products (1,3). The technology is cost effective and results products of acceptable quality. However, the flammability of hydrocarbons requires stringent safety precautions in the manufacturing process. This results in sizable investments in retrofitting. In addition, hydrocarbons are photochemically reactive and contribute to the formation of atmospheric ozone (smog).

<u>Liquified petroleum gases (LPG)</u> have also been proposed as replacement for CFCs in PE/PP and PS foams. LPG is,however toxic, flammable and not accepted for food packaging.

3 HYDROCHLOROFLUOROCARBONS

<u>HCFC-22</u>

Non-flammable, low in toxicity, high thermal and chemical stability, HCFC-22 has been proven effective (3,4) as a sole replacement (extruded PE/PS sheet) or in combination with HCFC-142b (extruded PS board). The compound has however an ODP, and only qualifies as an interim replacement.

<u>HCFC-142b</u>

Alone or in combination with HCFC-22, this compound represents a preferred option in thick sheet and plank applications (1,5). The price penalty is, however, considerable and equipment has to be modified to cope with the moderate flammability and the modified diffusivity of the compound.

4 HYDROFLUOROCARBONS

<u>HFC-134a</u>

Non-flammable, low toxicity and with no ODP, HFC-134a is just recently introduced in the market. The current pricing will prevent utilization in the very cost sensitive food serving and packaging applications. The utilization of HFC-134a in foams competes with the utilization as a refrigerant in appliances and automotive air conditioners.

<u>HFC 152a</u>

HFC-152a is low in toxicity, moderately flammable and possesses no ODP. It appears to be a likely long term alternative for CFCs in extruded polystyrene sheet (1,5). In polyolefine applications poor solubility and diffusivity has to be overcome before such a statement could be made. The compounds flammability will require extensive modifications of production equipment.

In summary, it can be concluded that technologies allowing immediate replacement of CFCs in polystyrene and polyolefine foams are available. Some of these technologies have an interim character. Others show promise as long term solutions, but are currently cost prohibitive for highly competitive applications such as food packaging.

5. REFERENCES

1. Montreal Protocol, "1991 Assessment, Flexible and Rigid Foams, Technical Options Committee.
2. Welsh, Gary C., European Patent Application, Date of filing: January 8, 1990>
3. "HCFC-22 as a Blowing Agent for Polystyrene Foam Packaging," Summary from Du Pont, Wilmington, USA, 1992.
4. Du Pont, Bulletin E-95698, "manufacture of Polystyrene Foam Sheet Using Formacel S-Food Grade Blowing Agent," 1990.
5. Du Pont, Bulletin ABA-5, "Alternative Blowing Agents for Thermoplastic Foams," 1990.

Annex B1.

Table III

BUDGET

Malaysia : Estimated cost for the conversion of CFC 12 to LPG (Butane)

Sub-Project I	Estimated Cost	Actual Cost
1) 2 x 7.5KL LPG storage tanks from Esso	US$ 10,800-00	US$ 10,506-00
2) Rehydrostatic test, repainting & tank	US$ 1,920-00	US$ 1,751-00
3) Civil work, piping & instn	US$ 27,080-00	US$ 5,401-00
4) Modification of machinery (1st unit) and accessories with expert consultation	US$ 30,800-00	US$ 68,517-00
5) Expenses for the Taiwanese during their stay in M'sia	US$ 4,000-00	US$ 6,000-00
6) Fire safety system	US$ 24,959-00	US$ 44,446-00
7) Others : Approval from Bomba, Local Authority, Fire Alarm System Electrical Work to LPG Pump and fan fitting	US$ 6,000-00	US$ 6,000-00
8) Expenses for training of two executives in Taiwan for a duration of one month	US$ 4,000-00	US$ 6,000-00
Total	US$109,559-00	US$148,621-00
Sub-Project II		
1) Modification and alteration of machinery (Unit 2) with Accessories from Taiwan	US$ 24,000-00	US$ 42,108-00
2) Civil work, Piping & instn	US$ 12,000-00	US$ 6,082-00
3) Expenses for Taiwanese duringtheir stay in Malaysia	US$ 2,400-00	US$ 4,000-00
Total	US$ 38,400-00	US$ 52,190-00
Grand Total :	US$147,959-00	US$200,811-00

145 ß - 1.125 ß = 2.58 MB

ANNEX-B/II

JUMAYA INDUSTRIES
BUDGET

o	Original budget (Annex-B/I)	USD 200,811
o	Additions per UNDP advice	USD 15,100
	o Portable hydrocarbon detector ... USD 6,300 o Extra fire extinguishers USD 6,800 o Blow-down fans ... USD 2,000	
o	Contingency	USD 38,089
	TOTAL	USD 254,000

Annex-C

5-5-1993

BUDGET

Sub-project 1.

	MALAYSIAN RINGGIT	U.S. DOLLARS
1) 2 x 7.5 KL LPG storage tanks from ESSO	$ 27,000.00	$ 10,506.00
2) Rehydrostatic test + repainting of Tanks	$ 4,500.00	$ 1,751.00
3) Civil work, piping + installation	$ 13,881.60	$ 5,401.00
4) Modification of machinery (first mill) + accessories with expert consultation etc.	$ 158671.10 12263.00 5170 176090.10	$ 61,740.00 68517.50
5). Fire Safety system	$ 105997.00 (114277)	$ 41,244.00 44446.00
6) Expenses for the Taiwanese during (Air ticket) their stay in Malaysia	= 21354 (US 8309)	
7/ Others : Approval from Bomba, local Authority, Fire alarm system, Electrical work to LPG pump + tank fitting		6000.00
8/ Expenses for training of two ~~personnel~~ executives in Taiwan for a duration of 1 month.		6000.00
Total =		

Sub-project II.

	MALAYSIAN RINGGIT	U.S DOLLARS.
1) Modification of machinery (unit two) & accessories with expert consultation etc.	$ 62885.40 45332.00 108217.4	$24,469.00 42108.00
2) Civil work, piping & installation.	12350 + 1520 1759.60 15630	6088.00
3) Expenses for the Taiwanese during their stay in Malaysia		
TOTAL =		

GRAND TOTAL = US$ ________

$1 US = $2.57 R.

5-5-1993.

BUDGET.

Malaysia.. Estimated cost for the conversion of CFC-12 to LPG.

Sub-Project I.

1) 2 × 7.5 KL LPG storage tanks from ESSO US$ 10,800.00. ($27000

2) Rehydrostatic test, repainting of tanks. = 4500

3) Civil work, piping & installation = ($1759.60 + 1197.00 + 1500 + 3250 + 35750.00 + 26000 = 13881.6.

4) Modification of machinery (first unit) ~~= 9800~~

& accessories with expert consultation etc

(~~US$ 24469~~ 50300 (unit ①) + 50 + 150 + 200 + 400 + 330 + 5483.00 + 1937.70 + 1600 + 1610.40 + 2484.00 + 238.00 + 9800 + 3352 + 110. + 470 + 120 + 3900 + 1700 + 2500 + 280 + 56600 + 150 + 750 + 780 + 400 + 2609 + 150 + 1440 + 200 + 5900 + 770 + 1760)

5) Fire safety system = ($27000 + 2565.00 + 700 + 44000 + 2565.00 + 9800 + 37 + 220 + 110 + 19.000 (105001) (22030.)) → (114227)

(4500) + → ~~Allied~~

158671.1

Expenses = 2454 + 1274 + (3100 MR). (1556 MR) (2892 MR). (S) (3178 MR). (4600 MR).

(S1) (3902) (2026)

Unit 2 = US$ 24469

Modif. (45.332)

① (122 49 MR.)

~~$169~~ 5170 MR).

US$ 145111 +

Table III

BUDGET

Malaysia : Estimated cost for the conversion of CFC 12 to LPG (Butane)

	PROJECTS	ESTIMATED COST	ACTUAL COST
	Sub-Project I		
1)	2 x 7.5KL LPG storage tanks from Esso	US$ 10,800-00	10,506.00
2)	Rehydrostatic test, repainting & tanks	US$ 1,920-00	1,751.00
3)	Civil work, piping & installation Regal Elite. Tac Air.	US$ 27,080-00	5,401.00
4)	Modification of machinery (First Unit) and accessories with expert consultation etc.	US$ 30,800-00	61,740.00 (68517.00)
5)	Expenses for the Taiwanese during their stay in Malaysia PL Eyr.	US$ 4,000-00	6000.00
6)	Fire safety system ← Heat detector, Gas ", Trunking / fan	US$ 24,959-00	41,244.00 (44446.00)
7)	Others : Approval from Bomba, Local Authority, Fire Alarm System, Electrical Work to LPG Pump and tank fitting	US$ 6,000-00	6000.00
8)	Expenses for training of two ~~personnels~~ executives in Taiwan for a duration of one month	US$ 4,000-00	6000.00
	Total	US$109,559-00	
	Sub-Project II		
1)	Modification and alteration of machinery (Unit Two) with accessories from Taiwan	US$ 24,000-00	24,469.00 (42108.00)
2)	Civil work, piping and installation (ph II)	US$ 12,000-00	6082.00
3)	Expenses for the Taiwanese during their stay in Malaysia	US$ 2,400-00	4000.00
	Total	US$ 38,400-00	
	Grand Total :	US$147,959-00	

2-98500

ESSO MALAYSIA BERHAD

(Incorporated in the States of Malaysia)

FORM 830-03
REV. MAY 1974

OFFICE LHF DIV/KL DATE 21/10/1992.

JUMAYA INDUSTRIES SDN BHD
7, JALAN KILANG
DATO ONN INDUSTRIAL ESTATE
80350 JOHORE BAHRU

DEBIT NOTE № 11587

YOUR ACCOUNT HAS BEEN DEBITED WITH THE FOLLOWING

PARTICULARS	ACCOUNTING CODE	AMOUNT
SALE OF 2x7.5KL BULK LPG TANKS, PMT NOS	CR MIO -748 -100	$27,000.00
46557 AND 46558		✓
(RINGGIT TWENTY SEVEN THOUSAND ONLY)		
DR MIO — 188 — 100 (2-985-4-77-1-11587)		

ESSO MALAYSIA BERHAD

BY

Sub project ?

Storage Tanks

ESSO MALAYSIA BERHAD

August 5, 1992

Jumaya Industries Sdn Bhd
7, Jalan Kilang
Dato Onn Industrial Estate
80350 Johore Bahru
Johore

In reply please refer to:
57 (IBS)

Sale of bulk LPG tanks

Attention: Mr. S.H. Ko

Tuan,

We thank you for your acceptance to purchase 2 x 7.5KL bulk LPG tanks, PMT Nos. 46657 and 46658, currently stored at Kosel Industries, Prai at M$13,500.00 each. x 2 = M$27000

Please be advised that as our sale is on "as is where is" basis, all reconditioning works on the tanks will be at your own cost.

Enclosed herewith please find a set of Agreement for your signature. Please return them for our subsequent execution and stamping.

Very truly yours,

Zakaria Mohd Nor
LPG Home Fuels Manager

cc: Kosel Industries Sdn Bhd
Lot 246, Lorong Perusahaan 10
Kawasan Perusahaan Perai
13600 Perai, Penang
Attn: Ir. Tan Kim Seng

10 AUG 1992

KOSEL

KOSEL INDUSTRIES SDN. BHD.
2586, Lorong Perusahaan 10,
Kawasan Perusahaan Perai, 13600 Perai, Penang, Malaysia.
Tel: 04-397201 Telefax: 04-397200

PB020.

INVOICE

JUMAYA INDUSTRIES SDN. BHD.
7, JALAN KILANG, DATO ONN
INDUSTRIAL ESTATE, 80350
JOHOR BAHRU, JOHOR.
ATTN:MR.KOH SWEE HEE

No. 0997

DATE: 01/01/93

ORDER DATE	CUSTOMER ORDER NO.	DELIVERY ORDER NO.	TERMS
12/08/92	-	1745	CASH

DESCRIPTION OF GOODS	QUANTITY	UNIT PRICE	AMOUNT
To cost of supplying labour and necessary equipment for rehydrostatic test witness by JKJ and repainting two units 7.5KL used LPG storage tank owned by ESSO. Our scope change of tank fittings and delivery to Johor, loading crane is inclusive in our offer.			
Total Lump Sum :-			RM 4,500.00
Ringgit : Four Thousand Five Hundred Only			
Ref: Our quotation fax ref. KS10808 dated 28/07/92 and your fax ref. JI/GC/F92/8-187 dated 12/08/92.			

Rehydrostatic
Sub project I
2)

Date 27 JAN 1993	
G. M.	
Fty Manager	
Asst. Manager	
Secretary	
A/C Dept.	

KOSEL INDUSTRIES SDN. BHD.

21

ELPIJI (M) SDN. BHD.

8, Jalan SS 25/22, Taman Mayang, 47301 Petaling Jaya, Selangor Darul Ehsan, Malaysia.
Tel: 03-7031377, 7031378, 7031379. Telex: MA 36788 ELPIJI Fax: 03-7031333, 7031372.

Customer Copy

Date 17 DEC 1992		
G. M.		
Fty Manager		
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

PB76.

INVOICE

NO: 4642

ATTN. : MR. KO SWEE HEE

JUMAYA INDUSTRIES SDN BHD
7, JALAN KILANG
DATO ONN INDUSTRIAL ESTATE
80350 JOHOR BAHRU
JOHOR.

Date: 09/12/92
Page: 1
TEL NO. : 07-369834

ORDER DATE	PURCHASE ORDER NO	DELIVERY ORDER NO	TERMS
09/12/92			30 DAYS

NO.	DESCRIPTION OF GOODS	QUANTITY	UNIT PRICE	TOTAL
	TANK FITTING FOR 2 NOS OF TANK			
	EXCESS FLOW VALVE REGO A3282C (FOR LIQUID OUTLET & FILLING LINE).	4	110.00	440.00
	EXCESS FLOW VALVE REGO 3272G (FOR SPARE POINT).	2	35.25	70.50
	CHECK-LOCK EXCESS FLOW 7580FC (FOR DRAIN LINE).	2	63.55	127.10
	ADAPTOR REGO 7572C-15A (FOR DRAIN LINE).	2	33.00	66.00
	GLOBE VALVE REGO A7505AP (FOR DRAIN LINE)	2	208.00	416.00
	5" DAIL THERMOMETER	2	320.00	640.00
	RINGGIT ONE THOUSAND SEVEN HUNDRED AND FIFTY NINE AND CENTS SIXTY ONLY			

ELPIJI (M) SDN. BHD.

E. & O.E.

TOTAL $1,759.60

Sub project I

ELPIJI (M) SDN. BHD.

8, Jalan SS 25/22, Taman Mayang, 47301 Petaling Jaya, Selangor Darul Ehsan, Malaysia.
Tel: 03-7031377, 7031378, 7031379. Telex: MA 36788 ELPIJI Fax: 03-7031333, 7031372.

Customer Copy

PB76.

INVOICE

NO: 4639

ATTN. : MR. KO SWEEN HEE

JUMAYA INDUSTRIES SDN BHD
7, JALAN KILANG
DATO ONN INDUSTRIAL ESTATE
80350 JOHOR BAHRU
JOHOR.

Date: 08/12/92
Page: 1
TEL NO. : 07-369834

ORDER DATE	PURCHASE ORDER NO.	DELIVERY ORDER NO.	TERMS
08/12/92			30 DAYS

NO.	DESCRIPTION OF GOODS	QUANTITY	UNIT PRICE	TOTAL
	TWO GAS TANK FITTINGS AT JUMAYA INDUSTRIES SDN BHD			
	2 PCS OF THERMOMETER 4" STEM LENGTH @ $150.00 x 2		300.00	
	2 PCS OF ANGLE VALVE REGO 7550 PX @ $150.00 x 2		300.00	
	1 UNIT OF TOP MOUNTING CONTENT GAUGE ROCHESTER 6280-25-48 @ $260.00 x 1		260.00	
	TO SUPPLY LABOUR AND TOOL TO DISMANTLE, CLEAN AND INSTALL.		400.00	
	TOTAL	1	1260.00	1,197.00
	LESS 5%			
	RINGGIT ONE THOUSAND ONE HUNDRED AND NINETY SEVEN ONLY			$1,197.00

14 DEC 1992

ELPIJI (M) SDN. BHD.

E. & O.E.

TOTAL

-1)

大亞工業有限公司
JUMAYA INDUSTRIES SDN BHD

7, Jalan Kilang, Dato Onn Industrial Estate, 80350 Johor Bahru, Johor, Malaysia.
Tel : 07-369834 Fax : 07-367636.

For Elpiji (M) Sdn Bhd
8 & 10, Jln SS25/22, Taman Mayang
47301 Petaling Jaya
Selangor

PB7J

DEBIT NOTE NO. DN01/12

Inv. No.

Date, 3/12/92

數量 QUANTITY	品名 DESCRIPTION OF GOODS	價格 UNIT PRICE	總計金額 TOTAL AMOUNT
	Being charges for rewinding 3 phase 1½ HP motor c/w replacing ball-bearing		$250-00
	Checking and installing motor		$500-00
	Other rectifications		$750-00
			$1,500-00

(Total M'sian Rgt One Thousand and Five Hundred only)

JUMAYA INDUSTRIES SDN.

E. & O. E.

ELPIJI (M) SDN. BHD.
8, Jalan SS 25/22, Taman Mayang, 47301 Petaling Jaya, Selangor Darul Ehsan, Malaysia.
Tel: 03-7031377, 7031378, 7031379. Telex: MA 36788 ELPIJI Fax: 03-7031333, 7031372.

Customer Copy

PB74.

ATTN. : MR. KO SWEEN HEE

JUMAYA INDUSTRIES SDN BHD
7, JALAN KILANG
DATO ONN INDUSTRIAL ESTATE
80350 JOHOR BAHRU
JOHOR.

INVOICE

NO: 4563

Date: 16/11/92
Page: 1
TEL NO. : 07-369834

ORDER DATE	PURCHASE ORDER NO.	DELIVERY ORDER NO.	TERMS
16/11/92			30 DAYS

NO.	DESCRIPTION OF GOODS	QUANTITY	UNIT PRICE	TOTAL
	INSTALLATION OF 2 UNITS OF 7.5 KL TANK AND PIPING WORK AT JOHOR BAHRU, JOHOR. 5% UPON TESTING	1	65000.00	3,250.00
	RINGGIT THREE THOUSAND TWO HUNDRED AND FIFTY ONLY			

Date 25 NOV 1992		
G. M.	✓	[illegible]
Mgr Manager		
[illegible]		
[illegible]		
A/C [illegible]		
[illegible]		
Store [illegible]		

ELPIJI (M) SDN. BHD.

E. & O.E.

TOTAL $3,250.00 ✓

ELPIJI (M) SDN. BHD.

8, Jalan SS 25/22, Taman Mayang, 47301 Petaling Jaya, Selangor Darul Ehsan, Malaysia.
Tel: 03-7031377, 7031378, 7031379. Telex: MA 36788 ELPIJI Fax: 03-7031333, 7031372.

Customer Copy

AB 71

INVOICE

NO: 4474

ATTN. : MR. KO SWEEN HEE

JUMAYA INDUSTRIES SDN BHD
7, JALAN KILANG
DATO ONN INDUSTRIAL ESTATE
80350 JOHOR BAHRU
JOHOR.

Date: 20/10/92
Page: 1
TEL NO. : 07-369834

ORDER DATE	PURCHASE ORDER NO.	DELIVERY ORDER NO.	TERMS
20/10/92			30 DAYS

NO	DESCRIPTION OF GOODS	QUANTITY	UNIT PRICE	TOTAL
	INSTALLATION OF 2 UNITS OF 7.5 KL TANK AND PIPING WORK AT JOHOR BAHRU, JOHOR. 55% UPON COMPLETION	1	65000.00	35,750.00

Date 27 OCT 1992		
G. M.	✓	KC
Gen. Manager		
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

ELPIJI (M) SDN. BHD.

RINGGIT THIRTY FIVE THOUSAND SEVEN HUNDRED AND FIFTY ONLY

E. & O.E.

TOTAL $35,750.00

ELPIJI (M) SDN. BHD.

8, Jalan SS 25/22, Taman Mayang, 47301 Petaling Jaya, Selangor Darul Ehsan, Malaysia.
Tel: 03-7031377, 7031378, 7031379. Telex: MA 36788 ELPIJI Fax: 03-7031333, 7031372.

Customer Copy

AB 69

INVOICE

NO: 4394

ATTN. : MR. KO SWEEN HEE

JUMAYA INDUSTRIES SDN BHD
7, JALAN KILANG
DATO ONN INDUSTRIAL ESTATE
80350 JOHOR BAHRU
JOHOR.

Date: 23/09/92
Page: 1
TEL NO. : 07-369834

ORDER DATE	PURCHASE ORDER NO.	DELIVERY ORDER NO.	TERMS
23/09/92	JI/GC/F92/8-192		30 DAYS

NO.	DESCRIPTION OF GOODS	QUANTITY	UNIT PRICE	TOTAL
	INSTALLATION OF 2 UNITS OF 7.5 KL TANK AND PIPING WORK AT JOHOR BAHRU, JOHOR. 40% UPON CONFIRMATION	1	65000.00	26,000.00

Date	25 SEP 1992	
G. M.	✓	[signature]
Fty Manager	✓	[signature]
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

~~[illegible] ini memberi notis untuk [illegible] dibalik duti kastam [illegible] Seksyen 99 Akta 1967 [illegible] 12 yang telah dikilang [illegible] INDUSTRIES SDN. [illegible] Kilang, Dato Onn Ind. [illegible] Johor Bahru.~~

~~JUMAYA INDUSTRIES SDN. BHD.~~

....

ELPIJI (M) SDN. BHD.

RINGGIT TWENTY SIX THOUSAND ONLY

E. & O.E.

TOTAL $26,000.00

發貨單
INVOICE

No. 1729

PG 24

Fende + gab

合興利工業機械工程
Hup Heng Lee Industrial Engineering Works

16, Jalan Anggerek 37, Taman Johor Jaya, 81100 Johor Bahru, Johor.
TEL: 547892, 010-771628 FAX: 553300 Pager: 249955-18760

M/s Jumaya Industries Sdn Bhd

賬期 Terms: 30days

送貨單號 D/O No. 1682

日期 Date: 28.3.93

請查收下列各貨完整無訛。
Please receive the following goods in good order and condition

數量 Quantity	摘要 Particulars	單價 Price	銀 Amount 額 $	cts.
2pcs	To Supply Sealing machine High Steeles steel shaft.	cutting	and	
	1/2" X 18" Long LPG section	65	130	00
1 job	To Supply pump cover shettle		660	00
1pc	Low & High pressure meter plate		280	00
4 pcs	Spring (cutting Dept)	7.5	30	00
1 unit	Brass washer + 5pcs Smachin the gas.	Cutting	Dept	
	high Rubber Size	140	140	00
1pc	To repair type Die Head Screw	Mach (A)	35	00
	(Die Head Screw)		mch	(A)
24	Die Head A & B Screw	18	432	00
	Mach (B)			
12pcs	Cap Screw 3/8" x 3" Long	18	216	00
1pc	To Supply motor Cover 33" L x 15" W x 16" H LPG section.		230	00
		TOTAL $	2153	00

92.

收貨人 Received by

經手人 Issued by

Sub-pr(?) ...

Accessories

發貨單
INVOICE No. 1679 PB22.

合興利工業機械工程
Hup Heng Lee Industrial Engineering Works

16, Jalan Anggerek 37, Taman Johor Jaya, 81100 Johor Bahru, Johor.
TEL: 547892, 010-771628 FAX: 553300 Pager: 249955-18760

M/s Jumaya Industrial Sdn Bhd

賬期 Terms: 30days
送貨單號 D/O No. 1655
日期 Date: 23-2-93

請查收下列各貨完整無訛。
Please receive the following goods in good order and condition

數量 Quantity	摘要 Particulars	單價 Price	銀額 Amount $	cts.
1 set	To Supply 20'L x 6'H x 3" Square Section Safety door for Rolling bering Roller		1600	00.

Date	9 MAR 1993
G. M.	
~~Fty Manager~~	Lee
~~Asst. Manager~~	
Secretary	
A/C Dept.	
Sales Dept.	
Store Dept.	

92.

TOTAL $ 1600 00.

收貨人 Received by

經手人 Issued by

發貨單
INVOICE No. 1626 PB77

合興利工業機械工程
Hup Heng Lee Industrial Engineering Works

16, Jalan Anggerek 37, Taman Johor Jaya, 81100 Johor Bahru, Johor.
TEL: 547892, 010-771628 FAX: 553300 Pager: 249955-18760

M/s Jumaya Industries Sdn Bhd

賬期 Terms: 30 days
送貨單號 D/O No. 1574
日期 Date: 9-12-92

請查收下列各貨完整無訛。
Please receive the following goods in good order and condition

數量 Quantity	摘要 Particulars	單價 Price	銀額 Amount $	cts.
1pc	To Lathe machine the S/S nipper		30	00.
1 job	To Workmanship & Supply material to Support the gas tank pipe	600/-	600	00
1pc	To Supply the High pressure pump Cover big.	500/-	500	00
1pc	Small Cover for safety Fire Tools	120/-	120	00.
1pce	Low pressure pump ~~shop~~ Safety Cover (Small)	180/-	180	00
1pc	High pressure pump meter box Support Rest	280/-	280	00
1pc	To Supply motor house (cover)	120/-	120	00
			TOTAL $ 1830	00.

Date 21 DEC 1992
G.M.
Ag. Manager
Acct. Manager
Secretary
A/C Dept.
Sales Dept.
Store Dept.

92.

收貨人 Received by

經手人 Issued by

發貨單
INVOICE No. 1553
PB/2.

合興利工業機械工程
Hup Heng Lee Industrial Engineering Works

16, Jalan Anggerek 37, Taman Johor Jaya, 81100 Johor Bahru, Johor.
TEL: 547892, 010-771628 FAX: 553300 Pager: 249955-18760

M/s Jumaya Industries Sdn Bhd
賬期 Terms: 30 days
送貨單號 D/O No. 1496

請查收下列各貨完整無訛。
Please receive the following goods in good order and condition
日期 Date: 15-10-92

數量 uantity	摘要 Particulars	單價 Price	銀 Amount 額 $	cts.
24 pcs	Dia Head adjustable 760 steel screw for (PEP) 130 mm long x 10 mm	22/-	528	00
16 pcs	Dia Head adjustable 760 steel screw for (640 PSP) 115 L x 10 mm	22/-	352	00
1 job	To workmanship to drill the hole for Rest & Supply the 200 mm x 200 mm x 3/16 plate	480/-	480	00
4 pcs	To machine the 4" x B3 pulley hole	25/-	100	00
1 job	To Supply M/S ~~saftty~~ Safty Cover & 8pcs brackets for Wonderway Services	460/-	460	00
3 pcs	To fabricate the square block 10" x 8" x 8" to Support lighter Roller shaft & Six pcs M/S Cover.	280/-	840	00
		TOTAL $	2760	00

92.

Date	7 NOV 1992	
G. M.	✓	
Fty Manager	✓	Lee
Asst. Manager		
Secretary		
A/C Dept.		

Received by

經手人 Issued by

發貨單
INVOICE No. 1506

合興利工業機械工程 PB69
Hup Heng Lee Industrial Engineering Works

16, Jalan Anggerek 37, Taman Johor Jaya, 81100 Johor Bahru, Johor.
TEL: 547892, 010-771628 FAX: 553300 Pager: 249955-18760

M/s Jumaya Industries Sdn Bhd

賬期 Terms: 30days.
送貨單號 D/O No. 1673.
日期 Date: 14-9-92

請查收下列各貨完整無訛。
Please receive the following goods in good order and condition

數量 Quantity	摘要 Particulars	單價 Price	銀 Amount 額 $	cts.
1 job	To repair the machin die Head		25	00
10 pcs	To Supply & machine the Cap Screw 10mm x 106mm L	7.50	75	00
6 pcs	To Supply the die Head adjustable screws	23.00	138	00

Date 16 SEP 1992		
G. M.		
Fty Manager		
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

92.

TOTAL $ 238 00

收貨人 *Received by*

經手人 *Issued by*

德風機電工程有限公司
TAC AIR ENGINEERING SDN. BHD.

No. 6, Jalan Anggerik 34, Taman Johor Jaya, 81100 Johor Bahru, Johor,
West Malaysia. Tel : 07-554313, 554310, 548960 Fax : 07-554315

INVOICE

No. 9304059

M/S : Jumaya Industries Sdn Bhd
7A Jalan Kilang
Dato Onn Industrial Estate
80350 Johor Bahru

Date : 17-04-93
~~Service Slip~~/D.O. No. : 1566
P/O No. :
Terms : 30 days

ITEM	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
1.	Lubrication Oil T-32	5 gals	$ 30.00	$150.00
				========
	Ringgit Malaysia One Hundred And Fifty Only			

(modification)

Sub-project I (H)

Date 26 APR 1993		
G. M.		
Fty Manager		
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

for TAC AIR ENGINEERING SDN. BHD.

N.B. Client are requested to examine goods on delivery as goods once sold cannot be returned or exchanged.
Cheques should be crossed and made payable to the company only.
If payment is made by cash or cash cheque to our representative, a temporary receipt must be obtained from him immediately.

德風機電工程有限公司
TAC AIR ENGINEERING SDN. BHD.

No. 6, Jalan Anggerik 34, Taman Johor Jaya, 81100 Johor Bahru, Johor,
West Malaysia. Tel : 07-554313, 554310, 548960 Fax : 07-554315

INVOICE

No. 9303082

PB24.

M/S : Jumaya Industries Sdn Bhd
7A, Jalan Kilang,
Dato Onn Industrial Estate,
80350 Johor Bahru.

Date : 18.03.1993

Service Slip No. : 1514

P/O No. :

Terms : 30 days

ITEM	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
	To rewind one unit of Torque Motor 3 Phase S/No. : 84516			$300.00
	Labour to dismantle and install			$170.00
				$470.00
	(Ringgit Malaysia : Four Hundred and Seventy Only)			

Date	3 APR 1993	
G. M.		
Fty Manager		
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

for TAC AIR ENGINEERING SDN. BHD.

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德風機電工程有限公司
TAC AIR ENGINEERING SDN. BHD.

No. 6, Jalan Anggerik 34, Taman Johor Jaya, 81100 Johor Bahru, Johor,
West Malaysia. Tel : 07-554313, 554310, 548960 Fax : 07-554315

INVOICE

No. 9303036

PB24.

M/S : Jumaya Industries Sdn Bhd
7A, Jalan Kilang,
Dato Onn Industrial Estate,
80350 Johor Bahru.

Date : 16.03.1993

Service Slip/D.O. No. : 1483

P/O No. :

Terms : 30 days

ITEM	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
1.	To repair sprinkle head for one unit of Liang Chi Cooling Tower.			
2.	To repair 1 pc gate valve			
	Total			$120.00
	(Ringgit Malaysia : One Hundred and Twenty Only)			

Date 30 MAR 1993		
G. M.		
Fty Manager		Lee
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

for TAC AIR ENGINEERING SDN. BHD.

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德風機電工程有限公司
TAC AIR ENGINEERING SDN. BHD.

No. 6, Jalan Anggerik 34, Taman Johor Jaya, 81100 Johor Bahru, Johor,
West Malaysia. Tel : 07-554313, 554310, 548960 Fax : 07-554315

INVOICE

No. 9301049 PB20.

M/S : Jumaya Industries Sdn Bhd
7A Jalan Kilang
Dato Onn Industrial Estate
80350 JOhor Bahru

Date : 21.01.93
Service Slip/~~XXXX~~ No. : 1437
P/O No. :
Terms : 30 days

ITEM	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
	COMPRESSED AIR PIPING To supply labour and material to install one lot of piping and fitting for one set of new 50Hp air compressor according to sketch drawing TAQ/92/370D-1.			M$3,900.00
	Malaysian Ringgit : Three Thousand And Nine Hundred Only.			

Date	9 FEB 1993	
G. M.		Chi
Fty Manager		Lee
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

for TAC AIR ENGINEERING SDN. BHD.

N. Kaye.

N.B. Client are requested to examine goods on delivery as goods once sold cannot be returned or exchanged.
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德風機電工程有限公司
TAC AIR ENGINEERING SDN. BHD.

No. 6, Jalan Anggerik 34, Taman Johor Jaya, 81100 Johor Bahru, Johor,
West Malaysia. Tel : 07-554313, 554310, 548960 Fax : 07-554315

INVOICE

No. 9301047 AB25

M/S : Jumaya Industries Sdn Bhd
7A Jalan Kilang
Dato Onn Ind. Est
80350 JOhor Bahru

Date : 18.01.93
Service Slip/~~D.O.~~ No. : 1339
P/O No. :
Terms : 30 days

ITEM	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
	VARIATION ORDERS			
	Awning Size : 48 ft x 10 ft			
	Concrete Foundation : 48 ft x 6 ft			
	Material : Galv. Zinc Roofing Grade 28#			
	Square Hollow Section			
	Additional Concrete Foundation : 10 ft x 10 ft			
	c/w fencing and angle iron.			M$1,700.00
	Malaysian Ringgit : One Thousand And Seven Hundred Only.			

Date	17 APR 1993	
G. M.		
Fty Manager		
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

for TAC AIR ENGINEERING SDN. BHD.

N.B. Client are requested to examine goods on delivery as goods once sold cannot be returned or exchanged.
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德風機電工程有限公司
TAC AIR ENGINEERING SDN. BHD.

No. 6, Jalan Anggerik 34, Taman Johor Jaya, 81100 Johor Bahru, Johor,
West Malaysia. Tel : 07-554313, 554310, 548960 Fax : 07-554315

INVOICE

No. 9301046 PB 20.

M/S : Jumaya Industries Sdn Bhd
7A Jalan Kilang
Dato Onn Industrial Estate
80350 Johor Bahru

Date : 18.01.93
Service Slip/~~D.O.~~ No. : 1338
P/O No. :
Terms : 30 days

ITEM	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
	AWNING AND CONCRETE FOUNDATION Awning Size : 40ft x 8 ft Concrete Foundation : 40 ft x 5 ft Material : Galv. Zinc Roofing Grade 30# Square Hollow Section.			M$2,500.00
	Malaysian Ringgit : Two Thousand And Five Hundred Only.			

Date - 9 FEB 1993		
G. M.	/	
Fty Manager	/	Lee
Asst Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

for TAC AIR ENGINEERING SDN. BHD.

N.B. Client are requested to examine goods on delivery as goods once sold cannot be returned or exchanged.
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德風機電工程有限公司
TAC AIR ENGINEERING SDN. BHD.

No. 6, Jalan Anggerik 34, Taman Johor Jaya, 81100 Johor Bahru, Johor, West Malaysia. Tel : 07-554313, 554310, 548960 Fax : 07-554315

INVOICE

No. 9301036 PB20.

M/S : Jumaya Industries Sdn Bhd
7A Jalan Kilang
Dato Onn Industrial Estate
80350 JOhor Bahru

Date : 18.01.93
Service Slip/~~XXXX~~ No. : 1436
P/O No. :
Terms : 30 days

ITEM	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
	To do one lot of wiring for cooling tower fan motor.			M$280.00

Malaysian Ringgit : Two Hundred And Eithty Only.

Date 4 FEB 1993		
G. M.		
Fty Manager		
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

for TAC AIR ENGINEERING SDN. BHD.

N.B. Client are requested to examine goods on delivery as goods once sold cannot be returned or exchanged.
Cheques should be crossed and made payable to the company only.
If payment is made by cash or cash cheque to our representative, a temporary receipt must be obtained from him immediately.

德風機電工程有限公司
TAC AIR ENGINEERING SDN. BHD.

No. 6, Jalan Anggerik 34, Taman Johor Jaya, 81100 Johor Bahru, Johor, West Malaysia. Tel : 07-554313, 554310, 548960 Fax : 07-554315

INVOICE

No. 9301005 PB20

M/S : Jumaya Industries Sdn Bhd
7A Jalan Kilang
Dato Onn Industrial Estate
80350 JOhor Bahru

Date : 08.01.93
~~Service Slip~~/D.O. No. : 1376, 1371
P/O No. :
Terms : 30 days

ITEM	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
1.	SMC Air Dryer Model : IDU 37C-3 c/w step down transformer S/No : WO 224	1 unit		M$ 9,800.00
2.	KOBELCO Rotary Screw Compressor Model : KST 37A S/No : TC376A-3624	1 unit		M$42,000.00
3.	M.S. Vertical Air Receiver Tank Working Pressure : 150 psi Size : 2'-6" x 7'-0" SL Volume : 1000 litres S/No : HA/HT/1834/1992	1 unit		M$ 4,800.00
				M$56,600.00

Malaysian Ringgit : Fifty-Six Thousand And Six Hundred Only.

Date	26 JAN 1993	
G. M.	✓	Chu
Fty Manager	✓	Loe
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		

N.B., Client are requested to examine goods on delivery as goods once sold cannot be returned or exchanged.
Cheques should be crossed and made payable to the company only.
If payment is made by cash or cash cheque to our representative, a temporary receipt must be obtained from him immediately.

for TAC AIR ENGINEERING SDN. BHD.

Kang

德風機電工程有限公司
TAC AIR ENGINEERING SDN. BHD.

No. 6, Jalan Anggerik 34, Taman Johor Jaya, 81100 Johor Bahru, Johor,
West Malaysia. Tel : 07-554313, 554310, 548960 Fax : 07-554315

INVOICE

No. 9301012
PB20

M/S : Jumaya Industries Sdn Bhd
7A Jalan Kilang
Dato Onn Industrial Estate
80350 Johor Bahru

Date : 07.01.93
Service Slip/~~D.O.~~ No. : 1336
P/O No. :
Terms : 30 days

ITEM	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
	To check and install one unit of Cooling Tower Motor.			M$150.00
	Malaysian Ringgit : One Hundred And Fifty ONly.			

Date 26 JAN 1993		
G. M.		
Fty Manager		
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

for TAC AIR ENGINEERING SDN. BHD.

N.B. Client are requested to examine goods on delivery as goods once sold cannot be returned or exchanged.
Cheques should be crossed and made payable to the company only.
If payment is made by cash or cash cheque to our representative, a temporary receipt must be obtained from him immediately.

TAC

德風機電工程有限公司

TAC AIR ENGINEERING SDN. BHD.

No. 6, Jalan Anggerik 34, Taman Johor Jaya, 81100 Johor Bahru, Johor, West Malaysia. Tel : 07-554313, 554310, 548960 Fax : 07-554315

INVOICE No. 9301011

PB20.

M/S : Jumaya Industries Sdn Bhd
7A Jalan Kilang
Dato Onn Industrial Estate
80350 Johor Bahru

Date : 06.01.93
~~Service Slip~~/D.O. No. : 1374
P/O No. :
Terms : 30 days

ITEM	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
	3Ph Teco Cooling Tower Motor 6P-1.5Hp AEMCAK 415V/3Phase/50Hz Remark : Modify key way	1 unit		M$750.00
	Malaysian Ringgit : Seven Hundred And Fifty Only,			

Date 26 JAN 1993		
G. M.	✓	
Fty Manager	✓	Lee
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

N.B. Client are requested to examine goods on delivery as goods once sold cannot be returned or exchanged.
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If payment is made by cash or cash cheque to our representative, a temporary receipt must be obtained from him immediately.

for TAC AIR ENGINEERING SDN. BHD.

德風機電工程有限公司
TAC AIR ENGINEERING SDN. BHD.
No. 6, Jalan Anggerik 34, Taman Johor Jaya, 81100 Johor Bahru, Johor, West Malaysia. Tel : 07-554313, 554310, 548960 Fax : 07-554315

PB18.

INVOICE

No. 9212084

M/S : Jumaya Industries Sdn Bhd
7A Jalan Kilang
Dato Onn Industrial Estate
80350 Johor Bahru

Date : 31.12.1992
Service Slip/~~D.O.~~ No. : 1333
P/O No. :
Terms : 30 days

ITEM	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
1.	To overhual one set of Water Pump and 15Hp Motor.			M$300.00
2.	To supply and replaced the spare parts as following :			M$480.00
	a. Bearing for pump	2 pcs		
	b. Bearing for motor	2 pcs		
	c. Mechanical Seal	1 set		
	d. Packing	1 set		
				M$780.00
	Malaysian Ringgit : Seven Hundred And Eighty Only.			

Date	13 JAN 1993	
G. M.		
Fty Manager		
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

N.B. Client are requested to examine goods on delivery as goods once sold cannot be returned or exchanged.
Cheques should be crossed and made payable to the company only.
If payment is made by cash or cash cheque to our representative, a temporary receipt must be obtained from him immediately.

for TAC AIR ENGINEERING SDN. BHD.

德風機電工程有限公司

TAC AIR ENGINEERING SDN. BHD.

No. 6, Jalan Anggerik 34, Taman Johor Jaya, 81100 Johor Bahru, Johor, West Malaysia Tel : 07-554313, 554310, 548960 Fax : 07-554315

PB78.

INVOICE

No. 9212083

M/S : Jumaya Industries Sdn Bhd
7A Jalan Kilang
Dato Onn Industrial Estate
80350 Johor Bahru
Johor

Date : 31.12.1992
Service Slip/~~D.O.~~ No. : 1332
P/O No. :
Terms : 30 days

ITEM	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
1.	To do 6000 hours servicing for one unit of KOBELCO Screw Air Compressor Model : KST 37.6 S/No : TC376A-2058 Working Hours : 14990			M$400.00
2.	To check and service one unit of CKD Air Dryer Model RD-37AC			F.O.C.
				M$400.00
	Malaysian Ringgit ; Four Hundred Only.			

Date	13 JAN 1993	
G. M.		
Fty Manager		Lee
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

for TAC AIR ENGINEERING SDN. BHD.

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德風機電工程有限公司
TAC AIR ENGINEERING SDN. BHD.

No. 6, Jalan Anggerik 34, Taman Johor Jaya, 81100 Johor Bahru, Johor, West Malaysia. Tel : 07-554313, 554310, 548960 Fax : 07-554315

PB78.

INVOICE

No. 9212082

M/S : Jumaya Industries Sdn Bhd
7A Jalan Kilang
Dato Onn Industrial Estate
80350 JOhor Bahru

Date : 30.12.1992

~~Service Slip~~/D.O. No. : 1367

P/O No. :

Terms : 30 days

ITEM	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
	KOBELCO Spare Part For KST 37.6			
1.	0160-553 Suction Filter	1 pc		M$ 328.00
2.	P-F03-3010 Pre Filter	1 pc		M$ 127.00
3.	P-S12-004-03 Seal Washer	1 pc		M$ 12.00
4.	P-CE03-521 Element	1 pc		M$1,169.00
5.	H04510094 Packing	2 pcs	M$ 38.00	M$ 76.00
6.	P-CE12-502-04 Filter	1 pc		M$ 67.00
7.	0160-593-05 Seal Washer	2 pcs	M$ 21.00	M$ 42.00
8.	BGKD-OP-0016 O Ring	2 pcs	M$ 6.00	M$ 12.00
9.	BGRD-OG-0035 O Ring	1 pc		M$ 4.00
10.	BGRD-OP-010A O Ring	1 pc		M$ 4.00
11.	P-F13-3001-01 Cartridge	1 pc		M$ 237.00
12.	H05310011 Valve Stem	1 pc		M$ 72.00
13.	BGRD-OP-0022 O Ring	1 pc		M$ 4.00
14.	AD 402 Drain Unit	1 pc		M$ 161.00
15.	P-H11-019-02 Packing	2 pcs	M$ 42.00	M$ 84.00
16.	T 32 Lubricating Oil	7 gals	M$ 30.00	M$ 210.00
				M$2,609.00

Malaysian Ringgit : Two Thousand Six Hundred And Nine Only.

Date	13 JAN 1993	
G.M.		
Fty Manager		
Asst. Manager		
Secretary		

N.B. Client are requested to examine goods on delivery as goods once sold cannot be returned or exchanged.
Cheques should be crossed and made payable to the company only.
If payment is made by cash or cash cheque to our representative a temporary receipt must be obtained from him immediately.

TAC AIR ENGINEERING SDN. BHD.

德風機電工程有限公司
TAC AIR ENGINEERING SDN. BHD.

No. 6, Jalan Anggerik 34, Taman Johor Jaya, 81100 Johor Bahru, Johor,
West Malaysia. Tel : 07-554313, 554310, 548960 Fax : 07-554315

PB76.

INVOICE

No. 9212070

M/S : Jumaya Industries Sdn Bhd
7A Jalan Kilang
Dato Onn Industrial Estate
80350 Johor Bahru

Date : 26.12.1992
~~Service Slip~~/D.O. No. : 1359
P/O No. :
Terms : 30 days

ITEM	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
	Shell Turbo T 32 Lubrication Oil	5 gals	M$30.00	M$150.00
	Malaysian Ringgit : One Hundred And Fifty Only.			

Date	2 DEC 1992	
G. M.	✓	[signature]
Fty Manager	✓	Lee
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

N.B. Client are requested to examine goods on delivery as goods once sold cannot be returned or exchanged.
Cheques should be crossed and made payable to the company only.
If payment is made by cash or cash cheque to our representative, a temporary receipt must be obtained from him immediately.

for TAC AIR ENGINEERING SDN. BHD.

[signature]

德風機電工程有限公司
TAC AIR ENGINEERING SDN. BHD.

No. 6, Jalan Anggerik 34, Taman Johor Jaya, 81100 Johor Bahru, Johor,
West Malaysia. Tel : 07-554313, 554310, 548960 Fax : 07-554315

INVOICE

No. 9212018 P876.

M/S : Jumaya Industries Sdn Bhd
7A Jalan Kilang
Dato Onn Industrial Estate
80350 Johor Bahru

Date : 5.12.1992
~~Service Slip~~/D.O. No. : 1324
P/O No. :
Terms : 30 days

ITEM	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
	CB Gear Head Type 2/CB 23	1 no.		M$1,440.00
	Malaysian Ringgit : One Thousand Four Hundred And Forty Only.			

Date	2 DEC 1992	
G. M.		
Fty Manager		Lee
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

N.B., Client are requested to examine goods on delivery as goods once sold cannot be returned or exchanged.
Cheques should be crossed and made payable to the company only.
If payment is made by cash or cash cheque to our representative, a temporary receipt must be obtained from him immediately

for TAC AIR ENGINEERING SDN. BHD.

德風機電工程有限公司
TAC AIR ENGINEERING SDN. BHD.
No. 6, Jalan Anggerik 34, Taman Johor Jaya, 81100 Johor Bahru, Johor, West Malaysia. Tel : 07-554313, 554310, 548960 Fax : 07-554315

INVOICE No. 9211025

PB74.

M/S : Jumaya Industries Sdn Bhd
7A Jalan Kilang
Dato Onn Industrial Estate
80350 Johor Bahru

Date : 06.11.1992
Service Slip/~~D.O.~~ No. : 1289
P/O No. :
Terms : 30 days

ITEM	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
1.	To repair one unit of gear reducer. Model : CB3F			
2.	To service CB gear and change 1 pc key.			
3.	To supply lubricating oil	1 liter		
	Total amount for above			M$200.00
	Malaysian Ringgit : Two Hundred Only.			

Date	25 NOV 1992	
G. M.		
Fty Manager		
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

for TAC AIR ENGINEERING SDN. BHD.

N.B., Client are requested to examine goods on delivery as goods once sold cannot be returned or exchanged.
Cheques should be crossed and made payable to the company only.
If payment is made by cash or cash cheque to our representative, a temporary receipt must be obtained from him immediately.

德風機電工程有限公司
TAC AIR ENGINEERING SDN. BHD.

No. 6, Jalan Anggerik 34, Taman Johor Jaya, 81100 Johor Bahru, Johor,
West Malaysia. Tel : 07-554313, 554310, 548960 Fax : 07-554315

INVOICE

No. 9210081 PS7>.

M/S : Jumaya Industries Sdn Bhd
7A Jalan Kilang
Dato Onn Ind. Est.
80350 Johor Bahru

Date : 28.10.1992
Service Slip/~~D.O.~~ No. : 1287 & 1288
P/O No. :
Terms : 30 days

ITEM	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
1.	To do 2" water inlet and water outlet pipe for cooling tower.	1 lot		
2.	To do 1/2" PVC pipe for cooling tower incoming supply.	1 lot		
3.	Shifting for air compressor, pump and cooling tower starter box.	2 sets		
4.	To do wiring for :			
	a) 15hp Hitachi Air Compressor (Star-Delta)	1 no		
	b) Liang Chi Cooling Tower (D.O.L.)	1 no		
	c) Water Pump (D.O.L.)	2 nos		
5.	To do 7' x 6' owning	1 no		
6.	Stand bracket for air compressor	1 no		
7.	To shift and install the air compressor, water pump and cooling tower.			
8.	To do concrete stand for cooling tower.			
9.	To do 1" air piping.	1 lot		
	Total amount for above			M$5,900.00
	Malaysian Ringgit : Five Thousand And Nine Hundred Only.			

Date	10 NOV 1992	
G. M.	✓	
Fty Manager	✓	Lee
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

N.B. Client are requested to examine goods on delivery as goods once sold cannot be returned or exchanged.
Cheques should be crossed and made payable to the company only.
If payment is made by cash or cash cheque to our representative, a temporary receipt must be obtained from him immediately.

for TAC AIR ENGINEERING SDN. BHD.

Kang.

德風機電工程有限公司
TAC AIR ENGINEERING SDN. BHD.

No. 6, Jalan Anggerik 34, Taman Johor Jaya, 81100 Johor Bahru, Johor, West Malaysia. Tel : 07-554313, 554310, 548960 Fax : 07-554315

INVOICE

No. 9209030 P869

M/S : Jumaya Industries Sdn.Bhd.
7A,Jalan Kilang,
Dato'Onn Industrial Estate,
80350,
Johor Bahru.

Date : 7.09.92
Service Slip/~~D.O. No~~ : 1178
P/O No. : -
Terms : 30 days

ITEM	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
	30 H.P. Screw Compressor			
1.	To check control circuit			
2.	To repair pressure control valve			
3.	To repair magnetic contactor			
	Labour Charges for item 1-3			M $ 400.00
4.	To supply magnetic contactor	1 pc		M $ 220.00
5.	To supply T 32 OIL	5 gals	$ 30.00	M $ 150.00
				M $ 770.00

Date	21 SEP 1992	
G. M.		
Fty Manager		Lee
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

Malaysian Ringgit: Seven Hundred and Seventy Only.

AIN

N.B. Client are requested to examine goods on delivery as goods once sold cannot be returned or exchanged.
Cheques should be crossed and made payable to the company only.
If payment is made by cash or cash cheque to our representative, a temporary receipt must be obtained from him immediately.

for TAC AIR ENGINEERING SDN. BHD.

Kang

TAC

德風機電工程有限公司
TAC AIR ENGINEERING SDN. BHD.

No. 6, Jalan Anggerik 34, Taman Johor Jaya, 81100 Johor Bahru, Johor,
West Malaysia. Tel : 07-554313, 554310, 548960 Fax : 07-554315

PB69.

INVOICE

No. 9209029

M/S : Jumaya Industries Sdn.Bhd.
7A,Jalan Kilang,
Dato' Onn Industrial Estate,
80350,
Johor Bahru.

Date : 7.09.92
Service Slip/~~D.O. No.~~ : 1177
P/O No. : -
Terms : 30 days

ITEM	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
	Kobelco Screw Compressor			
	Model : KST 37A-5			
	S/NO : TC 376A-2058			
	W/Hour: 12660			
1.	To rewind motor stator	1 unit		M $1,300.00
2.	To supply T 32 Oil	7 gals	$ 30.00	M $ 210.00
3.	To repair and clean magnetic contactor	2 nos		
4.	To clean Oil Cooler	1 unit		
5.	Labour Charges for item 3 & 4			M $ 250.00
				M $1,760.00

Date 21 SEP 1992		
G. M.		
Fty Manager		
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

Malaysian Ringgit: One Thousand Seven Hundred and Sixty Only,

AIN

N.B. Client are requested to examine goods on delivery as goods once sold cannot be returned or exchanged.
Cheques should be crossed and made payable to the company only.
If payment is made by cash or cash cheque to our representative, a temporary receipt must be obtained from him immediately.

for TAC AIR ENGINEERING SDN. BHD.

Kant

RADON TRADING PTE LTD

45 DEFU LANE 9, SINGAPORE 1953
TEL: 2813626, 2862875
TELEX: RS 26306 FAX: 2865975

INVOICE

NUMBER	DATE	PAGE
DA-0067	10/11/92	1

SOLD TO:

M/s JUMAYA INDUSTRIES SDN BHD
7A, JALAN KILANG, DATO ONN INDUSTRIAL ESTATE
80350 JOHORE BAHRU, JOHORE MALAYSIA

DELIVER TO: PB74

7A, JALAN KILANG, DATO ONN INDUSTRIAL ESTATE
80350 JOHORE BAHRU, JOHORE MALAYSIA

ORDER NO.	ORDER DATE	CUSTOMER A.C. NO.	P.O. NUMBER	TERMS	D.O. NUMBER
N.A	10/11/92	N.A	VERBAL	CASH	DA-0067

CODE	DESCRIPTION	UNIT	PRICE	QUANTITY	AMOUNT
	EXPLOSION PROOF PRESSURE TRANSMITTER				
	1.E363 B9 B3BR PRESSURE TRANSMITTER	PC	$1,328.00	1	$1,328.00
	2.MEN 401 DIGITAL DISPLAY	PC	$780.00	1	$780.00
	(SINGAPORE DOLLARS TWO THOUSAND ONE HUNDRED AND EIGHT ONLY)				
				TOTAL	$2,108.00

Sub-project I
(4)

Modification

Date	17 DEC 1992		
G. M.			
Fty Manager			
Asst. Manager			
Secretary			
A/C Dept.			
Sales Dept.			
Store Dept.			

R.3352/

1) All cheques should be crossed and made payable to **RADON TRADING PTE LTD**
2) Interest at the rate of 1½% per month will be charged on overdue accounts.

RADON TRADING PTE LTD

Received by　　　　Company Stamp

RADON TRADING PTE LTD
45 DEFU LANE 9, SINGAPORE 1953.
TEL: 2882875, 2813626
TELEX: RS 26306 FAX: 2885975

Your Ref:

Our Ref:

MR KOH SWEE HEE
M/S JUMAYA INDUSTRIES SDN BHD
7A, JALAN KILANG, DATO ONN INDUSTRIAL ESTATE
80350 JOHORE BAHRU, JOHORE MALAYSIA

18 NOVEMBER 1992

DEAR MR KOH

EXPLOSION PROOF PRESSURE SWITCH

Thank you for your order of the explosion proof pressure switch comprising:

1.ES63 B9 B38R PRESSURE TRANSMITTER (explosion proof)

2.MEN 401 DIGITAL DISPLAY (remote-non explosion proof)

Price: S$2108.00
Singapore dollars Two thousand one hundred and eight only

Delivery:Prompt

Notes: a)The price does note include installation
b)The sensing wire from the pressure transmitter to the digital display is not included
c)Please ensure that your system is ready before we assist you in the final calibration of the pressure switch

We would appreciate if you could acknowledge our proforma invoice for the above. Thank you

Yours faithfully,

Lee Hock Cheong

INVOICE

REGAL ELITE SDN. BHD.

No. 31-31A, Jalan Bakawali 35, Taman Johor Jaya, 81100 Johor Bahru, Johor. Tel : 07-548508/548507 Fax : 07-548511

AB78.

M/s JUMAYA INDUSTRIES SDN BHD
7 JALAN KILANG DATO ONN INDUSTRIAL
ESTATE 80350 JOHOR BAHRU JOHOR.

Our Bill No. : 0102
TERM : CASH
Your Order No. :
Date : 1st DEC, 1992

	Quantity		Unit Rate	Amount
		PROJECT : SUPPLY & INSTALLATION FOR M/S. JUMAYA IND. S/BHD AT 7 JLN KILANG DATO ONN INDUSTRIAL ESTATE		(modification of machinery Sub [illegible] I 4)
1.		Control panel to high pressure pump using 4Cx2.5mm p/s/p cable c/w exprosion proof on/off starter	L/sum	4,000.00
2.		Control panel to corken pump using 4Cx2.5mm p/s/p cable	L/sum	2,200.00
3.		Control panel to pressure switch using 4Cx2.5mm p/s/p cable	L/sum	1,283.00
4.		To rewind 3 phase 1 1/2HP motor c/w replace ball-bearing	L/sum	250.00
5.		Checking & install motor	L/sum	500.00
6.		Supply & install 2 nos 20A isolator & 2 nos 3p 415V DOL starter using 4Cx2.5mm p/s/p	L/sum	567.00
7.		Testing & commissioning (TNB)	L/sum	1,000.00
		Total		9,800.00

(M/Ringgit : Nine Thousand & Eight Hundred Only)

REGAL ELITE SDN. BHD.
No. 31A, Jln. Bakawali 35,
Tmn. Johor Jaya,
81100 Johor Bahru, Johor.
Tel: 548507 / 548508
Fax: 548511

Date	2 DEC 1992
G. M.	
Fty Manager	
Asst. Manager	
Secretary	
A/C Dept.	

8u - 77u89

REGAL ELITE SDN. BHD.

No. 31A, Jalan Bakawali 35, Taman Johor Jaya, 81100 Johor Bahru, Johor.
Tel.: 07-542217 Fax : 07-542913

Our Ref : [illegible]/QUO/0053

Date : [illegible]

ATTENTION : MR. [illegible]

M/S. [illegible] INDUSTRIES SDN BHD
7 [illegible]
DATO ONN [illegible]
80350 JOHOR BAHRU
JOHOR

Dear Sir

RE : QUOTATION FOR SUPPLY AND INSTALLATION FOR JUMAYA INDUSTRIES SDN BHD AT 7 JALAN KILANG DATO ONN INDUSTRIAL ESTATE

We enclosed herewith our quotation schedule for the above for your [illegible] attention.

We hope our quotation is satisfactory and awaiting your confirmation soon.

[illegible]

Yours faithfully
REGAL ELITE SDN BHD

[illegible]

25 NOV 1992

REGAL ELITE SDN BHD

PROJECT : TUMAYA INDUSTRIES SDN BHD

ITEM	DESCRIPTION	QTY	U/RATE	TOTAL AMOUNT
1.	CONTROL PANEL TO HIGH PRESSURE PUMP USING 4C X 2.5MM P/S/P CABLE C/W EXPROSION PROOF ON/OFF STARTER	L/SUM	4,667.00	4,667.00
2.	CONTROL PANEL TO CORKEN PUMP USING 4C X 2.5MM P/S/P CABLE C/W EXPROSION PROOF ON/OFF STARTER	L/SUM	4,728.00	4,728.00
3.	CONTROL PANEL TO PRESSURE SWITCH	L/SUM	1,587.00	1,587.00
4.	TESTING & COMMISSIONING (TNB)	L/SUM	1,000.00	1,000.00
	TOTAL			11,982.00
	LESS [illegible]%			359.00
	TOTAL AMOUNT			11,623.00

GRAPHIC ELECTRONIC & ELECTRIC SDN. BHD.
集藝電氣有限公司
No. 5, Jalan Dewani, Off Jalan Tampoi, Majidee 81100,
Johor Bahru, Johor. Tel: 07-338341

PB04.

M/s Jumaya Industries Sdn.Bhd.
7A Jalan Kilang Dato Onn Industrial Estate
80350 Johor Bahru.

發貨單
INVOICE
№ 0536

送貨單號 D.O. No: 0613
賬期 Terms: 30 Days
日期 Date: 18-03-93

編號 No.	數量 Quantity	摘 PARTICULARS 要	單價 Unit Price	銀額 $ Amount ¢	
1		Labour charge for checking of			
2		tripping of ELCB in Extruder			
3		section lighting.	$ 50.00	$ 50	00
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15		Mringgit: fifty only			
16					
			共銀 TOTAL $	$ 50	00

Date 12 APR 1993

G. M.	
Fty Manager	Lee
Asst. Manager	
Secretary	
A/C Dept.	
Sales Dept.	
Store Dept.	

玆收到上列各貨完整無訛
Received the above goods in good order & condition.

集藝電氣有限公司
GRAPHIC ELECTRONIC & ELECTRIC SDN. BHD.

Received by 收貨人簽

Issued by 經手人 Director

modification

(H)

GRAPHIC ELECTRONIC & ELECTRIC SDN. BHD.
集藝電氣有限公司
No. 5, Jalan Dewani, Off Jalan Tampoi, Majidee 81100,
Johor Bahru, Johor. Tel: 07- 338341

ABa24

M/s Jumaya Industries Sdn.Bhd.
7A Jalan Kilang Dato Onn Industrial Estate
80350 Johor Bahru.

發貨單
INVOICE

№ 0535

送貨單號 D.O. No: 0612 | 賬期 Terms: 30 Days | 日期 Date: 17-03-93

編號 No.	數量 Quantity	摘 PARTICULARS 要	單價 Unit Price	銀額 $ Amount	¢
		Labour and material charge for			
2		repairing of Jumaya Office light-			
3		ing system.	$ 150.00	$ 150	00
4					
5					
6					
7					
8					
9					
10					
12					
13					
14					
15		Mringgit: one hundred and fifty			
16		only.			
			共銀 TOTAL $	$ 150	00

Date	12 APR 1993	
G. M.		
Fty Manager		
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

妓收到上列各貨完整無訛
Received the above goods in good order & condition.

集藝電氣有限公司
GRAPHIC ELECTRONIC & ELECTRIC SDN. BHD.

Received by 收貨人簽

Issued by 經手人 Director

GRAPHIC ELECTRONIC & ELECTRIC SDN. BHD.
集藝電氣有限公司

No. 5, Jalan Dewani, Off Jalan Tampoi, Majidee 81100,
Johor Bahru, Johor. Tel: 07-338741

PB21

M/s Jumaya Industries Sdn.Bhd.
7A Jalan Kilang Dato Onn Industries Estate
80350 Johor Bahru.

發貨單
INVOICE

№ 0509

送貨單號 D.O. No: 0541
賬期 Terms: 30 Days
日期 Date: 20-01-93

編號	數量 Quantity	摘 PARTICULARS 要	單價 Unit Price	銀額 $ Amount	¢
1		Labour charge to check 120Øm			
2		extruder main motor fault. Stand-			
3		ing by for connection back of 75			
4		HP DC motor and tesring.	$ 300.00	$ 300	00
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					

Date	9 FEB 1993
G. M.	
Fty Manager	
Asst. Manager	
Secretary	
A/C Dept.	
Sales Dept.	
Store Dept.	

共銀 TOTAL $ | $ 300 | 00

玆收到上列各貨完整無訛
Received the above goods in good order & condition.

集藝電氣有限公司
GRAPHIC ELECTRONIC & ELECTRIC SDN. BHD.

Received by 收貨人簽

Issued by 經手人 Director

GRAPHIC ELECTRONIC & ELECTRIC SDN. BHD.
集 藝 電 氣 有 限 公 司
No. 5, Jalan Dewani, Off Jalan Tampoi, Majidee 81100,
Johor Bahru, Johor. Tel: 07-338341

PB21

M/s Jumaya Industries Sdn.Bhd.
7A Jalan Kilang Dato Onn Industries Estate
80350 Johor Bahru.

發貨單
INVOICE
№ 0508

送貨單號 D.O. No: 0534
賬期 Terms: 30 Days
日期 Date: 05-01-93

編號 No.	數量 Quantity	摘 PARTICULARS 要	單價 Unit Price	銀額 $ Amount	¢
1		Labour charge to study and connec-			
2		tion of freq inverter for motor.	$ 70.00	$ 70	00
3					
4	2 pcs	Checking extruding m/c control			
5		panel for short, changed 2 nos			
6		fuji 240V contactor.	$ 110.00	$ 220	00
7					
8		Checking extruding m/c for temper-			
9		ture controller fault change 2nos			
10		RKC temp controller supplied by			
11		company.	$ 110.00	$ 110	00
12		Date 9 FEB 1993			
13		G.M.			
14		Dy Manager			
15		Asst. Manager / Secretary			
16		A/C Dept.			
		Sales Dept.	共銀 TOTAL $	$ 400	00

茲收到上列各貨完整無訛
Received the above goods in good order & condition.

集藝電氣有限公司
GRAPHIC ELECTRONIC & ELECTRIC SDN. BHD.

Received by 收貨人簽

Issued by 經手人 Director

GRAPHIC ELECTRONIC & ELECTRIC SDN. BHD.

集藝電氣有限公司

~~No. 21, Jalan Dewani, Off Jalan Tampoi, Majidee 81100, Johor Bahru, Johor. Tel: 07-319660~~

PB78

Dewani, off Tampoi 81100 Johor Bahru, Johor. Tel: 07-

M/s Jumaya Industries Sdn.Bhd.
7A Jalan Kilang Dato Onn Industrial Estate
80350 Johor Bahru.

發貨單
INVOICE

№ 0472

送貨單號 D.O. No: 0500

限期 Terms: 30 Days

日期 Date 09-11-92

編號 No	數量 Quantity	摘 PARTICULARS 要	單價 Unit Price	銀額 $ Amount	¢
1	1 no	To supply labour and material for			
2		wiring of supply 3 phase 415V &			
3		Neutral + E to new Taiwan winding			
4		m/c.	$ 120	$ 120	00
5					
6	1 no	To supply labour and material for			
7		wiring of supply 3 phase 415V + E			
8		to capstan of new m/c. c/w 1no			
9		Taian 3HP direct on line starter			
10		and fix to imerter side.	$ 210	$ 210	00
11					
12					
13					
14		Mringgit: three hundred and thirty			
15		only			
16					
			共銀 TOTAL $	$ 330	00

Date	21 DEC 1992
C. M.	
Fty Manager	
General Manager	
Secretary	
A/C Dept.	
Sales Dept.	
Store Dept.	

茲收到上列各貨完整無訛
Received the above goods in good order & condition.

集藝電氣有限公司
GRAPHIC ELECTRONIC & ELECTRIC SDN. BHD.

Received by 收貨人簽

Issued by 經手人

Director

GRAPHIC ELECTRONIC & ELECTRIC SDN. BHD.
集藝電氣有限公司
No. ~~21, Jalan Dewani, Off Jalan Tampoi, Majidee 81100,~~
Jo~~hor Bahru, Johor. Tel: 07-319660~~
6, Lot ..., ... off Tampoi 81100 Johor Bahru, Johor. Tel: 07-...

PS78

M/s Jumaya Industries Sdn.Bhd.
7A Jalan Kilang Dato Onn Industrial Estate
80350 Johor Bahru.

發貨單
INVOICE
№ 0471

送貨單號 D.O. No: 0499
賬期 Terms: 30 Days
日期 Date: 09-11-92

編號 No.	數量 Quantity	摘 PARTICULARS 要	單價 Unit Price	銀額 $ Amount	¢
1		To supply the following and labour			
2		charge for modification of Taiwan			
3		winding m/c.			
4	2 nos	3phase 415V 6A voltage slider for			
5		for torque motor.			
6	2 nos	240V Aurronics two preset counter			
7		(digital type.)			
8	2 nos	Foot switch control to off the			
9		system.			
10	4 nos	Taian 230V contactor c/w Aux			
11		contact.			
12		Labour for rewiring of electrical			
13		control and circuit design.		$ 5,490	00
14					
15		Mringgit: five thousnad four hundred			
16		and ninety only.			

Date	21 DEC 1992
G. M.	
Fty Manager	
Asst Manager	
Secretary	
A/C Dept.	
Sales Dept.	
Store Dept.	

茲收到上列各貨完整無訛
Received the above goods in good order & condition.

共銀 TOTAL $ 5,490 00

集藝電氣有限公司
GRAPHIC ELECTRONIC & ELECTRIC SDN. BHD.

Received by 收貨人簽

Issued by 經手人 Director

INVOICE

№ 5902

PB20.

JAYA SARANA ENGINEERING SDN. BHD.

No. 102, Jalan Chengai, Melodies Garden, 80250 Johor Bahru, Johor. Tel: 338729 & 320896 Fax: 322515

Messrs; Jumaya Industries Sdn Bhd
No. 7, Jalan Kilang
Dato Onn Industrial Estate
80350 Johor Bahru

Ref: lmy/JB

Date: 31st. Dec. 19 92 (1/1/93)

YOUR P O NO:

Terms:

Quantity	Description	Unit Price	AMOUNT
	RE : GAS DETECTION SYSTEM		
	To supply & install :		
5 nos.	Gas detector		
1 no.	5 channel gas detector panel		(6)
2 nos.	Solenoid valve		
1 lot	Armoured cable		
	For the lump sum of		$27,000-00
	Ringgit : Twenty-seven thousand only.		

Date	18 JAN 1993	
G. M.	✓	Lee
Fty Manager		Lee
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

Interest at the rate of 2% per month or part of a month will be charged on amount outstanding for more than 30 days.

E. & O. E.

JAYA SARANA ENGINEERING SDN. BHD.

INVOICE

№ 5863

PB76.

JAYA SARANA ENGINEERING SDN. BHD.

No. 102, Jalan Chengai, Melodies Garden, 80250 Johor Bahru, Johor. Tel: 338729 & 320896 Fax: 322515

Messrs; Jumaya Industries Sdn Bhd
No. 7, Jalan Kilang, Dato' Onn Ind. Estate
80350 Johor Bahru.

Ref: mz/JB
Date: 19/12/92 19
YOUR P O NO:
Terms: 30 Days

Quantity	Description	Unit Price	AMOUNT
	To supply		
1 no	Trolley Mounted CO2 45kg Fire Extinguisher c/w Bomba Certificate		RM 2,565-00
	Ringgit : Two Thousand Five Hundred And Sixty Five Only		
	Refer to our d/o no. 7309 dd 18/12/92		

Date - 2 DEC 1992		
G. M.		
Fty Manager		
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

Interest at the rate of 2% per month or part of a month will be charged on amount outstanding for more than 30 days.

E. & O. E.

JAYA SARANA ENGINEERING SDN. BHD.

CREDIT NOTE

PB77.

JAYA SARANA ENGINEERING SDN. BHD.

55, JALAN PERISAI, TAMAN SERI TERBAU,
JOHORE BAHRU, JOHORE, MALAYSIA.

No. 92/004/93

Messrs Jumaya Industries Sdn Bhd
7, Jalan Kilang, Dato' Onn Ind. Estate
80380 Johor Bahru

Ref mz/JB

Date 16/12/92 19

PARTICULARS	AMOUNT $
UPGRADING OF WAREHOUSE WITH HEAT DETECTOR FOR MS ROKONG INDUSTRIES, 7, JLN. KILANG, JOHOR BAHRU - INVOICE NO. 5811	
Being discount for the above invoice	M$ 700-00
RM : Seven Hundred Only	

Date 19 DEC 1992		
G. M.		
Fty Manager		
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

JAYA SARANA ENGINEERING SDN. BHD.

C-W-P-FO-827

INVOICE

№ 5846

JAYA SARANA ENGINEERING SDN. BHD.

No. 102, Jalan Chengai, Melodies Garden, 80250 Johor Bahru, Johor. Tel: 338729 & 320896 Fax: 322515

Messrs; Jumaya Industries Sdn Bhd
No. 7, Jalan Kilang, Dato' Onn Ind.
Estate, 80350 Johor Bahru.

Ref: mz/JB
Date: 15/12/92 19
YOUR P O NO:
Terms: 30 Days

Quantity	Description	Unit Price	AMOUNT
	SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF GAS DETECTION SYSTEM AND VENTILATION SYSTEM		
	Ventilation System		
6 nos	Axial Exhaust Fan		
1 no	Exhaust fan Starter Panel		
1 lot	Duct Works		
1 lot	Wiring		
	Lump sum :		M$ 44,000-00
	Ringgit : Forty Four Thousand Only		
	Refer to our letter Ram/92 dd 24/10/92 (Item 8)		

Date	11 MAR 1993	
G. M.		
Fty Manager		
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

Interest at the rate of 2% per month or part of a month will be charged on amount outstanding for more than 30 days.

E. & O. E.

JAYA SARANA ENGINEERING SDN. BHD.

INVOICE

№ 5839

JAYA SARANA ENGINEERING SDN. BHD. P876

No. 102, Jalan Chengai, Melodies Garden, 80250 Johor Bahru, Johor. Tel: 338729 & 320896 Fax: 322515

Messrs; Jumaya Industies Sdn Bhd
No. 7, Jalan Kilang, Dato' Onn Ind. Estate
80350 Johor Bahru.

Ref: mz/JB
Date: 11/12/92 19
YOUR P O NO: 261192
Terms: 30 Days

Quantity	Description	Unit Price	AMOUNT
	To supply		
1 no	Trolley Mounted CO2 45kg Fire Extinguisher c/w Licence		M$ 2,565-00
	Ringgit : Two Thousand Five Hundred And Sixty Five Only		
	Refer to our d/o no. 7287 dd 11/12/92		

Date 21 DEC 1992	
G. M.	
Fty Manager	
Asst. Manager	
Secretary	
A/C Dept.	
Sales Dept.	
Store Dept.	

Interest at the rate of 2% per month or part of a month will be charged on amount outstanding for more than 30 days.

E. & O. E.

JAYA SARANA ENGINEERING SDN. BHD.

CREDIT NOTE

PB 74.

JAYA SARANA ENGINEERING SDN. BHD.
~~55, JALAN PERISAI, TAMAN SERI TERBAU,~~
JOHORE BAHRU, JOHORE, MALAYSIA.

No. 92/003/93

Messrs Jumaya Industries Sdn Bhd
7, Jalan Kilang
Dato Onn Industrial Estate
80350 Johor Bahru

Ref lmy/JB

Date 30th Nov. 1992

PARTICULARS	AMOUNT $
RE : OUR INVOICE NO.5744 dd. 30/10/92 Being the above Invoice overcharged. The amount should be $19,000-00 instead of $22,030-00. Ringgit : Three thousand and thirty only.	$3,030-00

JAYA SARANA ENGINEERING SDN. BHD.

INVOICE

№ 5811

P674

JAYA SARANA ENGINEERING SDN. BHD.

No. 102, Jalan Chengai, Melodies Garden, 80250 Johor Bahru, Johor. Tel: 338729 & 320896 Fax: 322515

Ref: lmy/JB

Messrs: Jumaya Industries Sdn Bhd
7, Jalan Kilang
Dato Onn Industrial Estate
80380 Johor Bahru

Date: 30th Nov. 19 92

YOUR P O NO:

Terms:

Quantity	Description	Unit Price	AMOUNT
	RE : UPGRADING OF WAREHOUSES WITH HEAT DETECTOR FOR MS POKONG INDUSTRIES, 7, JLN. KILANG JOHOR BAHRU		
	To supply & install :		
	24 nos. heat detector c/w wiring in metal conduit and also c/w armoured cable to your alarm panel		$ 8,900-00
	To service and putting bulb to your Keluar sign To replace and service emergency light		$ 1,600-00
			$10,500-00
	Ringgit : Ten thousand five hundred only.		

Date	3 DEC 1992	
G. M.	✓	
Fty Manager		
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

Interest at the rate of 2% per month or part of a month will be charged on amount outstanding for more than 30 days.

E. & O. E.

JAYA SARANA ENGINEERING SDN. BHD.

INVOICE

№ 5798

PB74

JAYA SARANA ENGINEERING SDN. BHD.

No. 102, Jalan Chengai, Melodies Garden, 80250 Johor Bahru, Johor. Tel: 338729 & 320896 Fax: 322515

Messrs; Jumaya Industries Sdn Bhd
No. 7, Jalan Kilang, Dato' Onn Industries
Estate, 80350 Johor Bahru.

Ref: mz/J8
Date: 24/11/92 19
YOUR P O NO:
Terms: 30 Days

Quantity	Description	Unit Price	AMOUNT
	To supply		
1 no	2½ L/A Branchpipe Nozzle		M$ 37-00
	Ringgit : Thirty Sewen Only		
	Refer to our d/o no. 7243 dd 24/11/92		

Date	7 DEC 1992	
G. M.		
Fty Manager		
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

Interest at the rate of 2% per month or part of a month will be charged on amount outstanding for more than 30 days.

E. & O. E.

JAYA SARANA ENGINEERING SDN. BHD.

INVOICE

№ 5776

P874

JAYA SARANA ENGINEERING SDN. BHD.

No. 102, Jalan Chengai, Melodies Garden, 80250 Johor Bahru, Johor. Tel: 338729 & 320896 Fax: 322515

Messrs; Jumaya Industrial Sdn Bhd
7, Jalan Kilang, Dato' Onn Ind. Estate,
80350 Johor Bahru

Ref: mz/JB
Date: 14/11/92 19
YOUR P O NO:
Terms: 30 Days

Quantity	Description	Unit Price	AMOUNT
	To supply		
2 nos	Eversafe 9kg ABC Dry Powder Fire Extinguisher c/w Licence	@$110-00	M$ 220-00
	Ringgit : Two Hundred And Twenty Only		
	Refer to our d/o no. 7208 dd 14/11/92		

Date 27 NOV 1992		
G. M.		
Pty Manager		Lee
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

Interest at the rate of 2% per month or part of a month will be charged on amount outstanding for more than 30 days.

E. & O. E.

JAYA SARANA ENGINEERING SDN. BHD.

INVOICE

№ 5764

PB74

JAYA SARANA ENGINEERING SDN. BHD.

No. 102, Jalan Chengai, Melodies Garden, 80250 Johor Bahru, Johor. Tel: 338729 & 320896 Fax: 322515

Messrs; Jumaiya Industries Sdn Bhd
No. 7, Jalan Kilang, Dato' Onn Ind. Estate
80350 Johor Bahru

Madam Wong

Ref: mz/JB
Date: 5/11/92 19
YOUR P O NO:
Terms: 30 Days

Quantity	Description	Unit Price	AMOUNT
	To supply		
1 no	Hosereel Drum		M$ 110-00
	Ringgit : One Hundred And Ten Only		
	Refer to our d/o no. 7182 dd 5/11/92		

Date	27 NOV 1992	
G. M.		
Fty Manager		Lee
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

Interest at the rate of 2% per month or part of a month will be charged on amount outstanding for more than 30 days.

E. & O. E.

JAYA SARANA ENGINEERING SDN. BHD.

INVOICE

№ 5744

P6/3

JAYA SARANA ENGINEERING SDN. BHD.

No. 102, Jalan Chengai, Melodies Garden, 80250 Johor Bahru, Johor. Tel: 338729 & 320896 Fax: 322515

Messrs; Jumaya Industries Sdn Bhd
7, Jalan Kilang, Dato' Onn Industrial
Estate, 80350 Johor Bahru.

Ref: mz/JB
Date: 30/10/92 19
YOUR P O NO:
Terms: 30 Days

Quantity	Description	Unit Price	AMOUNT
	To supply and Install		
22 nos	Spray Nozzle		M$ 1,320-00
1 no	4" Ø Butterfly Valve		300-00
1 no	4" Ø Gate Valve		280-00
2 nos	2½" Ø Gate Valve		360-00
2 nos	Double Outlet Pillar Hydrant		1,200-00
2 nos	4" Elbow Bend		90-00
4 nos	4" TE Flanges		80-00
2 nos	Hose Cabinet c/w Hose & Nozzle		2,600-00
1 lot	G.I. C Pipe, Fittings and Bracket		7,800-00
1 lot	Drawings		1,500-00
1 lot	Testing and Commissioning		3,000-00
1 lot	Bomba Inspection Fee		3,500-00
			M$22,030-00
	Ringgit : Twenty Two Thousand And Thirty Only		M$ 19000

Date: 7 NOV 1992		
G. M.	✓	Cleary
Fty Manager		
Asst. Manager		
Secretary		
A/C Dept.		
Sales Dept.		
Store Dept.		

Interest at the rate of 2% per month or part of a month will be charged on amount outstanding for more than 30 days.

E. & O. E.

JAYA SARANA ENGINEERING SDN. BHD.

INVOICE

O. NO-0201/93 Date: FEB. 20 1993

NVOICE of ONE SET HIGH PRESSURE PUMP

or account and risk of Messrs. JUMAYA INDUSTRIES SDN BHD

NO. 7 JLN KILANG DATO ONN INDUSTRIAL ESTATE 80350 JOHOR BAHRU, MALAYSIA.

hipped by NEW ONE MACHINERY CO., LTD. per CHINA SEA V-252W

ailing on or about FEB 23 1993 From KEELUNG, TAIWAN to SINGAPORE

/C No. Contract No.

Marks & Nos.	Description of Goods	Quantity	Unit Price	Amount
			C&F SINGAPORE	
	ONE SET HIGH PRESSURE PUMP	1SET	USD24,469.00	USD24,469.00
		1SET vvvv		USD24,469.00 vvvvvvvvvvvv

SAY TOTAL US DOLLARS TWENTY FOUR THOUSAND FOUR HUNDRED SIXTY NINE ONLY.
DRAWN UNDER: ORIENTAL BANK BERHAD. MALAYSIA
L/C NO. LC/JB/USD/930034 DATED : 11FEB93

SHIPPING-MARKS

JUMAYA INDUSTRIES SDN. BHD.
W/NO.1
N.W.:2,150KGS
G.W.:2,210KGS
MEAS:143CM X 91CM X 137CM
MADE IN TAIWAN
R. O. C.

HUA NAN COMMERCIAL BANK
HQB 303718

ORIENTAL BANK BERHAD
JOHOR BAHRU BR.

NEW ONE MACHINERY CO., LTD.

N.J. Ku

General Manager

Sub-Prgdl II

(1)

E. & O. E.

ANNEX-D

JUMAYA INDUSTRIES
RECURRING INCREMENTAL COSTS CALCULATION

1) **ASSUMPTIONS**

- o Prices from October 1992 (date of project submission by Jumaya),
- o Butane price from EEAA,
- o LPG use 20% higher than CFC-12; Butane use identical to CFC-12,
- o Required extra additives: USD 30/t of resin,
- o Preventive maintenance: 5% of project costs,
- o 1 USD = 2.58 M$ = 1.62 S$,
- o USD 400/container surcharge for reclassification of material (this may be changed if the company can show that the material shipped is essential free of hydrocarbons).

1) **MATERIAL**

o Before: 150t CFC-12 @ 2.09............**USD 313,500**
o Now: 180t LPG @ 0.36........65,233
additives..............27,000....**USD 92,233**
o Future: 150t Butane @ 1.50 225,000
additives...........27,000....**USD 252,000**

2) **OTHER RECURRING INCREMENTAL COSTS**

o 3 Safety inspectors.........28,000
o Extra Maintenance...........12,700
o Extra insurance.............15,000
o Lease Aging Room.............7,500
o Surcharge Transportation 18,600....**USD 81,800**

3) **TOTAL ANNUAL RECURRING INCREMENTAL COSTS**

o For LPG............................**(USD 139,467)**
============

o For Butane.......................... **USD 20,300**
===========

MEMORANDUM

FROM: BERT VEENENDAAL
UNDP SECTOR CONSULTANT

TO: MR. FRANK J.P. PINTO
UNDP/BPPE/ENR

DATE: MAY 14, 1993

SUBJECT: JUMAYA INDUSTRIES ELIMINATION OF CFC-12 IN THE MANUFACTURE OF EXTRUDED POLYSTYRENE FOAM SHEET
TECHNICAL REVIEW

I reviewed for the Jumaya project the following information:

- o Original proposal,
- o revised proposal, prepared with assistance of UNDP,
- o Related invoices and quotations.

In addition, I visited the Jumaya facilities and reviewed the progress on this project.

1. TECHNOLOGY

We agree with the selection of butane as the most suitable replacement technology. We understand the companies decision to start with LPG gas, as butane is currently not sold in Malaysia, but relate current inconsistencies in quality to the relative high volatility of some of the components in LPG, which is a mixture of several hydrocarbons. It is therefore recommended to replace LPG as soon as feasible and to base the project's economics on butane.

In addition we have recommended to the company to add some safety features to the design and to perform a comprehensive monitoring program that includes the measurement of gas concentrations around motors and other electrical and/or moving equipment parts. The costs of these additional features are already included in the project costs.

2. PROJECT COSTS

We commend the company with the excellent sourcing on cost effective replacement technology. We learned from the quotations that the initial offer from the original equipment supplier was much higher and more in line with those that we know from other projects. Jumaya searched further and was successful in soliciting a much lower offer from a company in Taiwan. Subsequently Jumaya was even able to improve on this proposal through the elimination of know-how costs! The company proceeded very cautious by insisting on proof of capability through the visit of a facility that was previously converted by this company. The effect of this procedure will be reflected in future EPS projects, that may carry significant lower Unit abatement costs than was usual until now.

To assure that the technology employed meets customary safety standards we have designed and included in the project costs a safety audit.

The recurring incremental costs analysis shows a slight disadvantage for the use of butane. This is not related to the costs of butane--clearly lower than CFC-12--but to surcharges in insurance and transportation. The company may be able to renegotiate these after the safety audit, assuming a positive result, and improve so with the cost structure to at least previous levels.

Jumaya proposed this project already mid last year, although UNDP received it only very recently, and acted immediately. The company decided not to wait, and has the project essentially implemented. A cost review revealed prudent procurement, and no elements that we feel we should object to. We therefore recommend to approve this project, under the observation that Jumaya's activities may save the MLF significant expenses in the future.

COUNTRY	:	MALAYSIA
SECTOR COVERED	:	AUTOMOBILE (RETROFITTING)
ODS CONSUMPTION IN AFFECTED AREA, 1992	:	OEM : 214 MT SERVICE : 857 MT TOTAL : 1,071 MT
PROJECT TITLE	:	AUTOMOBILE RETROFITTING DEMONSTRATION PROJECT WITH ALTERNATES TO CFC-12
PROJECT DURATION	:	DECEMBER 1993 - DECEMBER 1995
PROJECT IMPACT	:	a) ODS PHASE-OUT : 198.50KG DURING PILOT PROJECT. b) EXPECTED ODS PHASE-OUT AFTER PILOT PROJECT (1995 - 2000) : 936MT (CFC-12 BANK IN 1995).
PROPOSED BUDGET	:	USD426,806.00 (US DOLLARS FOUR HUNDRED AND TWENTY SIX THOUSAND EIGHT HUNDRED AND SIX).
IMPLEMENTING AGENCY	:	UNDP
NATIONAL COORDINATING AGENCY	:	MALAYSIA NATIONAL STEERING COMMITTEE FOR MONTREAL PROTOCOL.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Malaysia National Steering Committee for Montreal Protocol has taken the initiative to submit this proposal to assist motorists in Malaysia to cope with the eventual phase out of CFC-12 which is widely used in the automobile industry as a refrigerant. The sector data indicates that there are about two million existing passenger cars on the road today in Malaysia. Most of these cars are models made since 1977 and almost 100% of them are air conditioned with CFC-12. It is expected that at least 2.5 million cars containing CFC-12 as refrigerant will be on the road by 1995 (see Table 2), giving rise to a CFC-12 bank of 2,341MT and a minimum requirement of 936MT of CFC-12 for servicing based on a 40% leakage rate. While effort has been made to recover and recycle the CFC-12 bank through UNEP funding, it is expected that only 25% of the CFC-12 can be recovered. It is therefore important to highlight to the motorists the possible scenario after 1995 regarding CFC-12 supply and the options that will be available to them to retrofit their cars to more ozone friendly alternatives without incurring unnecessary losses. At the same time, the auto workshop mechanics will also have to be trained to handle the retrofit process. There are about 2,000 auto-workshops in Malaysia that service car air conditioner and that works out to be at least 4,000 mechanics. They have to be trained from now until 1995 to help the motorists. It is with these intents that Malaysia National Steering Committee for Montreal Protocol puts up this proposal so that Malaysia will be able to have an orderly transition in one of industrial world toughest metamorphosis.

PROJECT SUMMARY

This shall be a pilot project launch with the twin objectives of training the auto-workshop to retrofit as well as to educate the consumers on the challenges and options available in the post 1995 era when CFC-12 is no longer available as a result of production and consumption controlled under the Montreal Protocol. The project will involve the retrofitting of 200 cars with the help of the multilateral fund between 1994 and 1995. The retrofitting shall be done with established procedures (by Du Pont and OEMs) using alternative refrigerants HFC 134a and Suva MP52 blends (HCFC22/HCFC124/HFC152a). The idea of introducing two retrofit refrigerants is to provide the consumers (motorists) with a cheaper and established option in Suva MP52. This is especially a viable choice for cars that are near to the end of their useful economic life span, such as car models of 1987 and below. New cars and cars made after 1987 will be encouraged to retrofit to HFC134a in view of their longer life span after 1995. This approach, we believe will help to reduce unnecessary imports of parts and components due to premature obsolescence of useful vehicles. It will also reduce the dependency on HFC134a which is expected to be in high demand in the OEMs sector.

The mechanics will be trained in stages in line with the car retrofit programme. The National Steering Committee for Montreal Protocol, with the help of Du Pont, will initiate the first training of 50 mechanics who will then form the core of certified trainers to train the rest of the mechanics in the country.

Three administrative and training centres shall be set up in the central, northern and southern region of Malaysia for this purpose. Such centres shall be manned and equipped with softwares and equipments to undertake their tasks. Monthly progressive report shall be channelled back from these centres to the Technical Committee, who in turn reports to the Chairman, Malaysia National Steering Committee (NSC) for Montreal Protocol. The Technical Committee within the NSC will provide periodical review and advice to the retrofit programme.

Posters, "take-one" leaflets, car decals relating to the retrofit programme, will be widely distributed and publicized through mass media. It is hoped that at the end of 1995, the set objectives of the pilot project will be accomplished leading to a smooth and orderly transition. It is also hope that this project will form a blue print to other intending retrofitting programme such as chillers and home refrigerant retrofitting, in Malaysia.

SECTOR DATA

Malaysia currently imports all its CFC needs from developed countries. In 1992, Malaysia imports 1442MT CFC-11, 1306MT CFC-12 and 836MT CFC-113 totalling 3584MT (excluding Halon) which is equivalent to 3417 ODP tonnes. Out of the total CFC consumption in 1992, 1306 are CFC-12 which accounts for 36% of the total (Appendix I).

Background Information

1. Vehicles in Malaysia

Cars formed 35% of the total number of vehicles in Malaysia. Out of the near 2 million cars on the road in 1991, almost 100% are air-conditioned (App. II). The growth rate of the new cars is based on the annual population growth of 2% and the projected GDP growth as shown in Table 1.

Table 1: Growth of Cars in Malaysia From 1992 to 2000.

*Total No. of Cars Brought Forward	**Estimated Growth Rate of New Cars	New Cars	Less 15 Years Cars	Total No. Of Cars On The Road
	1977 }	39,281		
	1978 }	43,645		
	1979 }	48,495		
	1980 } Growth	53,883		
	1981 } 10%	59,870		
	1982 }	66,522		
	1983 }	73,914		
	1984] Recession	82,127		
	1985] 5%	86,450		
	1986]	91,000		
	1987 }	95,790		
	1988 } Growth	106,434		
	1989 } 10%	118,260		
	1990 }	131,400		
	1991 }	146,000		
2,000,000	1992	160,000	39,281	2,120,719
2,120,719	1993 } 9.6%	175,360	43,645	2,252,434
2,252,434	1994 } 9%	191,140	48,495	2,395,079
2,395,079	1995 } 7%	204,522	53,883	2,545,718
2,545,718	1996 } 5%	214,750	59,870	2,700,598
2,700,598	1997 } 5%	225,487	66,522	2,859,563
2,859,563	1998 } 5%	236,760	73,914	3,022,409
3,022,409	1999 } 5%	248,600	82,127	3,188,882
3,188,882	2000 } 5%	261,030	86,450	3,363,462

* Total number of cars as per Figure 1 is approximately 2MM in 1991. Useful economic life span of car at 15 years.

** Population growth at 2% per annum and Projected GDP growth as per 1992/1993 Economic Report.

2. CURRENT SITUATION

CFC-12 Distribution in 1992

In 1992, Malaysia imported 1442MT of CFC-11 and 1,306MT of CFC-12 (Source: NST). Out of the total CFC-11 consumption, 225MT (Source: Du Pont/Westech) was estimated to have been used in the air-conditioning segment. This together with the total CFC-12 import formed the total CFC consumption in the air-conditioning segment which amounts to 1531MT (225MT + 1306MT). DOE reported in ASHRAE Seminar 1992, 70% used for air-conditioning goes into Automobile market while 30% goes into the building application. Based on this information, the total CFCs used in the automobile segment is 1071MT which is 100% CFC-12.

The automobile industry is basically divided into two segments i.e. OEM (ORIGINAL EQUIPMENT MANUFACTURER) and SERVICE. Based on Du Pont's estimates 20% of the CFC-12 consumption in the automobile industry goes into the OEM and 80% goes into the service segment. Therefore, the total consumption of CFC-12 in 1992 in the auto OEM segment is 214MT while in the service segment is 857MT.

3. THE PROBLEM

In analysing the potential problem that will be faced by the car owners in Malaysia with regards to the phase out of CFC-12 according to Montreal Protocol, it is important to quantify the CFC-12 bank that is available from now to 1995.

Table 2: Estimated CFC-12 Bank in Malaysia until 1995

	* Car Population With CFC-12 System	Car Population with R134a	CFC Bank	**Annual Service Consumption
1992	2120719	Negligible	2120719	857
1993	2252434	Negligible	2252434	900
1994	2395079	95570	2299509	920
1995	2545718	204522	2341196	936

* 50% of new cars in 1994 will be charged with HFC134a. 100% of new cars in 1995 will be charged with 134a.

** Leakage rate at 40%

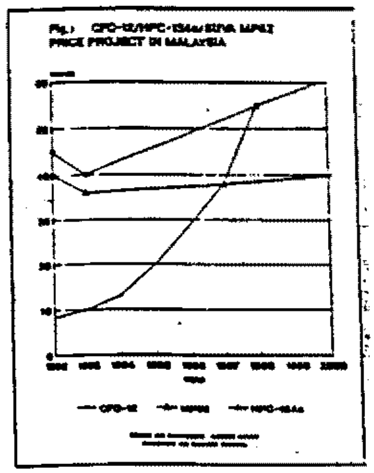
Cars population in 1995 = 2341196
Charged with CFC-12

CFC-12 Bank 1995 = 2341MT

Service = 936MT

Assuming 25% is recovered through recycling/reclaiming = 234MT
Therefore Net CFc requirement for service in 1995 = 702MT

Basing on 702MT and the projected requirement of CFC-12 for service it is estimated that the 1995 CFC-12 bank will not be sufficient to meet the demand by 1997. Cost of CFC-12 is expected to escalate in 1995 and should surpass cost of alternative products which are readily available by then (Fig. 1).



Car owners in Malaysia, especially those with cars less than 15 years old will most probably have to decide by 1996 on the path forward for their air conditioning system. They will be in dilemma if there is no direction from the government and the industry. The mechanics in the auto workshop may not have all the answers to fulfill the consumers' needs if they themselves are not trained to handle the new development.

Malaysia will stand to lose millions of Ringgit due to loss of useful product life of the existing car fleet or through massive importation of spare parts on an ad hoc basics to keep the existing fleet going. This may breed discontent among the consumers as it will be an added financial burden to them.

All these will not go down well for a nation that is striving to achieve a developed country status by year 2020 of which national savings of at least 35% of the GNP has been targetted.

4. THE OPTIONS

Based on current market information, the consumer has three options as proposed by the industry (compressor OEMs and refrigerant manufacturers).

Table 3: Malaysia automobile retrofitting options

Options Description	A	B	C
	Major retrofitting Using R134a	Basic Retrofitting Using R134a	Retrofitting Using Suva MP52
Generic of Refrigerant	HFC	HFC	HFC/HCFC Blends
ODP of Refrigerant	0	0	0.03
Proposed retroffiting cost	R,1,000**	RM400**	RM250**
Parts to be replaced from existing R12 system	Compressor, O-rings changing valves, lubricant, fitting parts, evaporator, condenser, receiver dyer hoses.	Lubricant, fittings, receiver dryer hoses, o-rings, condenser. *	Lubricant, fittings, receiver dryer hoses, * o-rings
Estimated total cost based on 1992 car population of 2 million	RM2 Billion	RM800 Million	RM500 Million
Total ODP saving based on 1992 car population of 2 million at 1 kg charge capacity/car	857MT	857MT	831MT

* Optional. Basic retrofit cost of RM400 does not include the condenser.

** Minimum cost for cars about 1.6 litres and below.

REMARKS

OPTION A : MAJOR RETROFITTING

The major retrofitting option involves the change of the existing CFC-12 compressor, hence almost the whole aircondition system in the car. We would prefer to refer this as "replacement to new" rather than "retrofitting".

OPTION B & C : BASIC RETROFITTING

The basic retrofitting with HFC134a and Suva MP52 (HFC152a/HCFC22/HCFC124) are thus prime candidates for consideration.

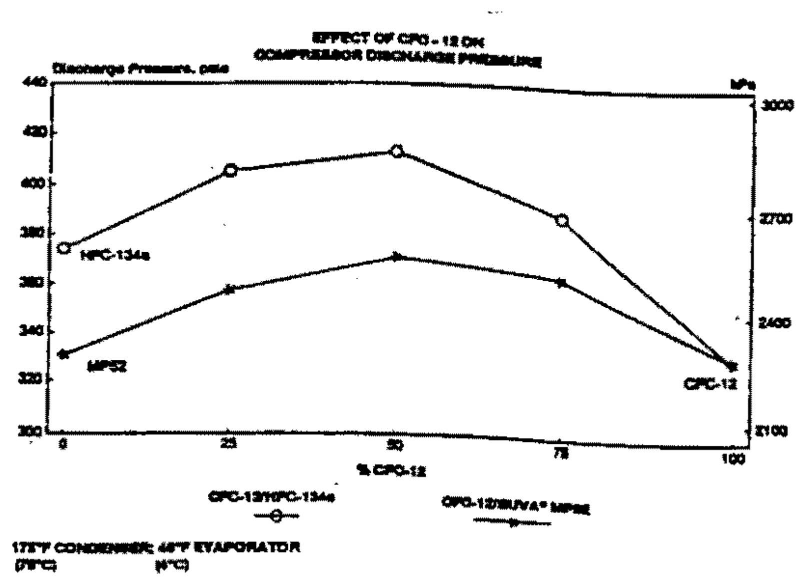
The two retrofitting procedures can be briefly summarized in Table No. 4

Table 4: Proposed retrofitting procedure with Suva MP52 and HFC134a.

SUVA MP52	**SUVA TRANS A/C (R134a)**
• Collect existing running conditions	• Collect existing running conditions
• Remove R12	• Remove R12
• Remove Accumulator/Drier	• Remove Accumulator/Drier
• If existing hoses are not nylon lined or nylon barrier hose, remove suction and discharge hoses. Replace with nylon lined or barrier hose. Use new Neoprene 'O' rings seals.	• Remove compressor, drain out mineral oil and flush with ester lubricant. Follow through with nylon lined or barrier hose.
• Fit new accumulator/Drier containing XH9 Desicant. Use new Neoprene 'O' rings.	• If existing hoses are not nylon lined or nylon barrier hose, remove suction and discharge hoses. Replace with nylon lined or barrier hose.
• Evacuate system, isolate from vacuum pump and ensure system will hold vacuum.	• Flush condenser and evaporator with ester lubricant via discharge line. Follow through with purge of dry nitrogen.
• Add 50CCs alkyl Benzene/ester oil to unit whilst under vacuum.	• Refit compressor using new neoprene ring seals to suction and discharge ports.
• Charge Suva MP52 into system. Note - must be charged in the liquid phase from the bottom of the cylinder. Liquid refrigerant should be admitted to the high pressure side.	• Fit new accumulator/drier containing XH9 dessicant. Use new neoprene 'O' ring seals to suction and discharge ports.
• Weight of Suva MP52 used should be 10% less than manufacturers recommended charge for R12.	• Evacuate system isolate from vacuum pump and ensure system will hold vacuum.
• Test run system - check for leaks and record cooling performance.	• Add 100CCs ester lubricant to unit whilst under vacuum.
• Note: Some bubbles might still be visible in the sight glass. This is normal.	Charge R134a into system.
	Weight of R134a used should be 10% less than manufacturers recommend charge for R12.
	• Test run system - check for leaks and record cooling performance.
	• Note: If high pressure switch is fitted it may be necessary to replace it due to the higher operating pressure of R134a.
	• Charge ports may need to be modified to ensure tht R12 cannot be introduced into the retrofitted system.

The need to flush the existing CFC-12 system in HFC134a retrofitting is to prevent the degradation of retrofit lubricant by residual chlorine and reduce additional impact on system pressure of mixing CFC-12 and HFC134a as illustrated in Fig. 4.

Fig. 4: Effect of CFC-12 on compressor discharge pressure.



Positive results of MP52 retrofit have been reported consistently throughout trials and test run conducted in Australia (since 1991), China, Singapore, Taiwan and Malaysia (test result - Appendix V). The MP52 retrofit besides being able to offer a cheaper option to the customers, also offer a green solution to the automobile industry today.

Positive results have also been reported in HFC134a retrofit trial conducted trhoughout the world by Auto OEMs and lubricant manufacturer (Appendix V).

4. OBJECTIVES OF RETROFITTING PROGRAM IN MALAYSIA

A) SHORT TERM OBJECTIVES

- Accelerates CFCs phase out and offers environmentally conscious government cost effective ozone friendly alternatives and systems.

- Meeting demands of Copenhagen amendments which requires rapid action to identify suitable "back up" ozone friendly transitional substances with ODP values near to zero for existing equipments to meet the anticipated high demand of HFC134a by OEMs. Demand of HFC134a is expected to be about 200,000MT per annum by year 1995. World capacity is about 120,000MT per annum by year 1995.

B) LONG TERM OBJECTIVES

- Prolong the useful economic life span of motor vehicles air conditioners in Malaysia.

- Sustain favorable economic growth by reducing unnecessary import of new equipments, parts and components thus achieving substantial net national savings while enhancing trade balance and surplus.

- Producing a new crop of mechanics from the existing pool with numbers at 2,000 (minimum) via training who will be knowledgeable and capable of handling retrofitting and alternative products.

- Create consumer awareness through consistent promotion of educational program.

- Avoid ad hoc decisions and ensure a smooth transition by year 2000.

STRATEGIES TO ACCOMPLISH THE OVERALL OBJECTIVES

1. Submission of Project Paper to UNDP Kuala Lumpur Office by April 30th 1993 through the Malaysian Government Representatives.

2. Working with Technical Committeefor Montreal Protocol and further establish a sub-committee on Auto Retrofit to oversee the implementation of the Project. The committee members shall be lead by Du Pont and others.

3. Establish a local pool of trainers. Du Pont shall undertake to train the first batch of 50 mechanics by bringing in technical experts. This can be done initially at licensed outlets while waiting for facilities to be set up under the Project.

   All participants will be issued with certificates at the end of the workshop and they shall form the core of trainers for the Project assisted by Du Pont. The cost of running this training shall be derived from the UNDP funding under item (b).

4. Establish local facilities for retrofit training. One each to be located in KL/PJ, Penang and Johor which shall be manned and equipped with the necessary system/hardware.

5. To initiate the retrofit of 200 cars using HFC134a (150 nos.) and Suva MP52 (50 nos.) upon the approval of UNDP funding to establish cost effectiveness and provide industry direction.

   - The source of cars shall be derived from Government bodies and private sector.

   - Du Pont and other committee members shall coordinate the launch and monitoring of performance. This shall include arrangement with educational institutions such as MARA and Local Universities.

   - A six months guarantee will be issued to the 200 motorists by the Auto Retrofit committee. The guarantee will be backed up with UNDP funding as per item (c), application cost. Motorists will be provided with guidelines maintenance and list of trained auto air-conditioning centers for subsequent service. All technical complaints, if any, shall be directed to the committee center in each region for recording purpose.

6. Printing and display of posters, "take-one" leaflets, car decals to be prominently displayed in air-con/auto workshop, petrol stations, to catch the eye of walk-in customers, with the objective of raising awareness and influencing them to trial/conversion (Retrofit). The main message shall be "Retrofit While Servicing".

7. Evaluation of the Project shall be done by June 1995. Follow up actions to be established to transform the Project into a Macro Project. Details such as further funding, incentive schemes or subsidies for conversion and the incorporation of MAC Network after 1995 shall be further worked out in 1995.

5. PROPOSED INCREMENTAL COST OF UNDP FUNDING FOR HFC134a/SUVA MP52 RETROFITTING PROGRAMME

a) Incremental capital cost based on initial 200 cars, 150 cars to HFC134a, 50 cars to Suva MP52 (1USD = RM2.63)

DESCRIPTION	HFC134a (RM)	SUVA MP52 (RM)
Alternative Refrigerant	**70.00**	**40.00**
Lubricant	**10.00**	**10.00**
XH9 Dryer	**50.00**	**50.00**
Hose/Fittings	**100.00**	**100.00**
Flushing	**30.00**	**-**
Charge Ports	**40.00**	**-**
Labour	**100.00**	**50.00**
Retrofit Cost Per Car	**400.00**	**250.00**

Sub-total for HFC 134a retrofit (150 Cars) = RM60,000.00
Sub-total for Suva MP52 retrofit (50 cars) = RM12,500.00
Total incremental capital cost = RM60,000.00 + RM12,500.00
= RM72,500.00
= USD27,566.53

b) Cost on operational and administration costs

i) Organizational, administrative and other costs borne by DOE and other government bodies such as ODS Secretariate = RM150,000.00

ii) Cost of setting up three localized training centre including softwares, human resources, rental and operation cost = RM400,000

TOTAL = RM550,000.00
= **USD211,538.00**

c) Application Cost

i)	Guarantee bond	= RM100,000.00
ii)	Performance database collection	= <u>RM100,000.00</u>
	TOTAL	RM200,000.00
		<u>USD76,923.00</u>

d) Awareness Campaign and promotional materials on Auto-Retrofit = RM300,000.00

= **<u>USD115,385.00</u>**

Therefore, total incremental cost

= (a) + (b) + (c) + (d)

= RM1,122,500.00

= **<u>USD426,806.08</u>**

7. PROJECT TIMEFRAME

1993 to 1995.

8. EXPECTED OUTPUTS

At the end of 1995, we hope to achieve

a) A well trained and knowledgeable autoservice workforce to service the consumer. The number of mechanics trained at the end of 1995 is expected to be about 4,000.

b) Instill/create awareness among consumer and consumer associations towards this phase change and to prevent negative ad hoc reaction as a result of ignorance. The key is retrofitting while servicing!

c) Project Malaysia as an environmentally conscious country.

d) Sustaining economic growth through orderly transition in one of industrial world toughest metamorphosis.

e) Create awareness among industrialist with regards to their responsibility towards the consumers and the country.

f) Retrofitting Program endorsed by Malaysian Government with incentive schemes and subsidiaries funded by World Bank or UNDP.

9. WHO SHOULD BE INVOLVED IN THE PROJECT?

a) Government agencies (eg. MOE, MITI)
b) Compressor OEMs
c) Auto OEMs
d) Compressor lubricant manufacturers
e) Refrigerant manufacturers
f) Mass media (eg. documentary on retrofitting, ozone issue through channels like Majalah 3, Film Negara)

10. BUDGET

Basically as per incremental cost proposal. The anticipated timing of disbursements shall be determined by the joint committee to be set up soon.

11. IMPLEMENTATION ARRANGEMENT

Du Pont shall lead the project and have full responsibility over its implementation, including monitoring and inspection. Government bodies such as DOE and MITI shall be the supervising bodies.

SECTOR DATA

TABLE 1: MALAYSIA: CONSUMPTION DATA OF CFCs, 1985 – 1991

	ACT.	ODP	ACT.	ODP	ACT.	ODP	ACT.	ODP	ACT.	ODP	ACT.	ODP	ACT	ODP	ACT	ODP
	1985		1986		1987		1988		1989		1990		1991		1992	
CFC–11	363	363	576	576	810	810	998	998	834	834	1005.8	1005.8	1123	1123	1442	1442
CFC–12	456	456	1064	1064	1358	1358	1645	1645	1470	1470	1381.2	1381.2	1380	1380	1306	1306
CFC–113	119	95	684	547	876	701	1216	973	1381	1104	1244.2	995.4	1215	1040	836	669
CFC–114	2	2	3	3	35	35	53	53	30	50	–	–	–	–	–	–
CFC–115	–	–	–	–	1	0.6	–	–	5.5	3.3	1.8	1.8	–	–	–	
CFC CONSUMP.	940	916	2327	2190	3080	2904.6	3912	3669	3720.5	3441.3	3634.2	3384.2	3748	3543	3584	3417
% CFC–12	49%		45%		44%		44%		39%		38%		40%		36%	

Source : ASHRAE SEMINAR 1992
DEPARTMENT OF ENVIRONMENT MALAYSIA

Footnote : <u>ODP VALUES</u>

CFC–11 = 1 CFC–113 = 0.8 CFC–115 = 0.6
CFC–12 = 1 CFC–114 = 1

PROJECT DESCRIPTION
Vehicles in Malaysia

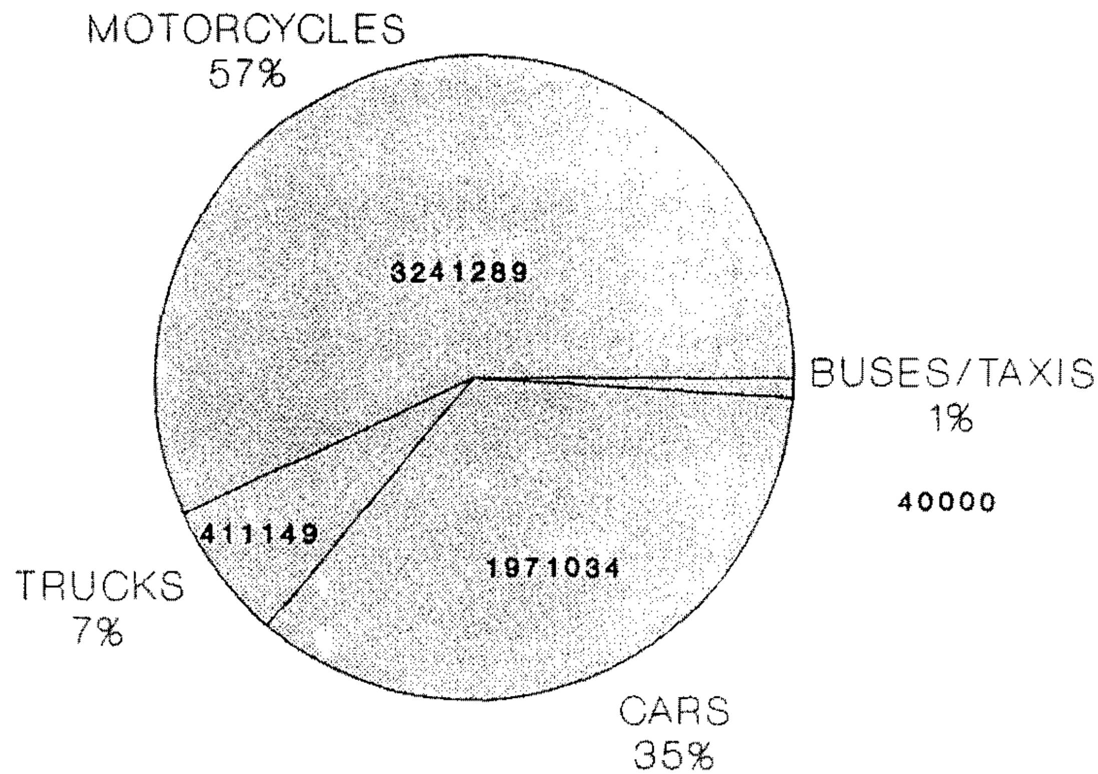


FIG. 2: NO OF VEHICLES BY TYPE AS AT DEC 1991.

Source: SIN CHEW JIT POH (6 MAR '92)

DRAFT

COMPETITIVE SUPPLY OUTLOOK
AFTER 94-95

EUROPE

ICI, Ato, Hoechst, Kali, etc — OUT 12/94

U.S.

Dupont, Allied — OUT 94-95

JAPAN

Export restrictions; currently inactive; one or two may continue to supply — OUT 94-95

A/P

Korea - no volume to export
Taiwan - — OUT 12/95
PRC - not enough volume to export. Commit to stop expansion.
India - Have sufficient capacity but quality problem

L/A

May continue ???

RUSSIA & EASTERN EUROPE

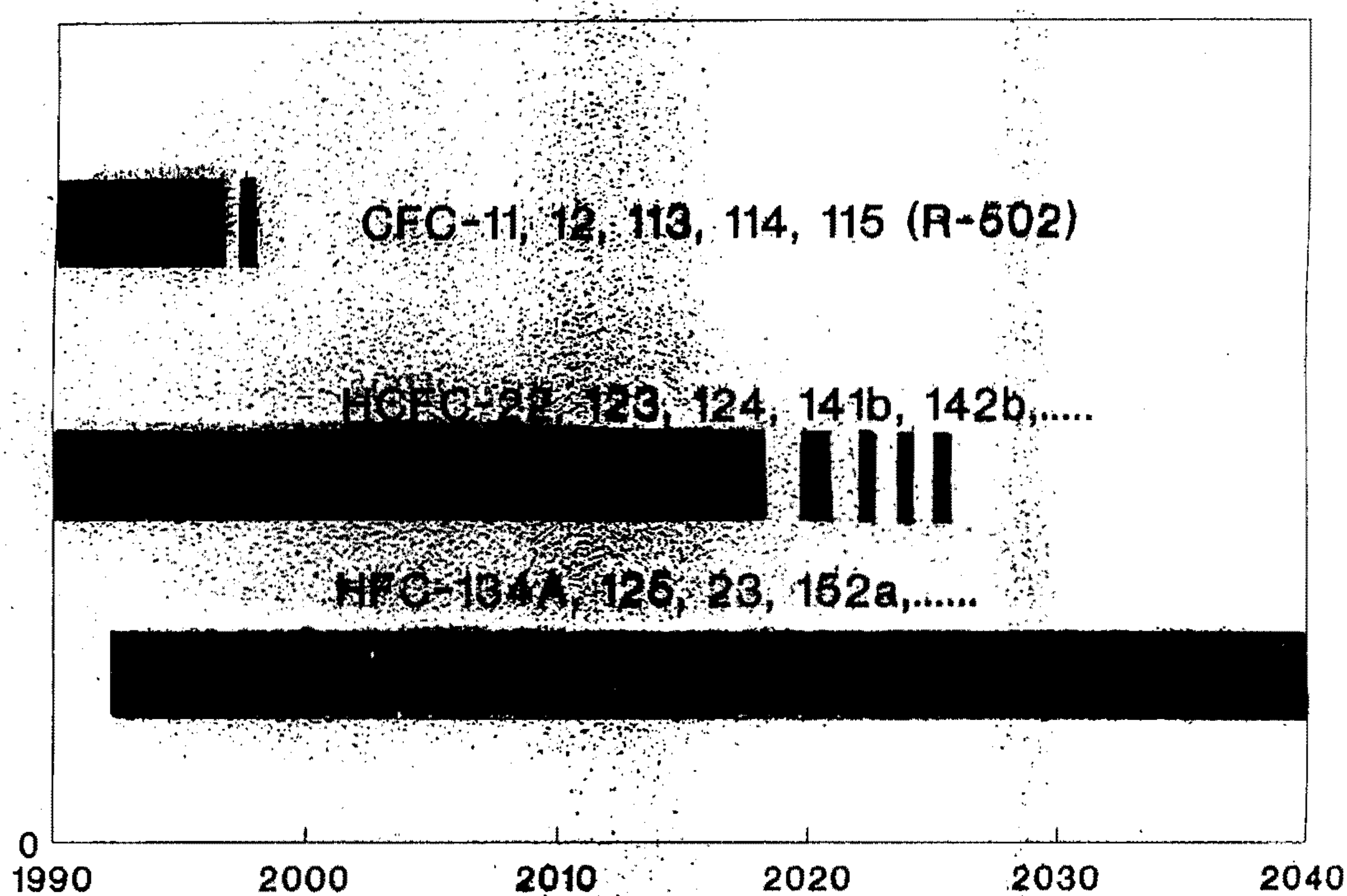
May continue

(L/A and Russia & Eastern Europe:) Logistics and quality issues

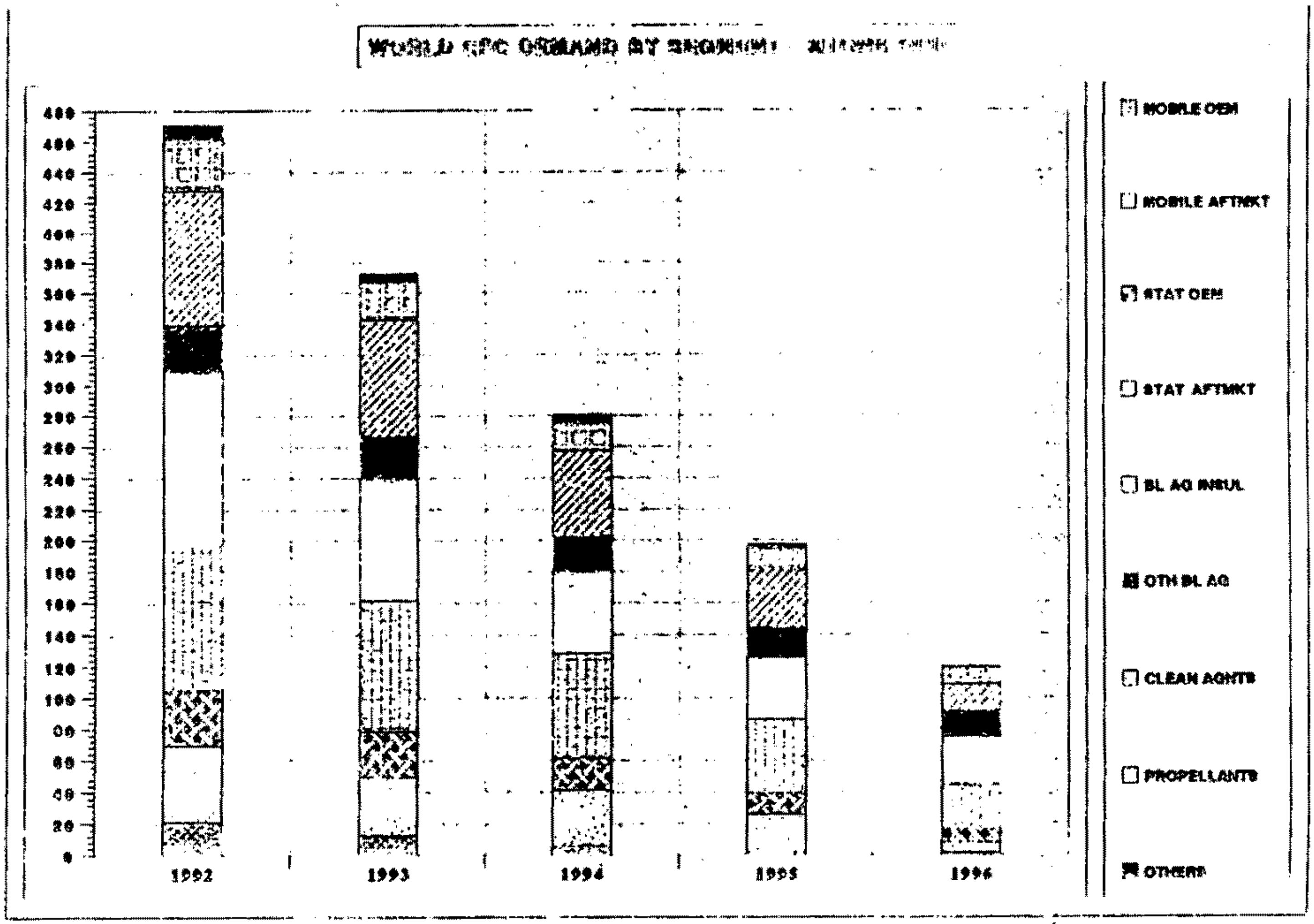
Pricing has been going up and may continue to increase - need to work together!

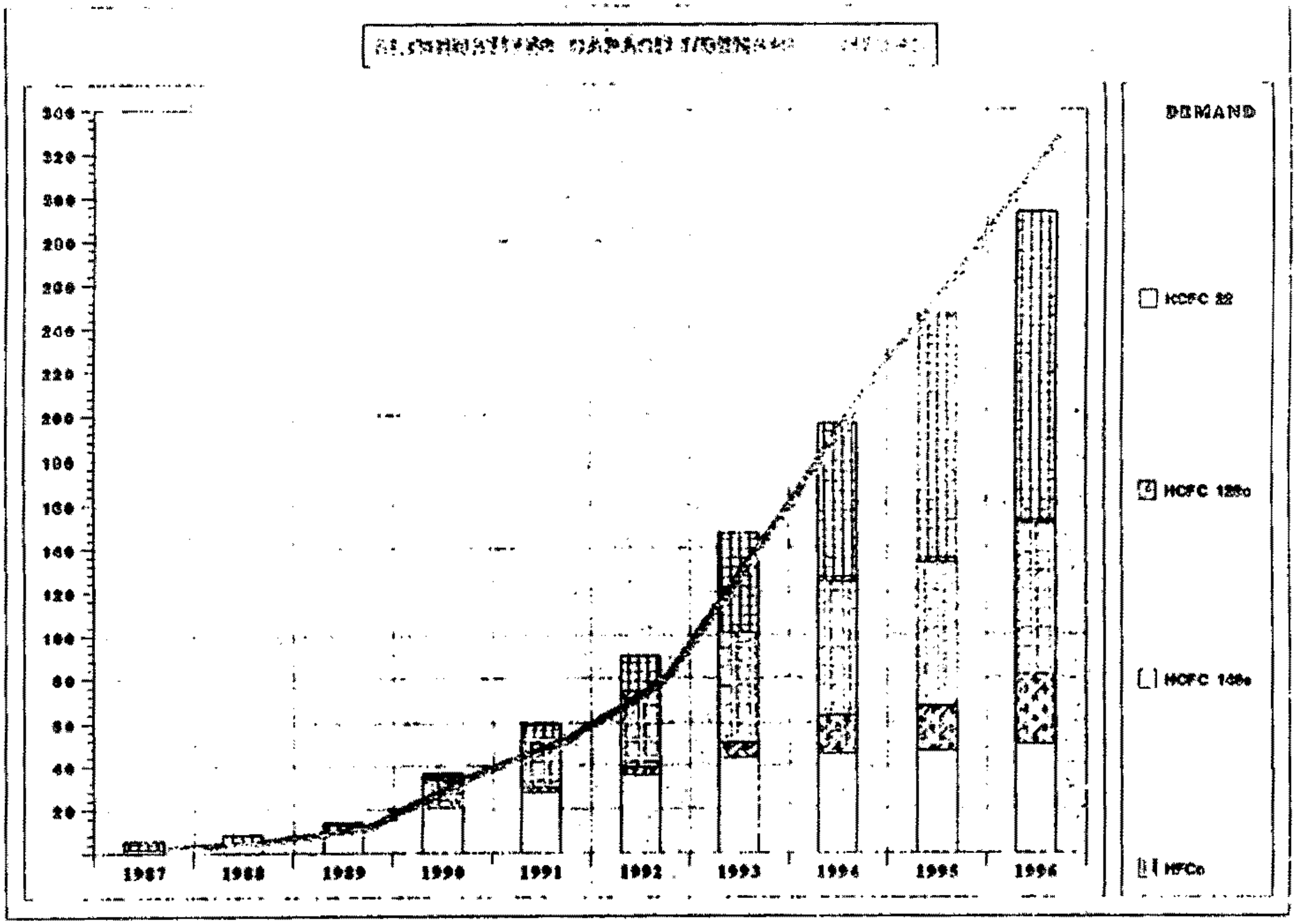
TTWR

OUTLOOK FOR FUTURE AVAILABILITY OF REFRIGERANTS



ASHRAE 7


WORLD CFC DEMAND BY SEGMENT
480
460
440
420
400
380
360
340
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
1992
1993
1994
1995
1996
MOBILE OEM
MOBILE AFTMKT
STAT OEM
STAT AFTMKT
BL AG INSUL
OTH BL AG
CLEAN AGNTS
PROPELLANTS
OTHERS



DEMAND
HCFC 22
HFCs
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996

41227400304

TO : PHONE NO. : 8813827748416 MAR. 5.1993 3:18PM F
FROM : WMO RESEARCH PHONE NO. : 41227400984

Dr Mack McFarlane

PRESS RELEASE

WORLD METEOROLOGICAL ORGANIZATION

A SPECIALIZED AGENCY OF THE UNITED NATIONS

(For use of the information media-
not an official record)

WMO No. 504

VERY LOW OZONE LEVELS OBSERVED DURING NORTHERN HEMISPHERE WINTER

Geneva, 5 March — The World Meteorological Organization (WMO) revealed today that after the record-breaking Antarctic-spring ozone destruction in September-October last year, there has been substantially less ozone than normal during the current winter over different regions in the Northern Hemisphere.

The ozone levels are from 9 to 20 per cent below normal in the middle and upper latitudes of the Northern hemisphere over the past three months, according to WMO. Based on ozone data from the WMO Ozone Observing System (GO$_3$OS) which included 140 ground stations as well as satellites, the drop over this region has happened two winters in a row, resulting in a record low total ozone value over the entire 45 to 65°N latitudinal belt.

The new data showed that during most of February, for example, "ozone levels were more than 20 per cent below the long-term normal values over the greater part of Europe, from the Atlantic to the Ural mountains and up to the polar circle", stated Dr. Rumen D. Bojkov, Special Advisor to the Secretary-General for Ozone and Global Environmental Issues.

According to Dr. Bojkov, the highest natural variability is observed during the months of December to March. The probability that certain values will occur no more than 5 times out of 100 cases is represented by ozone deviations of about 15 per cent of the long-term monthly averages. "When the total ozone values showed a persistent negative deviation of 20 per cent in the month of February, this represented an extreme case", said the ozone expert. Furthermore, the fact that such extreme conditions have been observed two winters in a row is unusual, according to WMO.

Possible reasons for the decline are the ozone destructive chlorine and bromine containing gases released into the atmosphere through human activities. And in some instances, it is due to the general circulation of the atmosphere during the past winter, particularly in the European region, which has been characterized by an intensive transport of ozone-poor air originating from the sub-tropical Atlantic.

Not all of Europe experienced the same conditions, however. During the 1992-93 winter season, Central and North Europe and Russia were close to normal during most of November and December with only two short low-ozone outbreaks in early and mid-December. But in North America, total ozone values north of 44° were lower in Canada with deviations sometimes exceeding minus 15 per cent. The average ozone amount for January over the entire 45-65N° belt was 12 to 15 per cent below normal.

At the end of January and most of February, the total ozone levels over North America and Northern, Central and Eastern Europe were more than 20 per cent below normal for long periods which caused the deviations in this case to exceed the negative ozone deviations during the same period in 1992. "This means that another low ozone record was registered," said Dr. Bojkov.

WMO emphasized, however, that the total ozone values seldom fell below 240m atm cm. "In contrast to the Antarctic, the northern hemisphere circulation experiences frequent meridional exchange of air masses and thus does not permit the creation of conditions that favour massive ozone destruction. Therefore, there is no Arctic ozone hole", said Dr. Bojkov. "Actually, the satellite information from the USA-National Oceanographic and Atmospheric Administration-TOVS on the darker part of the polar region reveals close to normal ozone levels for that area", he added.

Upon learning of these developments, the Secretary-General of WMO, Prof. G.O.P. Obasi, said today that "in order to avoid conditions for the further deterioration of the ozone layer, we reiterate our plea to all governments to implement the strengthened requirements of the Montreal Protocol and to stop the production and use of ozone-destructive chlorofluorocarbons (CFCs) and other related chemicals by the end of 1995, as agreed during the Copenhagen conference of the Parties to the Protocol in November 1992".

WMO is responsible for the international co-ordination of the atmospheric science and the systematic observations in support of the Vienna Convention for the Protection of the Ozone Layer. As the authoritative scientific voice on atmospheric issues within the United Nations family of agencies, WMO is striving to improve ozone monitoring and research.

While concerned over these low ozone values, WMO advises that there is no need for precautionary measures at this time of the year to offset the possible increase of the Ultra-violet (UV-B) radiation as a result of these observations, because the periods with extremely low ozone were relatively short in duration and also because the sun is very low during this time of the year. Additionally, the cloud frequently covers most of the sky and very little of the enhanced UV-B radiation reaches the Earth's surface.

In close partnership with the United Nations Environment Programme on ozone matters, WMO and UNEP are jointly hosting the second meeting of the Ozone Research Managers of the Parties to the Convention. The meeting, to be held from 10 to 12 March at WMO headquarters in Geneva, is expected to review the state of the ozone layer, the main tasks for further research and continuous monitoring of the ozone changes and their possible effects on the Earth's atmosphere as well as the biosphere.

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Ozone-friendly air-cond gas from next year

By TAN CHENG LI

KUALA LUMPUR: Technical adjustments to make car air-conditioners run on a chlorofluorocarbon substitute will be available only next year.

Makers said the necessary changes to car units, estimated to cost between RM300 and RM1,000, were still at a development stage and they were waiting for demand to pick up before introducing such service.

Nippondenso Capital planning and development manager Haw En Kwi expects the public to start adjusting their car air-conditioners next year when supplies of the current refrigerant R12 (or CFC12) run out and prices increase.

The R12, at RM7,000 per tonne, has seen a 10 per cent price increase this year.

Haw said air-conditioners in existing cars can be retrofitted to use the new refrigerant R134a (also called hydroflourocarbon or HFC 134a) in place of the ozone-depleting R12.

"At the moment, however, there is no urgency among the public to retrofit as the R12 is still widely available and the price rise has not been passed to consumers yet," he said.

Another major maker Sanden Air Conditioning plans to offer retro-fitting service, at the earliest late next year, at its workshops.

"There is no demand (for such service). We have received enquiries only," said senior engineering manager Lee Peng Seong.

As such, the company has not mass produced or stocked up on the necessary equipment.

Some of the equipment are made of stronger material to suit the new refrigerant which has a higher pressure and heat build-up.

For a major retrofitting around RM1,000, the compressor, O-rings, charging valves, compressor oil, hoses and fitting parts, evaporator, condenser and receiver dryer would be changed.

A basic retrofitting such as changing the hoses, receiver dryer and compressor lubricant would cost about RM300. (The prices depend on the make).

Haw said however, that retaining some of the old components while switching to R134a would damage the air-conditioner.

Lee said it would take longer to cool the car with just a basic retrofitting and for optimum performance, a large condenser was recommended.

He said a new air-conditioner system based on R134a would ensure good performance but this would only be for newly-assembled cars.

To date, Mercedes Benz, BMW, Volvo and Honda have equipped new models with air-conditioners which are CFC-free.

The latest would be the new Proton Saga to be launched in the middle of the year.

On moves by the Government to encourage recycling of R12 to ensure that supplies last, Lee said it was not viable because very little gas could be reclaimed since most cars were sent for repairs of leaks.

"The amount of gas recycled will not stretch the availability of the gas for long," he said.

c32480954 - P Zmi

The Malay Mail, Monday, March 8, 1993

A COOL RM400 FOR H~~C~~FC

Most car air-cond units to be modified

By P. SELVARANI

MOTORISTS may have to spend about RM400 to modify their car air-conditioning units when hydrofluorocarbons (HFC) replaces the ozone-depleting chlorofluorocarbons (CFC) as air-conditioning gas.

With the global production of CFC targetted to be reduced by 75 per cent next year, industries consuming CFC have been advised by the Ministry of International Trade and Industry to take measures to reduce its consumption in keeping with the Montreal Protocol agreement.

Under the agreement, signatories which include Malaysia are to phase out the consumption of CFC by 1996 and stop using the gas by 2010.

Because of this, owners of cars now on the road will have to at least modify their existing car air-conditioning system to accommodate the new gas.

They can also opt to change their entire air-conditioning system to a HFC-designed unit which would cost about 40 per cent more than the current market price.

Some new models of cars like Mercedes Benz, Volvo 940 Turbo, Honda Legend and BMW 3 series have already switched to the HFC air-conditioning system.

Mr Steven Liew, the business manager of ICI Industrial Chemicals (Malaysia) Sdn Bhd, said consumers should prepare to modify their vehicle air-conditioners to accommodate the HFC as the supply of CFC would diminish in time.

"However, there is no drop-in replacement for the CFC. The HFC which is widely accepted by the industries as the replacement of CFC has a higher pressure and it works with different lubricants and differs in material compatibility," he said.

Motorists can modify the units through retrofit kits expected to be sold in the market by the middle of next year.

The retrofit kits basically comprise a nylon hose, a receiver dryer, compressor lubricant, valves, joints and fittings, all of which are designed to withstand the high pressure of the new gas.

According to Nippondenso (M) Sdn Bhd's marketing manager, Haw En Kwi, unlike the CFC, the HFC is a water soluble gas which is able to permeate through rubber.

Shortage

The price of the retrofit kits range between RM300 and RM500, depending on the model of the car. For example, modifications for a Proton Saga would cost about RM400. Each kit is tailor-made for a particular model.

Motorists who try to use the HFC gas in their units which have not been modified would be asking for trouble.

According to Sanden Air Conditioning (M) Sdn Bhd senior manager (engineering) Lee Peng Seong, compatibility tests conducted on

SUVA REFRIGERANTS

ART–4

RETROFIT REFRIGERANT OPTIONS FOR THE MOBILE AIR CONDITIONING INDUSTRY

SUMMARY

Based on CFC regulations and various local market factors, we believe there will be a shortage of CFC-12 for most applications, including the mobile a/c service market. *There will be a need for "retrofit refrigerants" in the 1994–1996 time period*, possibly as early as 1993—depending on the global region and the local market situation.

Du Pont believes there are two viable options: HFC-134a and SUVA® MP52. Neither is a drop-in replacement and both will require some retrofit. Both refrigerants are available as needed by the industry. *We believe in many situations that SUVA MP52 will be the lower cost option while providing customer satisfaction.* In many other cases, retrofit cost of SUVA MP52 will be similar to HFC-134a.

Du Pont will continue to support both options with our own testing as well as working with OEMs, components suppliers and the mobile a/c service industry. Part of this effort will be to better identify the a/c systems which are most appropriate for each option. We feel it is important to offer both options to give the industry and the customer (car owner) the choice. There will be a place in the market for both options, to ensure customer satisfaction at reasonable cost.

Although retrofit development has been underway for a while, we believe it is prudent to accelerate these efforts to be prepared to provide viable solutions to car owners when needed. Cooperation between all involved (OEMs, components suppliers, service) as well as regulatory agencies is required. We urge the global mobile a/c industry to expedite the transition from CFC-12 to viable alternatives.

INTRODUCTION

Worldwide concern for the effect of CFCs on stratospheric ozone has led to over 70 countries agreeing to phase out their use by the turn of the century. Recent scientific evidence has indicated that ozone depletion is occurring faster than previously predicted, leading to a number of countries planning earlier phaseout, probably by 1997, or as early as 1995. The Bush Administration in the U.S. and the European community have asked for a phaseout of CFCs by the end of 1995.

Refrigerant conservation, improved mobile a/c service practices and the use of refrigerant recycle and recovery equipment as well as reclamation programs, will reduce the CFC-12 requirements for servicing the existing fleet. However Du Pont believes there will be insufficient CFC-12 available by the mid-1990s, and "retrofit refrigerants" will be required to avoid obsolescence of today's CFC-12 mobile a/c systems.

A recent study by R. E. Polk Company has estimated that there will be approximately 300 million CFC-12 vehicles in service in the world in 1994. Based on various factors such as vehicle age and value, availability of recycled CFC-12, climate and other market factors, more that 145 million vehicles (global basis) may require conversion of the a/c system to a "retrofit refrigerant" during their remaining service life. In the United States alone, there will be about 150 million CFC-12 vehicles in use. It has been estimated that about 75 million of the vehicles in the U.S. will require retrofit.

There are currently no "drop-in" replacements. Du Pont believes there are two viable options: HFC-134a and Du Pont SUVA MP52 (a three component blend containing HCFC-22, HFC-152a and HCFC-124). Both of these are being evaluated by Du Pont as well as several automotive OEMs and component suppliers, around the world. In addition to extensive laboratory studies, Du Pont is also conducting several vehicle fleet tests with HFC-134a and SUVA MP52. The two refrigerants have properties similar to CFC-12; some of the basic properties are listed in *Figure 1*:

Figure 1.

	Du Pont SUVA® MP52	HFC-134a
Composition	HCFC-22 HFC-152a HCFC-124	HFC-134a
Ozone Depletion Potential	0.03	0
Global Warming Potential[1]	0.17	0.28
Flammability	none	none
Safety (Acceptable Exposure Limit–ppm)	720[2]	1000[3]
Commercial Availability	1992 (limited)	Now

[1] 100-year integrated time horizon.

[2] The current AEL for HCFC-124 is 500 ppm; when blended with HCFC-22 and HFC-152a, the AEL of MP52 is 720 ppm. This material can be used very safely as a refrigerant. Toxicity testing is being conducted under PAFT-4; final report is expected in early 1995.

[3] Toxicity testing being conducted under PAFT-1; final report due in 1993.

RETROFIT CONSIDERATIONS FOR CUSTOMERS

The needs of the customer (car owner) must be addressed when considering retrofit choices. Some of these are:

- reliable cool air
- minimum cost for acceptable performance
- availability of timely service
- safety
- non-CFC refrigerant.

RETROFIT CONSIDERATIONS FOR PERFORMANCE (Refer to Figure 2)

Since neither candidate is a drop-in replacement, the existing a/c system will require some degree of retrofit. The extent (and cost) of retrofit will depend on the current system design as well as the refrigerant/lubricant chosen. Areas which must be addressed when considering either candidate are:

- cooling performance
- a/c system operability: pressures, temperatures and system control considerations
- lubricants
- long term compressor durability
- materials compatibility with desiccant, hoses, seals and O-rings
- possible mixing of retrofit refrigerant/lubricant with CFC-12/existing mineral oil
- cost of retrofit
- customer satisfaction.

Figure 2. Comparison of Retrofit Refrigerants

Issue	SUVA® MP52	HFC-134a
Cooling performance	Acceptable	Acceptable
Discharge pressure If mixed with CFC-12 (50%)	Same as CFC-12 Increase by 10%	10 to 20% higher Increase by 25%
Compressor discharge High pressure switch	No change	More frequent shutdown Reset or install new switch
System flush	No flush required	PAG/Esters – Yes: Complex procedures Flushing agent Flushing equipment Oil disposal Flushing agent disposal Residual contaminants in system Non-Flush also being considered Many issues!! (see text)
Compressor durability	Acceptable: – Short term – Additional testing	Higher discharge pressure New lubricant Residual contaminants More testing required
Expansion device Orifice tube TX valve	 No change Replace ?	 No change Replace ?
Other controls	Modify ?	Modify ?
Accumulator/drier	Change to XH-9	Change to XH-7 or XH-9
Recycling	Reclamation is recommended	New equipment required Reclamation Avoid mixing with CFC-12

IMPACT OF A/C SYSTEM DESIGN ON PERFORMANCE OF RETROFIT REFRIGERANTS

Mobile a/c systems have different designs and components, and perform over a wide range of operating conditions. Therefore, it is not possible to address all questions about all types of systems in this document. For a successful retrofit, a good understanding of the properties of the retrofit refrigerant as well as the a/c system design is required. The information included in this document is appropriate for most a/c systems found in passenger cars and light trucks, and provides general guidelines when considering retrofit. Other types of air conditioning systems, such as those in buses, large trucks and farm or construction equipment use the same basic technology, however there may be substantial differences in design—special consideration should be given to these design differences when considering retrofit.

COOLING PERFORMANCE/SYSTEM OPERABILITY

In high heat load [110°F (38°C), 40% relative humidity] wind tunnel testing conducted by Du Pont on unmodified vehicles with orifice tube systems (designed for CFC-12), both the SUVA® MP52 and HFC-134a demonstrated cooling capacity similar to CFC-12. Although the performance was somewhat vehicle dependent it is felt both refrigerants provide acceptable cooling under these conditions. The MP52 gave equivalent, or slightly lower compressor discharge pressure. When using HFC-134a in a light truck, the discharge pressure was 20 to 25 psi (138 kPa to 172 kPa) higher during normal speeds and 75 to 80 psi (517 kPa to 551 kPa) higher during the idle phase of the test. In a passenger car, the MP52 had discharge pressure similar to CFC-12; but with HFC-134a, the pressure was about 55 to 65 psi (380 kPa to 448 kPa) higher. Higher pressures could lead to more frequent a/c system shutdowns due to high pressure cut-out switches being activated. Possible solutions include: higher capacity condenser or fan, resetting of pressure switches, or increased air flow through the condenser. Higher discharge pressure causes higher loads on compressor bearings which might shorten compressor life.

In tests conducted with certain thermal expansion valve (TXV) systems, it has been determined that the performance of both the MP52 and the HFC-134a could be improved by adjusting or replacing the TXV in some of these systems. As mentioned earlier, this is system design dependent—some systems may not require a change. For example: systems that contain a TXV with a superheat setting of about 12°F (6.7°C) won't require a change for a retrofit to MP52.

It should be noted that the retrofit refrigerants may not perform as well as CFC-12 under all operating conditions. CFC-12 systems and their controls (such as TXV superheat setting, clutch cycling switch and compressor discharge pressure switches) have been designed to provide acceptable performance in conditions ranging from low ambient temperatures with high humidity to high ambients and high humidity, and all conditions in between. Depending on the system design, these controls may need to be modified or replaced during retrofit to either refrigerant.

MATERIALS COMPATIBILITY

During retrofit with HFC-134a or MP52, the accumulator or receiver/drier should be changed. HFC-134a requires XH-7 or XH-9 desiccant, while MP52 will require XH-9. The advantage of XH-9 is that it can be used with CFC-12, HFC-134a or MP52. XH-7 and XH-9 are trade names for molecular sieve desiccants produced by the UOP Molecular Sieve Company. Many a/c service manuals recommend replacing the accumulator or receiver/drier on a routine basis.

Tests have indicated that nylon-lined or nylon barrier hoses offer the lowest permeation rates for HFC-134a and the MP52. Many OEMs already use this type, or are converting to them. Laboratory tests indicate that permeation of MP52 and HFC-134a though some nitrile hose is higher than CFC-12. In certain vehicles it may be necessary to replace the existing nitrile hoses with nylon types, with retrofit to either HFC-134a or MP52.

NOTE: several of the leading hose manufacturers in the U.S. supply nylon-lined or nylon barrier hoses that can be "field installed" using new crimping technology. This may offer an economic option to installing pre-formed hose assemblies.

Several different elastomeric materials are used for a/c system seals and O-rings: tests have shown that Neoprene is suitable for use with HFC-134a and MP52. Many vehicles currently use Neoprene as well as certain types of nitrile. Other elastomers tested in the lab were not as compatible as Neoprene with HFC-134a or MP52. However, based on data being collected from the various fleet tests, certain nitrile materials currently being used may also be acceptable.

COMPRESSOR DURABILITY

Polyalkylene glycol lubricants (PAGs) are the initial choice for use with HFC-134a in OEM systems. However, there is some concern about using PAGs for retrofit, when residual chlorine from CFC-12 or chlorinated compounds in residual mineral oil will be present. Depending on the type and amount of the chlorinated compound, and the type of PAG, degradation of the

PAGs can occur. If PAGs are to be used, thorough flushing of the a/c system will most likely be required. After flushing, the flushing agent will have to be adequately removed from the system. Because of the concern with residual chlorinated compounds, ester lubricants are now being evaluated for possible use with HFC-134a for retrofit; this work is in the early development stages. Du Pont is conducting compatibility tests to determine the impact of residual chlorinated compounds on esters. Early indications are that system flushing may also be required to use esters in a retrofit to HFC-134a.

HFC-134A RETROFIT: TO FLUSH, OR NOT TO FLUSH?:

Many questions remain about the positives/negatives of flushing the a/c system to remove the existing mineral oil. Some believe it may be better not to flush, and add an extra charge (or partial charge) of "retrofit lubricant"; either PAG or ester. Others believe that flushing is the best option.

- If the a/c system is flushed:
  - What flushing agent should be used?
  - What type equipment will be required for flushing?
  - How much of the mineral oil has to be removed?
  - How much residual flushing agent is acceptable?
  - What is the affect of the flushing agent on the a/c system components?
  - Should system components such as the orifice tube or TXV, compressor, accumulator or receiver drier be removed to avoid damage or pluggage?
  - Will the service industry be able to understand and follow these potentially complex procedures for many different types of a/c systems?
  - How will the mineral oil and flushing agent be disposed?
- If the system is not flushed to remove the mineral oil, there are also several issues:
  - How much retrofit lubricant should be added?
  - Miscibility and chemical compatibility of the retrofit lubricant with mineral oil?
  - Impact on a/c system cooling performance due to having more than the normal lubricant charge?
  - Impact on compressor durability?
  - Impact of chlorinated compounds in the mineral oil on the retrofit lubricant?

Other issues still remain whether the system is flushed or not:

- Chemical stability of the retrofit lubricant with residual materials such as mineral oil, CFC-12, chlorinated contaminants, and flushing agents.
- Compatibility of lubricant with a/c system materials such as hoses, desiccants, seals and gaskets.
- Miscibility with HFC-134a.
- Lubrication capabilities.

Based on current information, Du Pont believes that a flush will be required with either a PAG or ester lubricant.

HFC-134A/LUBRICANT SUMMARY

At this point these issues are unresolved. In the U.S., a cooperative research program between the EPA, SAE and interested industry participants is underway to identify potential "retrofit lubricants" for HFC-134a. About 18 lubricant candidates have been submitted; results are due late in 1992 and will be provided to the program participants and the U.S. automotive OEMs. The OEMs, as well as compressor suppliers will then further evaluate appropriate candidates.

At the same time, the mobile a/c industry is beginning to study the other HFC-134a retrofit issues and evaluate the various options. This evaluation will require many months. Our best estimate is that U.S. OEMs will not have firm recommendations for retrofitting from CFC-12 to HFC-134a until late 1993. This timing may vary in different global regions based on regulations, available technology, and other market factors.

LUBRICANT FOR SUVA® MP52

Du Pont has selected a mixture of the existing mineral oil with a small amount of alkylbenzene (see footnote 1) lubricant for use with MP52. Using this concept, the a/c system does not have to be flushed; rather, the small amount of mineral oil that is removed when the accumulator or receiver/drier is replaced would be made up with the alkylbenzene. An additional amount would be added to ensure adequate lubricant circulation and compressor lubrication. This "non-flush concept" would eliminate the need to develop a flushing agent to replace CFC-11 or CFC-12 and it would also eliminate the need to handle waste oil and waste flushing agents. Laboratory tests have confirmed that the alkylbenzene and the MP52 are compatible with any amount of residual CFC-12 and mineral oil. Compressor durability tests have been conducted by Du Pont and there have been no compressor failures attributable to the refrigerant or lubricant.

The alkylbenzene lubricant that has been tested with MP52 is ZEROL 500T*, produced by the Shrieve Chemical Company and is commercially available. The ZEROL 500T contains a lubricity enhancing additive package.

The ZEROL 500T is being tested in some of the vehicles in the Du Pont Australian fleet test. The test has been underway for almost two years and there have been no compressor failures. Several compressor evaluations by the manufacturers have indicated normal wear during the test. (The blend in this test contains CFC-114 in place of HCFC-124 but is not expected to alter results and conclusions). There is also a 20-vehicle fleet test being conducted by Du Pont in the U.S. and Canada to evaluate the lubricant and other components. An additional 100-vehicle fleet test to evaluate both HFC-134a and SUVA MP52 began late in 1991. An ester lubricant is being used for the HFC-134a retrofit (with a system flush). The mineral oil/alkylbenzene mixture (about 50/50 wt %) is being used for the MP52 retrofit (with no flush). There have been no compressor problems with the MP52 vehicles.

Footnote 1: See U.S. Patent #4,046,043

* ZEROL 500T is a product of the Shrieve Chemical Company.

SERVICE ISSUES

There are several issues for retrofit vehicles that have been addressed:

1. **Vehicle Identification**

   Vehicles that are retrofit to either HFC-134a or MP52 should be identified with some type of permanent, highly visible tag in the engine compartment. This tag should be located near the a/c system service fittings so that it is obvious to the a/c technician that the vehicle no longer contains CFC-12. Additional labels or tags may also be required.

2. **Refrigerant Recycle or Recovery**

   How do you recycle or recover the retrofit refrigerant? Due to the incompatibility of some PAGs and esters with residual chlorinated compounds, and the need to avoid mixing of CFC-12 and HFC-134a, separate recycle or recovery machines will be required for HFC-134a in new vehicles. There is a question as to whether these same machines can be used for vehicles that have been retrofit to HFC-134a because the retrofit vehicle may contain different lubricants and chlorinated residues.

   We recommend recovery of the MP52, or HFC-134a, and then shipping the material off-site to a Du Pont reclamation facility. During reclamation, the material is returned to the original product specification. Recovery would minimize the possibility of mixing MP52 with CFC-12 or HFC-134a, and would also ensure that the proper composition of MP52 would be maintained during vehicle servicing. Recovery of HFC-134a would also ensure that quality is maintained, and mixing with CFC-12 would be minimized.

   On-site recycle for HFC-134a is an option to recovery/off-site reclamation.

3. **Mixing Refrigerants**

   What is the impact of a/c system operability/performance if the CFC-12 system is inadvertently "topped-off" with either HFC-134a or MP52?

   Figure 3 shows the effect of mixing CFC-12 with either HFC-134a or SUVA® MP52. The left side of the graph indicates the pressure of pure HFC-134a or SUVA MP52 (lower curve). The right side indicates the pressure of pure CFC-12. CFC-12 forms a high pressure azeotrope with HFC-134a. As CFC-12 is added to HFC-134a the pressure increases until it reaches a peak at about 50%. CFC-12 also forms azeotropes with HCFC-22 and HFC-152a, but the resulting pressures for MP52 are much less, as indicated by the lower curve. The MP52 pressure increases only 10% compared to a 25% increase with HFC-134a.

COST OF RETROFIT

HFC-134A

There are still many uncertainties about the best procedure to use for retrofit from CFC-12 to HFC-134a. The mobile OEMs are currently working diligently on evaluating the various options and developing retrofit procedures. Their recommendations probably won't be made for many months. Some of the major uncertainties (covering a wide variety of a/c system designs) include:

- PAG or ester lubricant
- Flush or non-flush
- Impact of residual chlorinated contaminants
- Higher discharge pressure
- Compressor durability
- Control modifications
- Nitrile hose permeation
- Compatibility of system seals/O-rings
- Impact on system pressure of mixing CFC-12 and HFC-134a
- Insufficient condenser capacity.

Because of these uncertainties, it is very difficult to estimate the cost to retrofit to HFC-134a. The cost may vary widely depending on the system design and the conditions of use. Also there may be different retrofit recommendations if the vehicle is still under warranty.

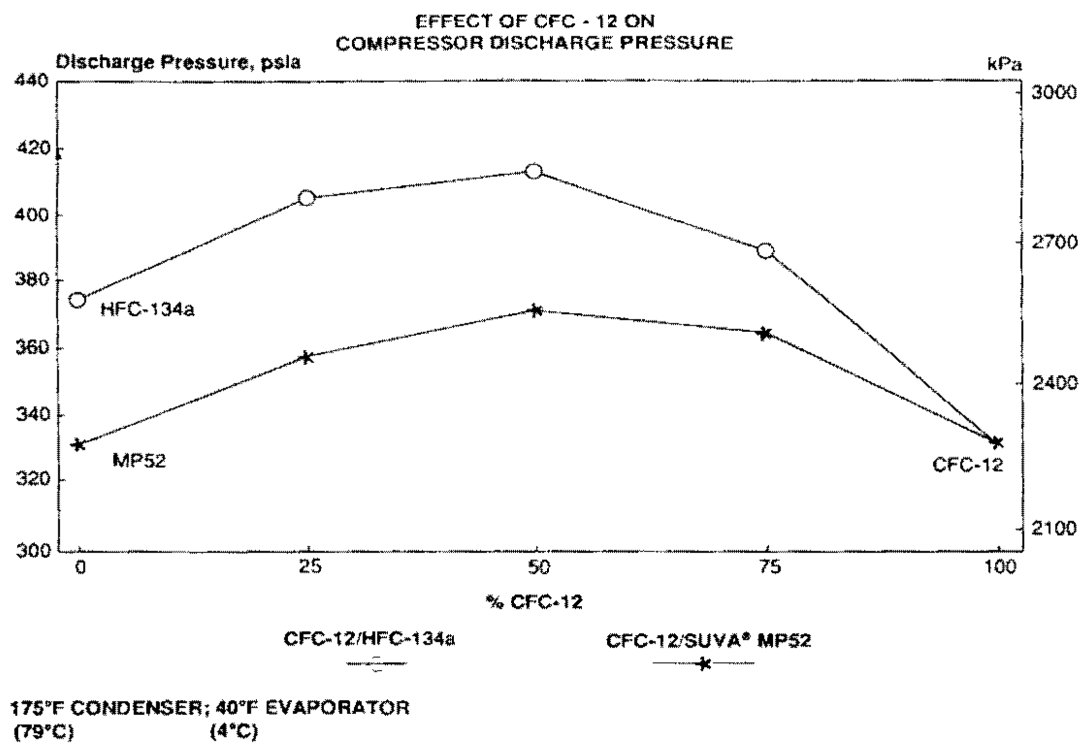
DU PONT SUVA MP52

As with retrofit to HFC-134a, due to the many different system designs, it is sometimes difficult to estimate the cost of retrofit to SUVA MP52. However, based on lab and fleet testing, Du Pont believes that MP52 offers the low cost retrofit for certain types of a/c system designs. For example, the incremental cost (parts and labor) to retrofit an orifice tube system that has nylon-lined or nylon barrier hoses, is estimated to be $55 to $145 (U.S.). The basic retrofit steps would be:

- Perform normal system diagnosis
- Recover the CFC-12
- Replace accumulator with appropriate unit containing XH-9 (in some cases, the accumulator would be replaced as part of the normal service for CFC-12—the incremental cost to the car owner for an XH-9 accumulator would be minor)
- Evacuate system (pull vacuum)
- Add ZEROL 500T (alkylbenzene) lubricant
- Charge SUVA® MP52 *liquid* phase from cylinder
- Check system performance and adjust system controls as needed.

More detailed retrofit procedures are available from your

Figure 3. Effect of CFC-12 on Compressor Discharge Pressure



local Du Pont Fluorochemicals representative. Additional considerations could change the cost of retrofit for other types of systems:

- Type of thermal expansion valve (some types would require a change; others would not)
- Hose type and length (short length of nitrile hose might not require replacement).

Estimated cost to retrofit to SUVA MP52 in various regions of the world depend on local service practices, cost and availability of parts, labor rates, etc. Consult your local Du Pont Fluorochemicals representative for more information.

OTHER TECHNICAL CONSIDERATIONS

SUVA MP52 IS NONFLAMMABLE!

Nonflammability is an essential requirement for refrigeration and air conditioning applications. Although HFC-152a is a flammable compound by itself, SUVA MP52 is formulated so that it is *not* flammable and will not become flammable during liquid or vapor leakage from equipment or a storage container, or any condition found when servicing mobile a/c systems.

Figure 4 is a typical flammability diagram for a three component mixture. A small vapor leak was imposed on a container of SUVA MP52 containing both liquid and vapor. Samples of both were taken periodically and plotted on the graph. The leakage path is from left to right. At no time do either paths enter the flammable region (the upper region). The tests were conducted at 25° C and 80° C.

Figure 5 is another way of graphing the change in composition of SUVA MP52 due to a vapor leak. In this test, a 0.25 ounce/minute (7.1 g/minute) vapor leak was imposed on a container of MP52 containing liquid and vapor. The key result of this test is that the HFC-152a concentration remains relatively constant and gradually decreases as the container is emptied (as the container becomes completely empty, the HFC-152a concentration continues to decrease). The HFC-152a concentration would have to increase above 20% to enter the flammable regions; *it does not.*

Hose permeation tests conducted with other blends of HCFC-22/HFC-152a/HCFC-124 indicate that the change in composition due to permeation is very similar to the change due to a vapor *leak*. These tests included nylon, HYPALON®, and nitrile hoses. Vapor and liquid compositions were measured as the material permeated from the hoses over time. Typically, the HFC-152a concentration would increase slightly in both the vapor and liquid phase until about 50% of the material had permeated. Then the HFC-152a concentration would gradually decrease with additional permeation. Based on these tests we are confident that SUVA MP52 would follow a similar path and would not become flammable

Figure 4. Flammability Diagram

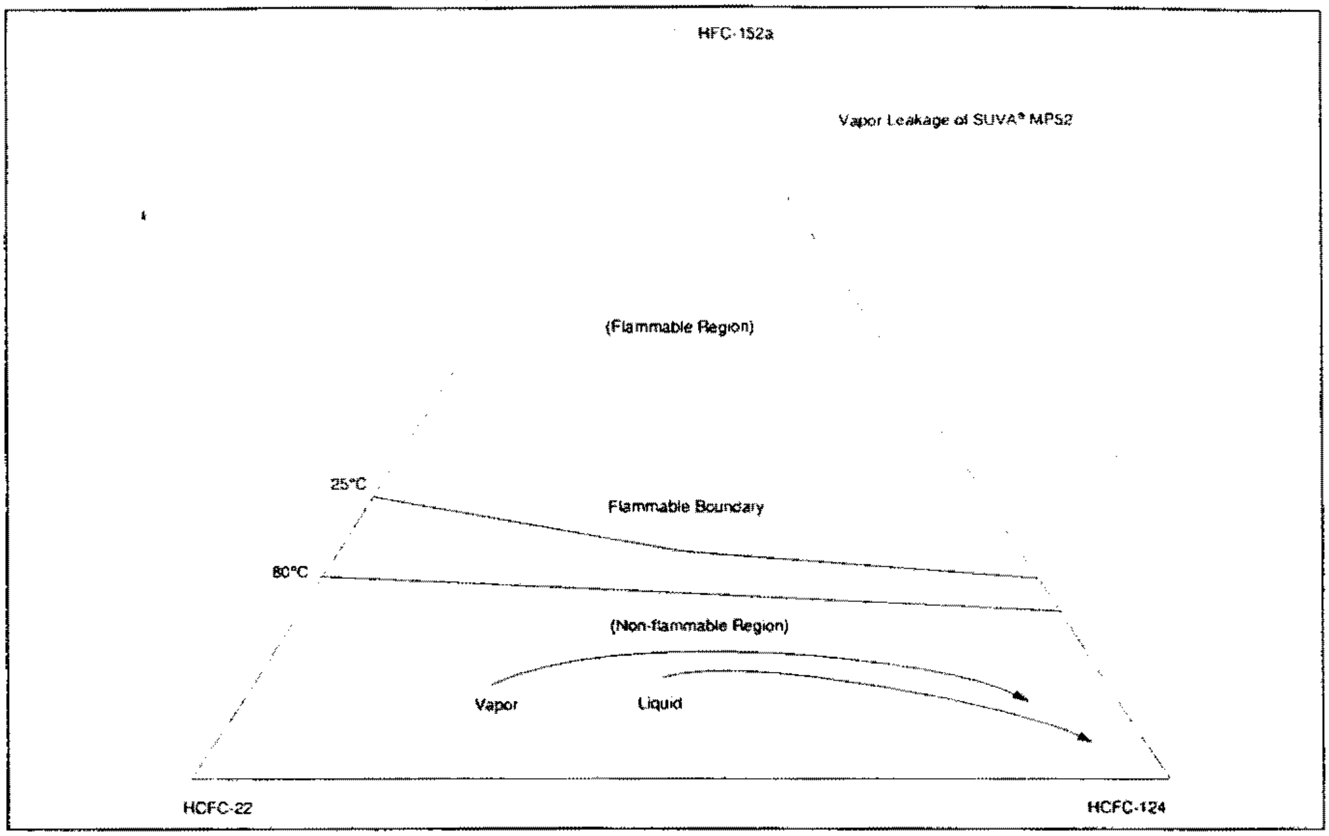


Figure 5. SUVA® MP52 Composition Change

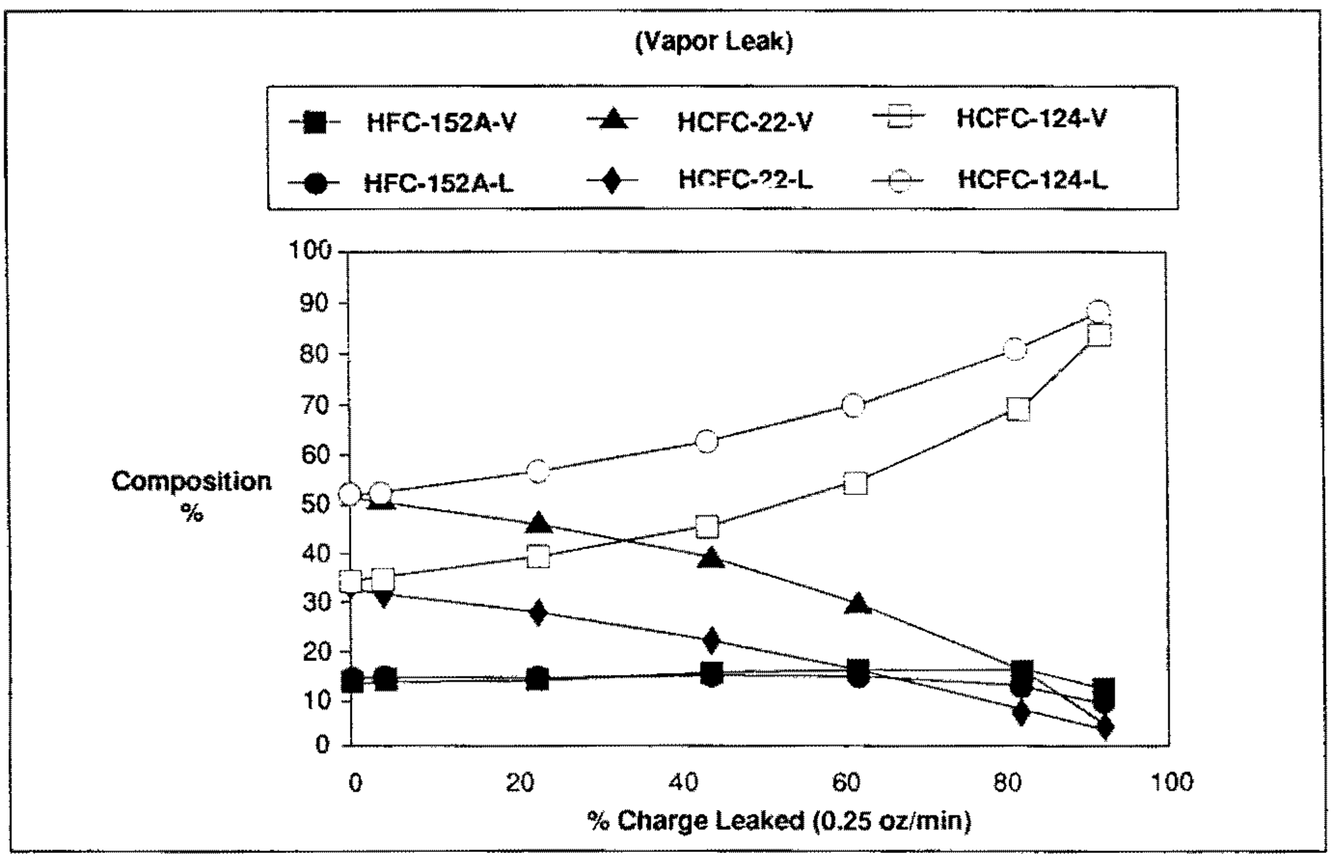
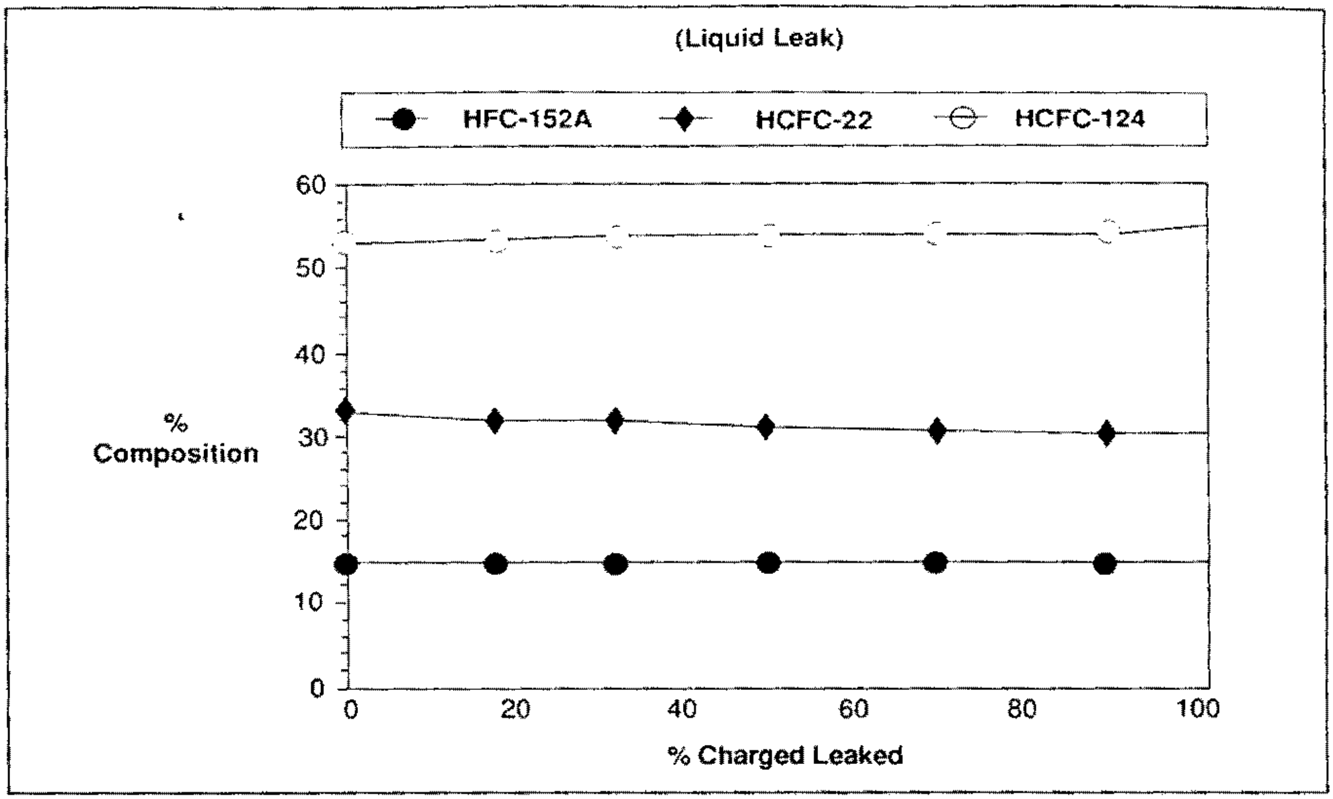


Figure 6. SUVA® MP52 Composition Change



due to permeation. To further confirm this, we are currently conducting additional hose permeation tests with several types of hose construction. Results will be published as soon as they are available.

Does SUVA MP52 become flammable if it is charged vapor phase into the a/c system? The answer is NO! Computer simulations and vehicle tests demonstrate that SUVA MP52 does not become flammable if it is inadvertently charged from the cylinder vapor phase. In the computer simulation, the HFC-152a concentration in the vapor phase peaked at about 18% and then began to reduce as the system was further emptied. The HFC-152a concentration in the liquid phase peaked at 17% and then began to reduce. The HFC-152a concentration would have to exceed 20% (at 80 C) for the mixture to become flammable.

In the vehicle test, the SUVA MP52 was charged vapor phase into the a/c system. A leak was then imposed on the system and samples taken periodically until the system was empty. In this test, the HFC-152a concentration in the vapor phase did not exceed 15.2% in either the liquid or vapor phase. Additional samples will be taken from fleet test vehicles in the next several months to further confirm this.

EFFECT OF LEAKAGE ON A/C SYSTEM PERFORMANCE

Figure 6 shows the change in composition of SUVA MP52 as liquid is leaked from an a/c system or container. As is indicated, there is very little change in composition. This slight change would have minimal effect on a/c system performance. *Figure 6* also demonstrates that there is very little change in composition when MP52 is charged liquid phase into vehicle a/c systems.

It should be noted that a change in composition occurs in SUVA® MP52 *only* if there is a vapor leak, AND liquid is also present. For example, if there is a vapor leak from the compressor suction or discharge hose, composition will not change since only vapor is present. If there is a liquid leak from any part of the system, composition will not change.

Since SUVA MP52 is a "near azeotrope," there is some composition change due to vapor leakage (if liquid is also present at the leak location). Tests have shown that a loss of 30% of the charge of SUVA MP52 due to vapor leak, would result in a composition that retains 93% of its original cooling capacity. This could result in a change in interior car temperature of about 1 to 2° C (2 to 4° F), depending on operating conditions.

NOTE: In a CFC-12 a/c system, it is generally expected that a 30% refrigerant loss will result in a decrease in cooling performance that will be perceptible to the driver.

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SAFETY OF SUVA® REFRIGERANTS

DuPont answers your questions about the safe handling and use of SUVA refrigerants

WHAT IS SUVA®?

SUVA is Du Pont's registered brand name for its environmentally enlightened family of refrigerants. SUVA refrigerants were developed as safe, effective alternatives to existing CFC refrigerants.

SUVA *Centri-LP* is Du Pont's brand name for its HCFC-123 refrigerant, which is targeted as a replacement for CFC-11. SUVA *Chill-LP* is Du Pont's brand name for its HCFC-124 refrigerant, which is a possible replacement for CFC-114. SUVA *Cold-MP* and SUVA *Trans A/C* are Du Pont's brand names for its HFC-134a refrigerant, which is a primary alternative for CFC-12.

The table on page 3 provides a quick overview of these refrigerants, including chemical formula, boiling point and calculated acceptable exposure limit (AEL) information.

INTRODUCTION

For many years, chlorofluorocarbons (CFCs) have been used successfully as refrigerants. CFCs seemed to be the ideal choice due to their unique combination of properties; however, the exceptional stability of these compounds, coupled with their chlorine content, has linked them to the depletion of the earth's protective ozone layer.

As a result, many companies, including Du Pont, are developing alternative refrigerants to replace CFCs. Du Pont's series of alternatives, based on hydrochlorofluorocarbon (HCFC) and hydrofluorocarbon (HFC) compounds, are called SUVA refrigerants.

Testing has shown that HCFCs and HFCs exhibit properties and performance characteristics similar to CFCs, but with greatly reduced environmental impact. They offer acceptable toxicity, in-use stability, non-flammability and low photochemical reactivity. And even though they are not "drop-in" replacements, HCFC- and HFC-based refrigerants require minimal changes to equipment when compared to other, not-in-kind alternative products. (For detailed discussions about retrofitting equipment with alternatives, refer to Du Pont Bulletins H-16449, H-31751-2 and H-31752.)

The Program for Alternative Fluorocarbon Toxicity Testing (PAFT), a cooperative research effort sponsored by 15 leading CFC producers, is currently evaluating six of the possible alternative products: HFC-134a, HCFC-123, HCFC-141b, HCFC-124, HFC-125 and HCFC-225 ca/cb. PAFT integrates past and present toxicological information to perform a careful risk assessment of the proposed alternatives.

The PAFT I program for HCFC-123 is well underway. Results to date indicate that there is nothing to preclude its use in general industrial areas, provided that recommended hygiene and ventilation practices are observed. However, the data also suggest that the occupational inhalation exposure limit for HCFC-123 will be lower than that for CFC-11.[1]

The PAFT II program on HFC-134a is complete, with the exception of the chronic study. All available results show that HFC-134a will be at least as safe in use as CFC-12.[1]

The PAFT III program on HCFC-124, begun in late 1989, is expected to be completed in 1994-1995. Although few results are currently available, no adverse toxicological findings have been reported.[1]

This brochure answers common safety-related questions, discusses potential symptoms of overexposure and provides first aid and medical advice for effects of overexposure that may occur from improper use or handling of SUVA refrigerants. Users of the SUVA refrigerants should review the Material Safety Data Sheet (MSDS) before using these products.

FLAMMABILITY

Are SUVA refrigerants flammable?

SUVA refrigerants are nonflammable and nonexplosive. However, mixing SUVA refrigerants with flammable gases or liquids can result in a flammable solution. Therefore, SUVA refrigerants should never be mixed with any flammable gas or liquid.

Also, SUVA refrigerants should not be exposed to open flames or electrical heating elements.

SUVA *Cold-MP* and *Trans A/C* are not flammable at ambient temperatures and atmospheric pressure. However, SUVA *Cold-MP* and *Trans A/C* have been shown in tests to be combustible at pressures as low as 5.5 psig (at 177°C) when mixed with air at concentrations of generally more than 60 volume % air. At lower temperatures, higher pressures are required for combustibility. SUVA refrigerants should not be mixed with air for leak testing. In general, they should not be used or allowed to be present with high concentrations of air above atmospheric pressure.

INHALATION TOXICITY/SUFFOCATION

Are SUVA refrigerants toxic?

The SUVA refrigerants pose no acute or chronic hazard when they are handled in accordance with Du Pont recommendations and when exposures are maintained at or below recommended exposure limits, such as the Du Pont Acceptable Exposure Limit (AEL).

What is an AEL?

An AEL, Acceptable Exposure Limit, is an airborne exposure limit established by Du Pont scientists for substances to ensure the safe handling and use of that substance. An AEL specifies time-weighted average (TWA) airborne concentrations, usually eight hours, to which nearly

[1]Reports from Montreal Protocol Review Meeting; 1990, June 27-29; London.

all workers may be repeatedly exposed without adverse effects. In practice, short-term exposures should not exceed three times the established exposure limit for more than a total of 30 minutes during a workday, provided that the TWA is not exceeded. *Under no circumstances* should exposures exceed five times the AEL. If a process displays this variability in airborne exposures, efforts should be made to restore control.

What are the symptoms of exposure above the AEL?

Inhaling high concentrations of SUVA refrigerant vapor may cause temporary central nervous system depression with narcosis, lethargy and anesthetic effects. Other effects that may occur include dizziness, a feeling of intoxication and a loss of coordination. Continued breathing of high concentrations of SUVA vapors may produce cardiac irregularities (cardiac sensitization), unconsciousness, and with gross overexposure, death.

If you experience *any* of the initial symptoms, move to fresh air and seek medical attention.

The chart below shows some of the physical properties of SUVA blend MP series refrigerants, including composition, boiling points and the calculated exposure limit, which is based on composition and existing exposure limits for the individual components.

What is cardiac sensitization?

If vapors are inhaled at concentrations well above the AEL, the heart may become sensitized to adrenaline, leading to cardiac irregularities and, possibly, cardiac arrest. The likelihood of these cardiac problems increases if you are under physical or emotional stress.

Medical attention must be given immediately if exposed to high concentrations of SUVA refrigerants. Do *not* treat with adrenaline (epinephrine) or similar drugs. These drugs may *increase* the risk of cardiac arrhythmias and cardiac arrest. If the person is having difficulty breathing, administer oxygen. If breathing has stopped, give artificial respiration.

Can inhaling SUVA refrigerant vapors cause suffocation?

If a large release of vapor occurs, such as from a large spill or leak, the vapors may concentrate near the floor or low spots and displace the oxygen available for breathing, causing suffocation. When a large spill or leak occurs, always wear appropriate respiratory and other personal protective equipment.

What are Emergency Exposure Limits?

Emergency Exposure Limits (EELs) are set for emergency situations, such as a spill or accidental release of a chemical. EELs specify brief durations and concentrations from which escape is feasible without any irreversible effects on health. EELs are only applicable to emergency situations where occurrence is expected to be very rare in the lifetime of an individual, and where exposure is brief.

Physical Properties of SUVA® Refrigerants

Product	Formula	Boiling Point °C	Boiling Point °F	AEL* ppm (v/v)	1-hour EEL** ppm (v/v)
SUVA *Centri-LP*	CF_3CHCl_2	27.9	82.2	10	1,000
SUVA *Chill-LP*	$CHClFCF_3$	-11.0	12.2	500	N/A
SUVA *Cold-MP* and *Trans A/C*	CH_2FCF_3	-26.5	-15.7	1,000	N/A

*Acceptable Exposure Limit (refer to page 2).
**Emergency Exposure Limit (refer to this page).

How can I work safely on systems in enclosed areas?

First, route relief and purge vent piping outdoors, away from air intakes. Second, make certain the area is well ventilated, using auxiliary ventilation if necessary to move refrigerant vapors. Third, make sure the area is clear of vapors prior to beginning work. And finally, install air monitoring equipment to detect leaks. (For a complete discussion about leak detection, refer to Du Pont Bulletin H-31753. Also, refer to ASHRAE Standard 15-1989 for ventilation requirements.)

Is the deliberate inhalation of SUVA refrigerant vapors dangerous?

Intentional misuse or deliberate inhalation of SUVA refrigerants may cause death without warning. This practice is extremely dangerous.

Can I smell SUVA refrigerants?

Some SUVA refrigerants have a slightly sweet odor that can be difficult to detect. Others, such as SUVA *Centri-LP*, have such a faint odor that they cannot be detected by smell at levels that are considered safe for exposure. Therefore, frequent leak checks and the installation of permanent leak detectors may be necessary for enclosed areas used by personnel.

SPECIAL REQUIREMENTS FOR SUVA® *Centri-LP*

- Install an air monitor capable of detecting HCFC-123 in concentrations of 0 ppm to 50 ppm.
- Install suitable alarms that activate at, or below, the AEL of 10 ppm and alert persons inside and outside of the equipment room that a leak condition exists.
- Route relief valve discharge headers and purge units outdoors, away from all air intakes.
- Install local exhaust to ventilate the workplace in the event that the air monitor alarm point is exceeded.
- Follow minimum standards for class one refrigeration systems as required by ASHRAE Standard 15-1989, but with the addition of the air monitor mentioned above.

For more information about leak detection, refer to Du Pont Bulletin H-31753.

What should I do if a large spill or leak occurs?

Evacuate *everyone* until the area has been ventilated. Use blowers or fans to circulate the air at floor level. Do not re-enter the affected area unless you are equipped with a self-contained breathing apparatus.

Always use an air mask when entering tanks or other areas where vapor concentration might exist. Use the buddy system *and* a lifeline. (Refer to the MSDS.)

SKIN AND EYE CONTACT

Is skin or eye contact with SUVA refrigerants hazardous?

At room temperature, SUVA refrigerant *vapors* have little or no effect on the skin or eyes. However, SUVA refrigerants that are liquid at room temperature tend to dissolve the skin's protective fat, causing dryness and irritation, particularly after prolonged or repeated contact.

Always wear protective clothing when there is a risk of exposure to liquid SUVA refrigerants. Where splashing is possible, *always* wear eye protection and a face shield. If your eyes are splashed, flush them with plenty of water. (See the MSDS.)

In addition, because the AEL for SUVA *Centri-LP* is much lower than that for most other refrigerants, a few extra precautions should be taken. For example, when handling SUVA *Centri-LP*, use lined butyl gloves to avoid prolonged skin contact and chemical splash goggles to avoid eye contact. Also, provide self-contained breathing apparatus for use in the event of a major spill or system failure. Finally, install air monitoring equipment to detect leaks. (For a complete discussion on leak detection, refer to Du Pont Bulletin H-31753.)

FROSTBITE

Is frostbite a possible hazard?

In liquid form, low- and medium-temperature SUVA refrigerants can freeze skin on contact, causing frostbite.

Following contact, soak the exposed area in *lukewarm* water, *not* cold or hot.

If treatment cannot begin immediately, apply a light coat of a non-medicated ointment, such as petroleum jelly. If the exposed area is in a location where the presence of the ointment would be awkward, such as on the eye, apply a light bandage.

In *all* cases of frostbite, seek medical attention as soon as possible.

PRESSURE

Can pressure ever cause a hazard?

Yes. Some of the potential hazards are:

- An overfilled container, vessel or pipeline whose temperature is increased. This may make the container "liquid full" and immediately cause a dangerous increase in hydrostatic pressure.

  Du Pont owns returnable refrigerant cylinders and ton tanks. No containers may be refilled without Du Pont's consent. Tanks to be returned to Du Pont must comply with Department of Transportation (DOT) regulations.

- A correctly filled returnable or disposable cylinder that is heated above the recommended maximum temperature of 52°C (125°F) could result in dangerously high pressures, in excess of the cylinder design pressure.

- A returnable or disposable refrigerant cylinder connected to the discharge side of refrigeration or air conditioning systems. Pressure may increase beyond the capacity of the relief devices, causing the cylinder to rupture or shatter.

What are the do's and don'ts for handling disposable and returnable cylinders?

- Do verify proper hookup.
- Do open valves slowly.
- Do protect from rusting during storage.
- Do verify that the label matches the color code.
- Don't tamper with the pressure relief devices.
- Don't drop, dent or mechanically abuse containers.
- Don't use disposable cylinders as air tanks.
- Don't reuse disposable cylinders.
- Don't *ever* force connections.
- Don't heat above 52°C (125°F).

How should I braze or weld pipes on air conditioning or refrigeration systems?

- Make certain there is adequate ventilation in the area. Provide auxiliary ventilation if necessary.
- Evacuate SUVA refrigerant from the refrigeration or air conditioning system. Make sure that refrigerant is not vented to the workspace.
- Purge system with nitrogen.
- Leave system open before beginning welding or brazing. This will prevent a dangerous increase in the hydrostatic pressure in the system and potential refrigerant decomposition.

DECOMPOSITION

What causes decomposition?

SUVA refrigerants will decompose when exposed to high temperatures from flames or electric resistance heaters. Decomposition may produce toxic and irritating compounds, such as hydrogen chloride and hydrogen fluoride.

How can I tell if SUVA refrigerant has decomposed?

The pungent odors released will irritate your nose and throat. The irritating nature of the fumes released from decomposition will generally force people to evacuate the area. Therefore, it is important to prevent decomposition by following Du Pont recommendations for handling and use.

Are decomposition products hazardous?

Yes, the acidic vapors produced are dangerous and the area should be evacuated and ventilated to prevent exposure to personnel. Anyone exposed to the decomposition products should be taken to fresh air and given medical treatment immediately. In fact, the irritating nature of the fumes will generally *force* people to leave the area well before hazardous effects can occur.

Caution!

- *Never* mix SUVA refrigerants with air.
- *Never* heat cylinders above 52°C (125°F).
- *Never* tamper with valves or pressure relief devices.
- *Never* refill disposable cylinders with anything.

  Disposable cylinders should never be refilled or converted for use as compressed air tanks. Empty cylinders should be vented and discarded.

  Reuse of these cylinders can result in a serious hazard because of the possibility of corrosion and subsequent weakening of the container walls. The hazard is particularly great when corrosion is caused by water vapor in the gas or compressed air with which the cylinder is refilled; there may be no visible evidence of the damage to the cylinder until the walls are seriously weakened and the cylinder ruptures violently.

  The shipment of refilled disposable cylinders is prohibited by DOT regulations.
- *Always* store disposable cylinders in a dry area. Storage in dampness can permit rusting to occur, which will weaken the cylinder over a period of time.

Du Pont Chemicals
Customer Service Center, B-15305
Wilmington, DE 19898
1-800-441-9442
In Delaware: 302-774-2099

Europe

Du Pont de Nemours International S.A.
2 Chemin du Pavillon
P.O. Box 50
CH 1218 Le Grane-Saconnex
Geneva, Switzerland
41-22-717-5111

Canada

Du Pont Canada, Inc.
P.O. Box 2200, Streetsville
Mississauga, Ontario
L5M 2H3
(416) 821-3300

Mexico

Du Pont, S.A. de C.V.
Homero 206
Col. Chapultepec Morales
C.P. 11570 Mexico, D.F.
52-5-250-8000

South America

Du Pont do Brasil S.A.
Alameda Itapicuru, 506
Alphaville 06400 Barueri
Sao Paulo, Brazil
55-11-421-8005

Du Pont Argentina S.A.
Casilla Correo 1888
Correo Central
1000 Buenos Aires, Argentina
54-1-311-8167

Australia

Du Pont Australia
P.O. Box 930
North Sydney, NSW, 2060
Australia
61-2-923-6165

Japan

Mitsui Du Pont Fluorochemicals
Company, Ltd.
Mitsui Seimei Building
2-3, 1-Chome Ohtemachi
Chiyoda-Ku, Tokyo 100 Japan
81-3-3216-8471

Asia

Du Pont Taiwan
P.O. Box 81-777
Taipei, Taiwan
886-2-514-4400

Du Pont Asia Pacific Limited
P.O. Box TST 98851
Tsim Sha Tsui
Kowloon, Hong Kong
852-734-5345

Du Pont Thailand
P.O. Box 2398
Bangkok 10501, Thailand
66-2-238-4361

Du Pont Far East Inc.
C.P.O. Box 5972
Seoul, Korea
82-2-734-3661

Du Pont Singapore Pte. Ltd.
1 Maritime Square #07 01
World Trade Centre
Singapore 0409
65-273-2244

Du Pont Far East, Philippines
5th Floor, Solid Bank Building
777 Paseo de Roxas
Makati, Metro Manila
Philippines
63-2-818-9911

Du Pont Far East Inc.
7A Murray's Gate Road
Alwarpet
Madras, 600 018, India
011-91-44-454-029

Du Pont Far East Inc. – Pakistan
9 Khayaban-E-Shaheen
Defence Phase 5
Karachi, Pakistan
011-92-21-533-350

Du Pont Far East Inc.
P.O. Box 2553/Jkt
Jakarta 10001
Indonesia
011-62-21-511-519

H-27350-2

Printed in U.S.A.

DU PONT

SHIPPING

FOR TANK TRUCKS, TONS, HALF TONS, CYLINDERS, AND DRUMS

PROCEDURES

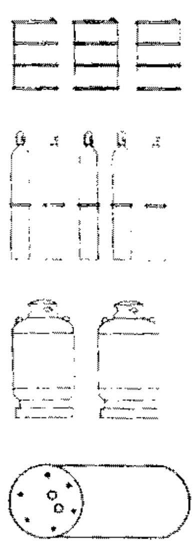
Overview

This bulletin outlines the proper procedures for shipping used refrigerant to Du Pont for reclamation. Specific guidelines are provided for shipping used refrigerant in recovery tank trucks, ton tanks, half ton tanks, cylinders and drums. The shipper (generally the used refrigerant owner) is responsible for container integrity at all times, as well as preparing and properly labeling the recovery ton tanks, half ton tanks, drums or cylinders. The shipper is also responsible for preparing a proper bill of lading.

To assist the shipper, Du Pont will provide labels; Department of Transportation (DOT) placards and tags; a Material Safety Data Sheet (MSDS); and an easy-to-use bill of lading form.

Choosing a Carrier

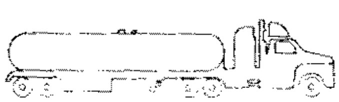
Exhibit 1 on page 5 lists, by state, carriers for transporting recovery ton tanks, half ton tanks, drums and cylinders. If suitable arrangements cannot be made with one of the listed carriers in your state, call Du Pont Customer Service at 1-800-441-9442 for assistance.



Recovery tank truck shipments are made by Du Pont company trucks that are designated for "Used Refrigerants."

Safety Precautions

1. Use personal safety equipment, such as side shield glasses, gloves, hard hat and safety shoes, when handling recovery ton tanks, half ton tanks, drums or cylinders.



2. When moving recovery ton tanks, half ton tanks, drums or cylinders with a forklift, follow the manufacturer's safety recommendations.

3. Exercise caution when moving recovery containers because of the weight involved.

Emergency Response

Companies shipping used refrigerant to Du Pont may use the CHEMTREC 24-hour emergency telephone number (800-424-9300). However, if your company is not a member of the Chemical Manufacturing Association (CMA) in Washington, D.C., this telephone number must not be used as the DOT required emergency response telephone contact when shipping other hazardous materials.

Shipping Procedures

Recovery Tank Trucks

1. Verify with the Du Pont driver that the tank truck valves are not leaking. If a leaking valve is identified, contact Du Pont at 1-800-441-9442 for assistance.

2. Give a completed "Used Refrigerant Identification Tag" (refer to Exhibit 2 on page 6) to the Du Pont driver. Du Pont will *not* accept tank truck shipments of used refrigerant if this tag is missing or incomplete.

3. Complete the bill of lading according to the directions on page 4.

4. Give three copies of the bill of lading to the Du Pont driver; retain one copy for your files.

5. Return the MSDS, provided by Du Pont, to the Du Pont driver.

Recovery Ton Tanks

1. Recovery ton tanks provided by Du Pont will have a product identification tag at each end of the ton tank; verify that both product identification tags are in place.

2. Verify the number of ton tanks to be shipped.

3. Verify that the valves are not leaking by performing a leak test using soapy water. If a leaking ton tank is identified, contact Du Pont at 1-800-441-9442 for assistance. Leaking ton tanks must *not* be shipped.

4. If no leaky valves are detected, install the plastic valve caps. These caps protect the valve threads and prevent foreign material from entering the valves.

5. Complete the "Used Refrigerant Identification Tag" (Exhibit 2) found in the protective plastic holder and attach it to one of the ton tank valves using the plastic tie. Each ton tank must have this tag. Ton tanks will *not* be accepted by Du Pont if this tag is missing or incomplete.

6. Complete the bill of lading according to the directions on page 4.

7. Give two copies of the bill of lading to the driver and retain one copy for your files.

8. Place one copy of the bill of lading into the protective plastic holder containing the "Used Refrigerant Identification Tag."

9. Install the hood cap over the ton tank valves, enclosing the "Used Refrigerant Identification Tag" and the copy of the bill of lading inside the cap.

10. Give the MSDS, provided by Du Pont, to the driver.

11. Complete the two green DOT classification tags (refer to Exhibit 3 on page 6) provided for each ton tank. Make sure one tag is attached securely to each end of the ton tank.

NOTE:

The green DOT classification tag is not required for shipments of used R-114.

12. With the driver, verify the number of ton tanks as they are loaded onto the truck.

13. Verify that the driver properly chocks the ton tanks on the truck so that they do not move during shipment.

Recovery Half Ton Tanks

1. Recovery half ton tanks provided by Du Pont will have a product identification tag attached to the lifting lug on the collar area of the tank; verify that this product identification tag is in place.

2. Verify the number of half ton tanks to be shipped.

3. Verify that the valves are not leaking by performing a leak test using soapy water. If a leaking half ton tank is identified, contact Du Pont at 1-800-441-9442. Leaking half ton tanks must *not* be shipped.

4. If no leaky valves are detected, install the plastic valve caps. These caps protect the valve threads and prevent foreign material from entering the valves.

5. Complete the "Used Refrigerant Identification Tag" (Exhibit 2) found in the protective plastic holder and attach it to the half ton tank valves using the plastic tie. Each half ton tank must have this tag. Half ton tanks will *not* be accepted by Du Pont if this tag is missing or incomplete.

6. Complete the bill of lading according to the directions on page 4.

7. Give two copies of the bill of lading to the driver and retain one copy for your files.

8. Place one copy of the bill of lading into the plastic protective holder containing the "Used Refrigerant Identification Tag."

9. Close the half ton tank lid, enclosing the valves and the "Used Refrigerant Identification Tag."

10 Give the MSDS, provided by Du Pont, to the driver.

11. Complete the green DOT classification tag (Exhibit 3) provided for each half ton tank. Make sure the tag is attached securely to the lifting lug on the collar area of the half ton tank.

NOTE:

The green DOT classification tag is not required for shipments of used R-114.

12. With the driver, verify the number of half ton tanks as they are loaded onto the truck.

Recovery Drums

1. Verify the number of drums to be shipped.

2. Verify that all drums have a bung that is properly installed and securely tightened.

3. Inspect all drums for leaking. If a leaking drum is identified, contact Du Pont at 1-800-441-9442 for assistance. Leaking drums must *not* be shipped.

4. Verify that each drum has a legible product identification label. If necessary, completely remove any old labels and apply a new product identification label, provided by Du Pont, to the middle one-third section of the drum.

NOTE:

If the recovery drum has been provided by Du Pont, the upper one-third section of the drum will be painted yellow to identify the drum as a used refrigerant recovery vessel. If an old refrigerant drum is being used, the shipper should wrap a strip of yellow tape (at least 4 in. wide) around the upper one-third of the drum to identify the contents as used refrigerant.

5. Complete a "Used Refrigerant Identification Tag" (Exhibit 2) for each recovery drum. Then, remove the backing of the supplied plastic envelope to expose the adhesive side and place the "Used Refrigerant Identification Tag" into the envelope. Firmly press the envelope onto the upper one-third section of each drum. Make sure that the plastic envelope is closed (use tape if necessary) to avoid loss of contents. Drums will *not* be accepted by Du Pont if this tag is missing or incomplete.

6. Complete the bill of lading according to the directions on page 4.

7. Give two copies of the bill of lading to the driver and retain one copy for your files.

8. Place one copy of the bill of lading in a plastic envelope and attach it to one of the drums.

9. Give the MSDS, provided by Du Pont, to the driver.

10. With the driver, verify the number of drums as they are loaded onto the truck.

Recovery Cylinders

1. Recovery cylinders provided by Du Pont will have a product identification label on the shoulder area of the cylinder; verify that this label is legible.

2. Verify the number of cylinders to be shipped.

3. Perform a leak test with soapy water. If a leaking cylinder is identified, contact Du Pont at 1-800-441-9442 for assistance. Leaking cylinders must *not* be shipped.

4. If no leaky valves are discovered, install the plastic valve caps. These caps protect the valve threads and prevent foreign material from entering the valves.

5. Install the gold hood cap over the cylinder valve.

6. Complete the "Used Refrigerant Identification Tag" (Exhibit 2) provided with each recovery cylinder. Then, place the tag in the protective plastic holder and attach it to the gold hood cap using the plastic tie. Recovery cylinders will *not* be accepted by Du Pont if this tag is missing or incomplete.

7. Complete the green DOT classification tag (Exhibit 3) provided with each cylinder. Make sure that the tag is attached securely to the gold hood cap.

NOTE:

The green DOT classification tag is not required for shipments of used R-114.

8. Complete the bill of lading according to the directions on page 4.

9. Give two copies of the bill of lading to the driver, along with the MSDS provided by Du Pont. Retain one copy of the bill of lading for your files.

10. Place one copy of the bill of lading into one of the "Used Refrigerant Identification Tag" protective plastic holders.

11. Securely fasten the cylinders to a pallet for shipment.

12. With the driver, verify the number of cylinders as they are loaded onto the truck.

Bill of Lading Preparation

Du Pont will provide a bill of lading form for shipment of used refrigerants. All items on this form should be filled out by the shipper except those specifically indicated as being filled out by the carrier. The bill of lading must contain the following information:

A) Company name of carrier

B) Date

C) Company name and address of shipper

D) Signature of shipping company's representative

E) Shipping destination:

Du Pont Chemicals
Chambers Works
Building K-29
Route 130 & Plant Street
Deepwater, NJ 08023

F) Identity of refrigerant (11, 12, 22, etc.)

G) Type of container (drum, cylinder, ton tank, half ton tank or tank truck)

H) Number of containers being shipped (for tank truck, list "1")

I) Gross product weight, in pounds (the gross product weight includes the weight of the containers, except for tank trucks)

J) Appropriate shipping information from Exhibit 4. Be sure to show the shipping information **exactly** as it is presented in Exhibit 4.

K) Placard Use

DOT "Nonflammable Gas" placards are not required for shipment of used refrigerants 11, 113, 114 or 123 in any container size, since these materials are not regulated by the DOT. Shipment of the remaining used refrigerants listed in Exhibit 4 may or may not require placards, according to the following guidelines.

For Cylinders and Half Ton Tanks:

If the gross product weight is 1,000 lbs (454 kg) or more, four DOT "Nonflammable Gas" placards must be given to the carrier. The driver should initial the bill of lading.

For Ton Tanks:

Four DOT "Nonflammable Gas" placards must be given to the carrier. The driver should initial the bill of lading.

For Tank Trucks:

The tank truck will be a Du Pont company truck designated for used refrigerants. It will have the appropriate DOT placards.

L) Confirmation that placards, if required, were placed on the truck (Refer to K)

The driver must verify that the placards are placed on the truck and then initial the bill of lading.

M) Fill in "Nonflammable Gas," if applicable

N) Same as I

O) Number and weight of pallets (required for drums and cylinders)

P) Gross shipping weight (the sum of N and O)

Q) Company name of shipper (same as C)

R) Signature of shipping company's representative

S) Same as A

T) Driver's signature

Exhibits 5, 6 and 7 are examples of properly prepared bills of lading for several common used refrigerant shipments.

Exhibit 1

Carriers for Transporting Recovery Ton Tanks, Half Ton Tanks, Drums and Cylinders

The following is a list of carriers, by state, for transporting recovery ton tanks, half ton tanks, drums and cylinders to Du Pont. This list is not considered exhaustive, nor should it be construed as an endorsement of any particular service or business entity.

STATE	PRIMARY CARRIER	SECONDARY CARRIER
Alabama	Yellow Freight System Inc.	Consolidated Freightways
Alaska	Viking Freight System, Inc.	
Arizona	Yellow Freight System Inc.	Consolidated Freightways
Arkansas	Yellow Freight System Inc.	Consolidated Freightways
California	Yellow Freight System Inc.	Consolidated Freightways
Colorado	Yellow Freight System Inc.	Consolidated Freightways
Connecticut	Red Star Express Lines	APA Transport Corp.
Delaware	Harold G. Cline Inc.	Red Star Express Lines
District of Columbia	Preston Trucking Co.	Overnite Transportation Co.
Florida	Yellow Freight System Inc.	Consolidated Freightways
Georgia	Overnite Transportation Co.	Yellow Freight System Inc.
Idaho	Yellow Freight System Inc.	Consolidated Freightways
Illinois	Yellow Freight System Inc.	Consolidated Freightways
Indiana	Yellow Freight System Inc.	Consolidated Freightways
Iowa	Yellow Freight System Inc.	Consolidated Freightways
Kansas	Yellow Freight System Inc.	Consolidated Freightways
Kentucky	Yellow Freight System Inc.	Consolidated Freightways
Louisiana	Yellow Freight System Inc.	Consolidated Freightways
Maine	Red Star Express Lines	Preston Trucking Co.
Maryland	Preston Trucking Co.	Overnite Transportation Co.
Massachusetts	Red Star Express Lines	APA Transport Corp.
Michigan	Yellow Freight System Inc.	Consolidated Freightways
Minnesota	Yellow Freight System Inc.	Consolidated Freightways
Mississippi	Yellow Freight System Inc.	Consolidated Freightways
Missouri	Yellow Freight System Inc.	Consolidated Freightways
Montana	Yellow Freight System Inc.	Consolidated Freightways
Nebraska	Yellow Freight System Inc.	Consolidated Freightways
Nevada	Yellow Freight System Inc.	Consolidated Freightways
New Hampshire	Red Star Express Lines	APA Transport Corp.
New Jersey	Harold G. Cline Inc.	Red Star Express Lines
New Mexico	Yellow Freight System Inc.	Consolidated Freightways
New York	Red Star Express Lines	APA Transport Corp.
North Carolina	Overnite Transportation Co.	Carolina Freight Carriers Corp.
North Dakota	Yellow Freight System Inc.	Consolidated Freightways
Ohio	Overnite Transportation Co.	Preston Trucking Co.
Oklahoma	Yellow Freight System Inc.	Consolidated Freightways
Oregon	Yellow Freight System Inc.	Consolidated Freightways
Pennsylvania	Red Star Express Lines	APA Transport Corp.
Rhode Island	APA Transport Corp.	Red Star Express Lines
South Carolina	Overnite Transportation Co.	Carolina Freight Carriers Corp.
South Dakota	Yellow Freight System Inc.	Consolidated Freightways
Tennessee	Yellow Freight System Inc.	Consolidated Freightways
Texas	Yellow Freight System Inc.	Consolidated Freightways
Utah	Yellow Freight System Inc.	Consolidated Freightways
Vermont	Red Star Express Lines	APA Transport Corp.
Virginia	Overnite Transportation Co.	Preston Trucking Co.
Washington	Yellow Freight System Inc.	Consolidated Freightways
West Virginia	Overnite Transportation Co.	Preston Trucking Co.
Wisconsin	Yellow Freight System Inc.	Consolidated Freightways
Wyoming	Yellow Freight System Inc.	Consolidated Freightways

Exhibit 2. Used Refrigerant Identification Tag

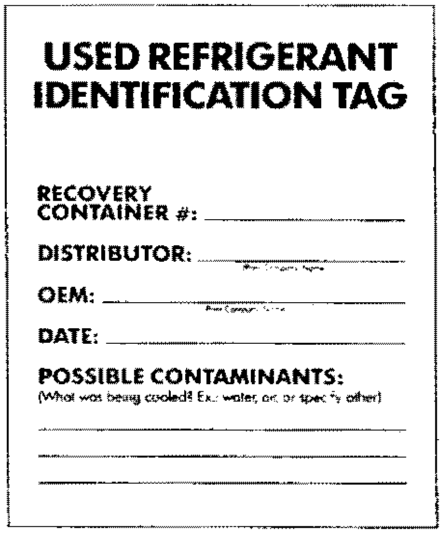


Exhibit 3. Department of Transportation (DOT) Classification Tag

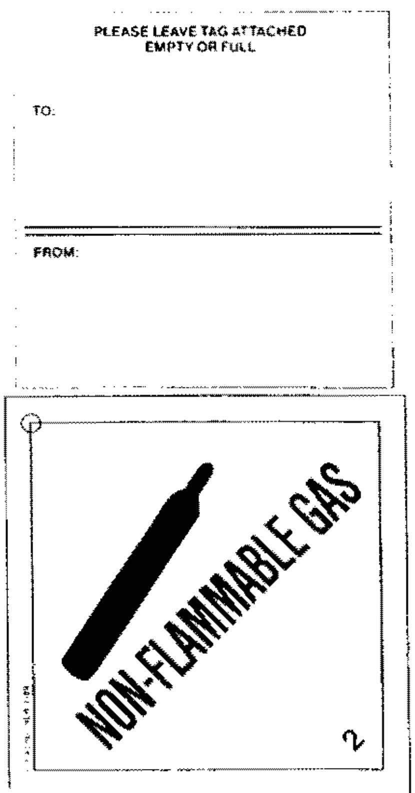


Exhibit 4. Shipping Information for Used Refrigerants

TYPE	SHIPPING INFORMATION
Used R-11 (Tank Truck, 5,000 lb [2,268 kg] or more)	RQ Hazardous Substance, Liquid, N.O.S. (Contains Trichlorofluoromethane) ORM - E NA 9188
Used R-11 (All other cases)	Not DOT Regulated
Used R-12	Refrigerant Gas, N.O.S. (Contains Dichlorodifluoromethane) Nonflammable Gas UN 1078
Used R-22	Refrigerant Gas, N.O.S. (Contains Chlorodifluoromethane) Nonflammable Gas UN 1078
Used R-113	Not DOT Regulated
Used R-114	Not DOT Regulated
Used R-123	Not DOT Regulated
Used R-134a	Refrigerant Gas, N.O.S. (Contains Tetrafluoroethane) Nonflammable Gas UN 1078
Used R-500	Refrigerant Gas, N.O.S. (Contains Halogenated Hydrocarbon R-500) Nonflammable Gas UN 1078
Used R-502	Refrigerant Gas, N.O.S. (Contains Halogenated Hydrocarbon R-502) Nonflammable Gas UN 1078

Exhibit 5. Example of Completed Bill of Lading for Cylinders

USED REFRIGERANT

H-33017

STRAIGHT BILL OF LADING SHORT FORM – ORIGINAL – NOT NEGOTIABLE

CARRIER NAMED BELOW, RECEIVED, subject to the classifications and lawfully filed tariffs in effect on the date of the issue of this Shipping Order.

CARRIER: XYZ TRUCKING CO. (A)

FROM: DATE: 5/14/91 (B)

COMPANY ABC CO. (C)

ADDRESS 1000 RIVER RD. (C)

CITY WILMINGTON (C) STATE DE (C) ZIP 19803 (C)

the property described below, in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned, and destined as indicated below, which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed, as to each carrier of all or any of said property over all or any portion of said route to destination, and as to each party at any time interested in all or any of said property, that every service to be performed hereunder shall be subject to all the terms and conditions of the Uniform Domestic Straight Bill of Lading set forth (1) in Official, Southern, Western and Illinois Freight Classifications in effect on the date hereof, if this is a rail or a rail-water shipment, or (2) in the applicable motor carrier classification or tariff if this is a motor carrier shipment.

Shipper hereby certifies that he is familiar with all the terms and conditions of the said Bill of Lading, including those on the back thereof, set forth in the classification or tariff which governs the transportation of this shipment, and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

FREIGHT COLLECT–Send Freight Bills to:
F.M.I.S. FREIGHT
P.O. BOX 8964
WILMINGTON, DE 19899

Subject to Section 7 of conditions of applicable bill of lading, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement.

The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

Per John Q. Doe (D)
(Signature of Consignor)

If charges are to be prepaid, write or stamp here "To be Prepaid."

CONSIGNED TO: (E)
DESTINATION

DUPONT CO.
CHAMBERS WORKS
"FREON" BUILDING K-29
ROUTE 130 & PLANT ST.
DEEPWATER, NJ 08023

EMERGENCY CONTACT:
FOR A CHEMICAL EMERGENCY
Spill, Leak, Fire, Exposure, or Accident
CONTACT DU PONT Day or Night By Calling
CHEMTREC (800) 424-9300 (Toll Free)
Washington D.C. 483-7616
Outside Continental USA (202) 483-7616

MATERIAL BEING SHIPPED: USED REFRIGERANT 12 (F)

TYPE OF CONTAINER: CYLINDER (G)

NUMBER OF CONTAINERS: 8 (H)

GROSS PRODUCT WEIGHT: 1200 LBS. (I)

SHIPPING INFORMATION: (J)

REFRIGERANT GAS, N.O.S.
(CONTAINS DICHLORODIFLUOROMETHANE)
NONFLAMMABLE GAS
UN 1078

PLACARDS: Only required if gross product weight is 1000 LBS. or more.

PLACARDS OFFERED AJ (Driver Initial) (K) PLACARDED: AJ (Check if Yes) (L) NAME OF PLACARD: NONFLAMMABLE GAS (M)

SHIPPING WEIGHT: GROSS PRODUCT WEIGHT 1200 LBS. (N)

(O) 1 PALLETS @ 100 LB EA. 100 LBS. (O)

GROSS SHIPPING WEIGHT 1300 LBS. (P)

This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.

Shipper ABC CO. (Q) XYZ TRUCKING CO. Agent

By John Q. Doe (R) Per Al Jones

SEE REVERSE FOR D.O.T. EMERGENCY RESPONSE PROCEDURE FOR REFRIGERANT GAS, N.O.S.

Exhibit 4. Shipping Information for Used Refrigerants

TYPE	SHIPPING INFORMATION
Used MP-39	Refrigerant Gas, N.O.S. (Contains Chlorodifluoromethane and Difluoroethane) Nonflammable Gas UN 1078
Used MP-52	Refrigerant Gas, N.O.S. (Contains Chlorodifluoromethane and Difluoroethane) Nonflammable Gas UN 1078
Used R-124	Refrigerant Gas, N.O.S. (Contains Chlorotetrafluoroethane) Nonflammable Gas UN 1078
Used R-13	Compressed Gas, N.O.S. (Contains Chlorotrifluoromethane) Nonflammable Gas UN 1956
Used R-13b1	Compressed Gas, N.O.S. (Contains Bromotrifluoromethane) Nonflammable Gas UN 1956
Used R-14	Compressed Gas, N.O.S. (Contains Tetrafluoromethane) Nonflammable Gas UN 1956
Used R-23	Compressed Gas, N.O.S. (Contains Trifluoromethane) Nonflammable Gas UN 1956
Used R-116	Compressed Gas, N.O.S. (Contains Hexafluoroethane) Nonflammable Gas UN 1956
Used R-503	Compressed Gas, N.O.S. (Contains Chlorotrifluoromethane and Trifluoromethane) Nonflammable Gas UN 1956

Exhibit 6. Example of Completed Bill of Lading for Ton Tanks

USED REFRIGERANT

H 35017

STRAIGHT BILL OF LADING SHORT FORM – ORIGINAL – NOT NEGOTIABLE

CARRIER NAMED BELOW, RECEIVED, subject to the classifications and lawfully filed tariffs in effect on the date of the issue of this Shipping Order.

CARRIER: XYZ TRUCKING CO. (A)

DATE: 5/14/91 (B)

FROM:

COMPANY: ABC CO. (C)

ADDRESS: 1000 RIVER RD. (C)

CITY: WILMINGTON (C) STATE: DE (C) ZIP: 19803 (C)

the property described below, in apparent good order, except as noted (contents and condition of contents of packages unknown) marked, consigned, and destined as indicated below, which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed, as to each carrier of all or any of said property over all or any portion of said route to destination, and as to each party at any time interested in all or any of said property, that every service to be performed hereunder shall be subject to all the terms and conditions of the Uniform Domestic Straight Bill of Lading set forth (1) in Official, Southern, Western and Illinois Freight Classifications in effect on the date hereof, if this is a rail or a rail-water shipment, or (2) in the applicable motor carrier classification or tariff if this is a motor carrier shipment.

Shipper hereby certifies that he is familiar with all the terms and conditions of the said Bill of Lading, including those on the back thereof, set forth in the classification or tariff which governs the transportation of this shipment, and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

FREIGHT COLLECT–Send Freight Bills to:
F.M.I.S. FREIGHT
P.O. BOX 8964
WILMINGTON, DE 19899

Subject to Section 7 of conditions of applicable bill of lading, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement.

The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

Per John Q. Doe (D)
(Signature of Consignor)

If charges are to be prepaid, write or stamp here "To be Prepaid."

CONSIGNED TO: (E)
DESTINATION
DUPONT CO.
CHAMBERS WORKS
"FREON" BUILDING K-29
ROUTE 130 & PLANT ST.
DEEPWATER, NJ 08023

EMERGENCY CONTACT:
FOR A CHEMICAL EMERGENCY
Spill, Leak, Fire, Exposure, or Accident
CONTACT DU PONT Day or Night By Calling
CHEMTREC (800) 424-9300 (Toll Free)
Washington D.C. 483-7616
Outside Continental USA (202) 483-7616

MATERIAL BEING SHIPPED: USED REFRIGERANT 22 (F)

TYPE OF CONTAINER: TON TANK (G)

NUMBER OF CONTAINERS: 2 (H)

GROSS PRODUCT WEIGHT: 5000 LBS. (I)

SHIPPING INFORMATION: (J)
REFRIGERANT GAS, N.O.S.
(CONTAINS CHLORODIFLUOROMETHANE)
NONFLAMMABLE GAS
UN 1078

PLACARDS: Only required if gross product weight is 1000 LBS. or more.

PLACARDS OFFERED: AJ (Driver Initial) (K) PLACARDED: AJ (Check if Yes) (L) NAME OF PLACARD: NONFLAMMABLE GAS (M)

SHIPPING WEIGHT: GROSS PRODUCT WEIGHT 5000 LBS. (N)

(O) — PALLETS @ ____ LB EA. — LBS. (O)

GROSS SHIPPING WEIGHT: 5000 LBS. (P)

This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.

Shipper: ABC CO. (Q) XYZ TRUCKING CO. Agent (S)

By: John Q. Doe (R) Per: Al Jones (T)

SEE REVERSE FOR D.O.T. EMERGENCY RESPONSE PROCEDURE FOR REFRIGERANT GAS, N.O.S.

Exhibit 7. Example of Completed Bill of Lading for Drums

H-33017

USED REFRIGERANT

STRAIGHT BILL OF LADING SHORT FORM – ORIGINAL – NOT NEGOTIABLE

CARRIER NAMED BELOW, RECEIVED, subject to the classifications and lawfully filed tariffs in effect on the date of the issue of this Shipping Order.

CARRIER: XYZ TRUCKING CO. (A)

FROM: **DATE:** 5/14/91 (B)

COMPANY ABC CO. (C)

ADDRESS 1000 RIVER RD. (C)

CITY WILMINGTON (C) **STATE** DE (C) **ZIP** 19803 (C)

the property described below, in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned, and destined as indicated below, which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed, as to each carrier of all or any of said property over all or any portion of said route to destination, and as to each party at any time interested in all or any of said property, that every service to be performed hereunder shall be subject to all the terms and conditions of the Uniform Domestic Straight Bill of Lading set forth (1) in Official, Southern, Western and Illinois Freight Classifications in effect on the date hereof, if this is a rail or a rail-water shipment, or (2) in the applicable motor carrier classification or tariff if this is a motor carrier shipment.

Shipper hereby certifies that he is familiar with all the terms and conditions of the said Bill of Lading, including those on the back thereof, set forth in the classification or tariff which governs the transportation of this shipment, and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

FREIGHT COLLECT–Send Freight Bills to:
F.M.I.S. FREIGHT
P.O. BOX 8964
WILMINGTON, DE 19899

Subject to Section 7 of conditions of applicable bill of lading, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement:

The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

Per John A. Doe (D)
(Signature of Consignor)

If charges are to be prepaid, write or stamp here, "To be Prepaid."

CONSIGNED TO: (E)
DESTINATION
DUPONT CO.
CHAMBERS WORKS
"FREON" BUILDING K-29
ROUTE 130 & PLANT ST.
DEEPWATER, NJ 08023

EMERGENCY CONTACT:
FOR A CHEMICAL EMERGENCY
Spill, Leak, Fire, Exposure, or Accident
CONTACT DU PONT Day or Night By Calling
CHEMTREC (800) 424-9300 (Toll Free)
Washington D.C. 483-7616
Outside Continental USA (202) 483-7616

MATERIAL BEING SHIPPED: USED REFRIGERANT 11 (F)

TYPE OF CONTAINER: DRUM (G)

NUMBER OF CONTAINERS: 4 (H)

GROSS PRODUCT WEIGHT: 2200 **LBS.** (I)

SHIPPING INFORMATION: (J) NOT DOT REGULATED

PLACARDS: Only required if gross product weight is 1000 LBS. or more. NOT REQUIRED

PLACARDS OFFERED: ______ (Driver Initial) (K) PLACARDED: ______ (Check if Yes) (L) NAME OF PLACARD: ______ (M)

SHIPPING WEIGHT: GROSS PRODUCT WEIGHT 2200 LBS (N)

(O) 1 PALLETS @ 100 LB EA 100 LBS (O)

GROSS SHIPPING WEIGHT 2300 LBS (P)

This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.

Shipper ABC CO. (Q) XYZ TRUCKING CO. Agent (S)

By John A. Doe (R) Per Al Jones (T)

SEE REVERSE FOR D.O.T. EMERGENCY RESPONSE PROCEDURE FOR REFRIGERANT GAS, N.O.S.

DU PONT AUTHORIZED DISTRIBUTOR

FREON® REFRIGERANTS

SUVA® ALTERNATIVE REFRIGERANTS

Du Pont Fluorochemicals
Customer Service Center, B-15305
Wilmington, DE 19898
800-441-9442
302-774-2099

DUPONT

H-33016-1

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VOLVO

RETROFITTING FOR CUSTOMER SATISFACTION

Presented at the SAE-congress in Detroit, March 1 1993

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ABSTRACT

Due to legislation, the CFC:s will soon be out of production. One of the CFC:s (R12) are commonly used in the automotive A/C-systems. For new cars, all manufacturers have now or are in the process of changing the refrigerant to R134a.

For service of older cars, the AC-system has to be retrofitted to an alternative refrigerant. Here, the preferrable choice is R134a, which is also Volvos decision.

However, R134a needs a new lubricant, since it is not miscible with mineral oil. Out of the two alternatives PAG oil or ester oil, Volvo has decided to choose ester oil. There are two important reasons for this choise. We have not, nor do we expect to get, satisfying durability/reliability in our R12 wobble-plate compressors if using PAG-oils. The other reason is material compatibility with ECO (epichlorohydrine). This rubber material swells heavily in PAG, and finally dissolves.

One objective has been to prove that residual amounts of R12 mineral oil, does not effect durability after retrofit, nor that it affects AC-performance too much. By performing various tests at Volvo, we have proven we have solved these problems, without having to clean-flush the AC-system.

The Volvo decision is therefore to choose R134a as retrofit refrigerant, ester oil as lubricant and that we will not have clean-flushing in our retrofit procedure/instructions. At the end, this will mean a very inexpensive, but yet reliable retrofit to the Volvo customer.

Depending on different models and age, the Volvo retro-kits will be avaliable at different times during 1993, and we will have the first kits available to this coming AC-season.

930292

Experience of Retrofitting Automotive Air-Conditioning from CFC12 to HFC134a

A. M. Smith, M. C. Beggs, and B. D. Greig
Castrol International

ABSTRACT

A method of retro-fitting automotive air-conditioning systems from CFC12 to HFC134a has been developed.

This method only requires the use of conventional refrigerant recovery and recycle machines and offers a cost effective method of retrofitting a range of automotive air-conditioning systems to HFC 134a.

INTRODUCTION

Until recently many vehicle manufacturers showed little interest in retrofitting automotive air-conditioning systems. This was in contrast to many industrial concerns, who have been carrying out trials on retrofitting from R12 to R134a for a number of years. Castrol first became involved in light industrial retrofits in September 1990 [Ref 1]. However, by January 1990 two R12 automotive air-conditioning systems were running on R134a using first generation Polyalkalyne Glycol (PAG) lubricants. These PAG lubricants were discontinued in mid 1990 in favour of the more robust polyol ester based products.

LUBRICANT SPECIFICATION FOR RETROFITTING

The viscosity grade used for automotive retrofitting, and initial fill of compressors, is a fully formulated polyol ester based lubricant, Icematic SW100 and is one of a range from ISO 10 to ISO 350. All of these products are formulated using a low treat ashless additive package. Automotive air-conditioning demands good lubricant/refrigerant miscibility characteristics coupled with good thermal and hydrolytic stability, in addition to good lubricating properties in the absence of chlorine from the R12. Elastomer compatibility is also an important issue.

MISCIBILITY - Good miscibility characteristics are necessary for automotive applications to ensure that the lubricant is rapidly moved around the refrigeration circuit. Icematic SW100 has a similar miscibility characteristic with R134a to that of mineral oil and R12. Therefore it can be expected that conventional R12 systems would function correctly on R134a and Icematic SW100. Many PAG lubricants have significantly different miscibility characteristics which may affect lubricant transport around the refrigeration circuit.

Table 1

	UCST[1]	LCST[2]
Icematic SW100/CFC12	>100°C	<-50°C
Icematic SW100/R134a	>100°C	-33°C*
Typical Mineral Oil/R12	>100°C	-24°C#

[1] Upper Critical Solution Temperature
[2] Lower Critical Solution Temperature - the temperature at which the lubricant begins to separate from the refrigerant

** This value occurs at 15% Icematic SW100 in R134a (w/w).*
 # This is the Floc Point as in ANSI68-1983.

The values given above for UCST indicate that the refrigerant/lubricant mixture remains a one phase mixture up to at least 100°C which represents the highest temperatures commonly found in automotive air-conditioning systems.

Any mineral oil contamination in the ester lubricant tends to increase the LCST. Therefore it is desireable for the neat ester to have a low LCST which then allows it to tolerate a large amount of mineral oil contamination in retrofit applications. The formation of floc in mineral oil when mixed with R12 is a result of the waxy components dropping out of the mineral oil. The formation of floc in a working system would tend to reduce lubricant flow around the system.

At 20% mineral oil in Icematic SW 100 a two phase mixture occurs if mixed in the ratio two parts R134a to one part lubricant. At zero °C this mixture consists of 95% heavy phase. This phase contains 97% of all the R134a, 99% of all the Icematic SW and 35% of all the mineral oil present in the system. This would mean that at zero °C up to 7% mineral oil will remain miscible in liquid R134a. Any additional mineral oil would tend to float on the liquid surface, however given the turbulence present in a real application this would not happen. The mineral oil would be carried around the system unaffected by the R134a.

THERMAL STABILITY - The thermal stability of the lubricant/refrigerant mixture is particularly important in an automotive air-conditioning system due to the elevated temperatures that the system components are exposed to. Generally the refrigeration circuit will be manufactured from a variety of materials including copper, steel and aluminium. One of the main concerns with retrofitting was to prevent copper plating onto steel components. This has been prevented by the addition of additives designed to passivate the copper surfaces in the system.

A typical stability test, the ASHRAE 97 method, can be used to assess the stability of the lubricant/refrigerant mixture. This test is carried out at 175°C for 14 days in the presence of metal coupons to simulate the working environment. See Table 2 for results.

Table 2

	Refrigerant	Copper	Steel	Aluminium
Icematic SW100	R12	Bright	Bright	Clean
Icematic SW100	R134a	Bright	Bright	Clean
SW100 + 20% SGS	R134a	Bright	Bright	Clean

The clean and bright appearance of all the metal coupons indicates that there is no chemical reaction occurring between the lubricant/refrigerant mixture and the metal coupons.

HYDROLYTIC STABILITY - Hydrolytic stability refers to the lubricant/refrigerant mixture's tolerance to moisture contamination when subjected to high temperatures. If a product is not hydrolytically stable chemical reactions may occur that would be harmful to system components.

The ASHRAE 97 test procedure was modified, by deliberately introducing moisture into the tubes to provide an indication of hydrolytic stability. The results of these tests are given in Table 3 below.

Table 3

Lubricant	Refrigerant	Water (ppm)	Copper	Steel	Aluminium
Icematic SW100	HFC 134a	300	Bright	Bright	Clean
Icematic SW100	HFC 134a	1,000	Bright	Copper Plating (50%)	Clean
Base Stock (no additives)	HFC 134a	300	Bright	Copper Plating (75%)	Clean
Icematic SW100	CFC12	300	Bright	Bright	Clean

The above results show that the fully formulated Icematic SW100 will tolerate 300ppm moisture contamination with both HFC134a and CFC12. The effectiveness of the hydrolytic stabiliser is indicated by comparison of the performance of the base stock only figure of 75% copper plating, and the bright appearance of the steel coupon when tested with Icematic SW100.

An additional test used to demonstrate the effectiveness of the hydrolytic stabiliser was the Turbine Oxidation Stability Test (TOST) as in DIN 51587. This test is very severe for a refrigeration lubricant since it was designed to assess the oxidative stability of steam turbine lubricants. A 16% water/oil emulsion was heated to 95°C and bubbled with oxygen at the rate of 50 cc/minute. After 500 hours the acidity was measured at 1.85mg KOH/gm for the Icematic SW100 product. This compared with a result of 160mg KOH/g obtained for the polyol ester base stock. The acidity of the blended product when new is 0.15mg KOH/g.

LUBRICATING PROPERTIES OF ICEMATIC SW 100 - Popular methods for assessment of anti wear performance of refrigeration lubricants are the modified ASTM D2670-88 and D3233-86 procedures using the Falex Pin and Vee Block machine. Modifications include a device to bubble refrigerant gas through the test lubricant before and during test, and selection of load to suit application. Table 4 shows the steel/steel wear and seizure test results for a typical mineral oil/R12 and Icematic SW100 with R12 and R134a. Results are also given without refrigerant for both lubricants.

Table 4

	Wear (mg) 15 minutes @ 400lbs	Seizure Load (lbs) Method B
Mineral Oil Only	Seizure occurs before 15 minutes	750
Mineral Oil Plus R12	13.2	750
Icematic SW100 only	6.8	750
Icematic SW100 Plus R12	10.2	1,750
Icematic SW100 Plus R134a	24.8	~~2,750~~ 1750

The result presented in Table 4 show that the mineral oil alone is a relatively poor lubricant, but the inclusion of R12 improves the situation. The Icematic SW 100 however is a relatively good lubricant alone and its performance is compromised by the inclusion of R134a. The fact that the seizure load increases for Icematic SW 100 when mixed with R134a is probably due to a combination of factors including the reduction in viscosity and the increased cooling effect achieved by bubbling R134a through the test bath.

ELASTOMER COMPATIBILITY - For automotive air-conditioning systems elastomer compatibility is particularly important, due to the presence of flexible hoses, shaft seals and O-ring seals. Many compatibility tests have been conducted using elastomer samples supplied by various component manufacturers. These tests have shown Icematic SW 100 and R134a to be compatible with HNBR, NBR, Neoprene and Nylon. Viton and SBR have been shown to be unsuitable for use with Icematic SW 100 and R134a. In the course of these compatability tests it became apparent that within generic elastomer groupings significant variation occurs between suppliers. It is therefore essential that each source of elastomer is tested with the lubricant/refrigerant mixture to ensure compatability.

ADVANTAGES OF ICEMATIC SW OVER POLY-ALKYLENE GLYCOLS

HYGROSCOPICITY - Icematic SW has a moisture saturation value of 1100ppm compared with in excess of 10,000 ppm for many PAG products. From this point of view Icematic SW is much more user friendly, since the only handling precautions necessary to avoid excessive moisture contamination are those normally associated with current good practice. Moderate levels of moisture contamination, up to around 600 ppm, can be tolerated in a working system due to the action of the additive package which includes a hydrolytic stabiliser.

CFC COMPATIBILITY - Icematic SW is compatible with both CFC12 and HFC134a. This means that it is an ideal retrofit lubricant especially considering levels of 300 to 400 ppm residual chlorine are common in retrofitted automotive air-conditioning systems. PAG's are not tolerant to such levels of chlorine. [Ref 2]. Recently developed highly modified PAG's that are more tolerant are very expensive.

MISCIBILITY WITH MINERAL OILS - Icematic SW is miscible with mineral oil over the entire range from zero to 100% mineral oil (in Icematic SW 100), whereas many PAG's exhibit little or no miscibility with mineral oils.

FIELD TRIAL EXPERIENCE

Automotive air-conditioning systems were first used by Castrol Technology Centre with R134a in January 1990. Three company owned vehicles were fitted with after market air-conditioning units which were specifically chosen to include three different compressor types, namely Sanden SD 508, Diesel Kiki DKS (York) and Seiko Seiki SS170. All used standard 'off the shelf' R12 components.

The lubricants used were first generation PAG's which were not chlorine tolerant. The trials were designed to demonstrate, what many believed to be impossible in 1990 [Ref 3], that a conventional R12 system could be operated satisfactorily on R134a. No attempt was made to measure system performance other than subjectively by the individual drivers.

The systems performed as expected when new and only time would tell if this situation continued. Unfortunately one vehicle survived only one week. This was a Ford Granada fitted with the York Diesel Kiki system, which was crushed by a large tree falling on the vehicle during the storms over Southern England on 25th January 1990! Fortunately both other vehicles were undamaged.

The only problem experienced with the Rover 820 (Seiko Seiki SS170 compressor) was due to under-condensing when stationary. This problem was due to an undersize condenser being fitted due to lack of space. From previous experience even R12 systems suffered from this problem.

The compressor shaft seal failed after four months operation (176 compressor running hours). The opportunity was taken to strip this compressor and inspect for wear. The components showed wear consistent with normal operation and the test was re-started with a new compressor of the same type. The failed O-ring had swollen to such a degree that it had been extruded between the shaft and the seal housing leading to eventual failure. The O-ring material was identified as being similar to Viton A and the swelling was attributed to the incompatibility between Viton and R134a. This vehicle was eventually re-filled with the second generation ester based lubricant, Icematic SW. After a total of 710 hours operation (97,000 km), half on PAG and half on Icematic SW , the compressor proved to be in excellent condition with wear and lacquer deposits consistant with normal operation.

The third vehicle was a Vauxhall Carlton using a Sanden SD508. This vehicle was retrofitted to Icematic SW100 after 360 compressor running hours (73,000 km) on PAG and will continue testing for a further two years.

DEVELOPMENT OF THE RETRO-FIT PROCEDURE

Retrofitting to R134a was not seriously considered by the automotive industry until well into 1991. [Ref 4] Castrol had carried out a number of light industrial retrofills in late 1990 and early 1991 [Ref 1]. These systems were typically beer cellar cooling and bulk milk refrigeration systems. The procedure used required repeated oil changes (flushes) of the Icematic SW whilst running on R12 to remove the bulk of the mineral oil from the system. This process was clearly not acceptable for automotive retrofits, bearing in mind the many millions of vehicles likely to require retrofitting in the next five to ten years.

The first vehicle retrofits were carried out on a broad cross-section of system types in many worldwide locations. The method used to convert the systems was generally based on compressor removal followed by flushing the system with liquid R12. This process results in very low levels of residual mineral oil in the converted system, but is time consuming. Another method used followed the procedure of repeated oil changes whilst operating on R12. However, this method required the compressor to be removed from the vehicle three or four times to drain and re-fill with lubricant [illegible] R12. Apart from the added risk of accidentally discharging R12 to the atmosphere this method was also very time consuming.

In early 1992 a retrofit was carried out without removing the compressor, or any other component from the vehicle system. This process involved using a conventional recovery-recycle rig to remove the R12 from a previously warmed system. The act of recovering the R12 quickly from a hot system results in a portion of the mineral oil being removed from the system. The system was then recharged with the recycled R12 and operated again for a short period. The R12 was again recovered and recycled by the recovery machine. At the end of each recovery cycle the mineral oil was drained from the recovery machine and saved. The above procedure was repeated, with the exception of running the system, another two or three times until most of the mineral oil had been recovered. The effectiveness of this procedure in recovering mineral oil depends largely on the system configuration and on the recovery machine used.

A full charge of Icematic SW 100 was then drawn into the system through the LP port by applying a slight vacuum to the HP port. After applying a vacuum the system was charged with R134a using a charge weight of 90% of that recommended for R12.

In excess of 50 vehicles have now been retrofitted using one of the above mentioned procedures. All have been in operation throughout 1992 and no failure has occured, despite mineral oil levels of 25% in Icematic SW being measured. Many drivers actually report an improvement in system performance whilst on open roads. Performance at idle is poor compared with R12, possibly due to the limited ability of the 'R12' condenser to condense the R134a, which has a higher latent heat than R12.

CASTROL AUTOMOTIVE RETROFIT PROCEDURE

The program of work described above has led to [illegible] Procedure which is the absolute minimum of work required to retrofit an existing R12 system to R134a. Many manufacturers and operators may wish to increase the level of mineral oil recovery by carrying out further work, but the method as detailed in attachment 1 and figure 1 has been shown to perform satisfactorily.

CONCLUSIONS

The automotive industry has now started to give serious thought to retrofitting. Estimates of the total number of vehicles likely to require retrofitting vary widely but it will certainly be many tens of millions worldwide. [illegible] are unlikely to be suitable for use as retrofit lubricants. This aspect should be considered by vehicle manufacturers since it will increase the number of air conditioner lubricants that must be held in stock. This in turn will lead to errors in lubricant selection during service with consequent costly system failures.

Although other parties have proposed highly modified PAG's for both initial fill and retrofit, Castrol consider that the Icematic SW range of lubricants offer the best option at lower cost to the automotive industry. The Castrol retrofit procedure has been developed on the assumption that the industry needs a fast and cost effective method to retrofit vehicle systems.

ACKNOWLEDGEMENTS

The authors would like to thank colleagues at Castrol International Technology Centre and numerous operating units around the world for their assistance in the preparation of data used in this paper.

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Wei-Te Wu, Robert McNary and Raymond Thomas, Allied Signal Inc.
Paper presented at the International CFC and Halon Alternatives Conference, Washington DC, 1992.

3. The Search for CFC Substitutes - Kenneth J Korane published in Machine Design, May 24 1990.

4. Letter from Spauschus Associates Inc. to IFC dated 24 July 1991 regarding the Strawman Proposal for Mobile A/C Retrofit Materials Compatibility.

ATTACHMENT 1
CASTROL AUTOMOTIVE AIR-CONDITIONING RETROFIT PROCEDURE

Application: The Castrol retrofit procedure is designed to enable an automotive air-conditioning system to be converted from R12 to R134a in the minimum time. The cost is also kept to a minimum by the use of conventional refrigerant handling equipment. This procedure should only be carried out by trained refrigeration fitters following normal safety precautions.

Note: Any conventional R12 air-conditioning system may be converted using this procedure provided the shaft seal material is compatible with R134a.

1. Operate engine and air-conditioning to warm up and check that the system is functioning correctly.

2. Connect R12 recovery rig to vehicle and recover R12 from system as quickly as possible. This process results in some mineral oil being carried out of the system and into the recovery rig. Separate this oil from the gas, saving the oil in an empty container to enable an estimate to be made of the final volume of oil recovered.

3. Re-charge the vehicle system with the recovered R12, operate the system again for a short period and recover the refrigerant again. Different installations may require a slightly different approach such as recovering the R12 through the LP port rather than the HP port. Repeat the recovery and recharge process until 80 to 90% of the original fill of lubricant is recovered.

   Do not operate the system once more than half of the original lubricant volume has been recovered otherwise serious compressor damage may result.

4. Following the final recovery of R12 from the system the filter/drier should be replaced with a unit suitable for use with R134a. In systems employing orifice tubes it may be worthwhile replacing the tube with one slightly smaller, check this with system manufacturer.

5. The system is now ready for the charge of Castrol Icematic SW 100 to be added. This can be achieved by drawing a vacuum on the HP port and pouring the correct volume of lubricant into the LP port via a suitable adaptor. The volume of lubricant added should be as per the system manufacturers recommendation with no allowance for any lubricant remaining in the system.

6. Apply a vacuum in the normal way via the HP port to ensure that the Icematic SW 100 is not removed from the system.

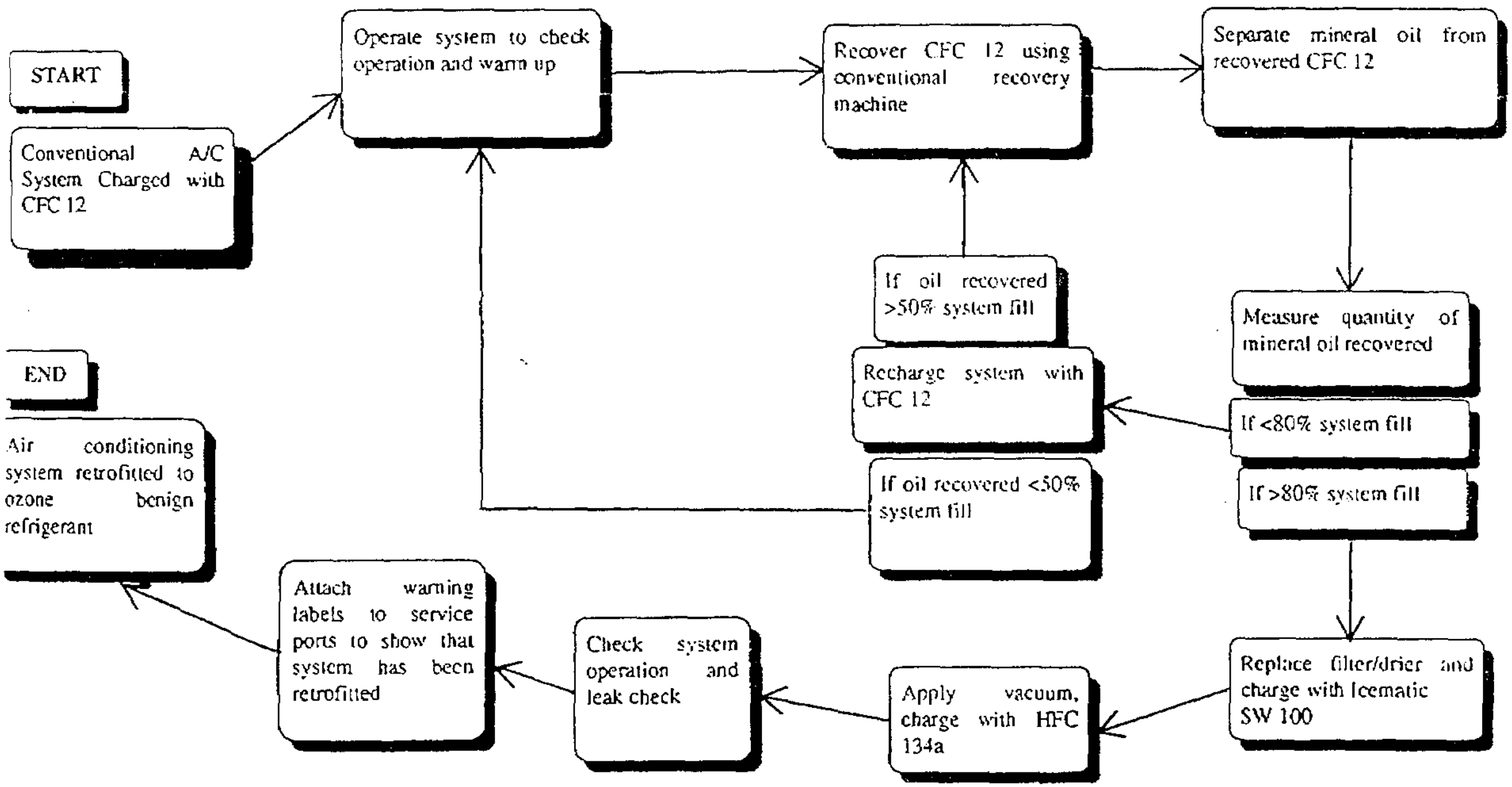
7. The system is now ready for charging with R134a. The charge weight should be that used for R12 unless experience or other information indicates a slightly lower charge weight. It is not uncommon for R134a retrofitted systems to have some bubbles visible in the sight-glass even when fully charged.

8. Operate the system checking for leaks and correct system operation. Some systems tend to give slightly lower stationary performance when operating on R134a, if this is suspected carry out a road test.

9. Attach suitable warning labels to the service ports to indicate that the system has been retrofitted to R134a using Castrol Icematic SW 100.

930292

FIGURE 1
CASTROL AUTOMOTIVE AIR-CONDITIONING RETROFIT PROCEDURE



DATA SUMMARY - MP52 FLEET TEST

	VEHICLE NO / REG	OCT 92		NOV 92		DEC 92		JAN 93		FEB 93		MAR 93	APR 93
		8/10/92		28/11/92		13/12/92		9/1/93		27/2/93			
1)	WCH 6828	TEMP.	29.8°C	Temp	30°C	Temp	29°C	Temp	32°C	Temp	31°C		
		P.S	26psi	P.S	26psi	P.S	27psi	P.S	24psi	P.S	25psi		
		P.D	250psi	P.D	260psi	P.D	265psi	P.D	240psi	P.D	250psi		
2)	PBH 866	Temp	29	Temp	31	Temp	30						
		P.S	22	P.S	24	P.S	27psi						
		P.D	260	P.D	190	P.D	260psi						
3)	WCJ 9410	Temp	32	Temp.	31	Temp.	33	Temp.	30	Temp	33		
		P.S	22	P.S	24	P.S	23	P.S	23	P.S	20		
		P.D	200	P.D	190	P.D	210	P.D	220	P.D	210		
4)	PBY 9356	-		Temp.	20°C								
				P.S	32								
				P.D	160								

VEHICLE DATA SHEET

DATE: 8/10/92 DU PONT TEST VEHICLE NO: ____________

NAME: WESTECH S/B ADDRESS: Shah Alam

CITY: ____________ STATE: ____________ ZIP CODE: ______

PHONE NO: ____________ MILEAGE: 499937

YEAR: ____________ MAKE: ____________ TYPE OR MODEL: SANDEN 507 S/N: 32906

LICENSE NO: WCH 6828 STATE: ____________ V.I.N.: ____________

WORK PERFORMED BY: SIN SOON FATT

PERFORMANCE TEST BEFORE RETROFIT:

- WARM ENGINE TO NORMAL OPERATING TEMPERATURE

  CONTROL ENGINE SPEED AT ABOUT 2,000 RPM

- SET A/C CONTROL TO NORMAL

- CLOSE VEHICLE DOORS AND WINDOWS

- SET A/C FAN ON HIGH (TEST "A"). LET SYSTEM STABILIZE FOR 10 MINUTES
  - VERIFY THAT ELECTRIC COOLING FAN AND CONDENSER FANS ARE OPERATING (IF APPLICABLE)

- MEASURE AND RECORD ITEMS 1 THRU 5 UNDER TEST "A"

A	B	
29.8°C	30.5°C	1. AMBIENT TEMPERATURE
30%	41%	2. RELATIVE HUMIDITY
7.2°C	6.2%	3. AIR TEMPERATURE AT A/C DUCT
26 psi	20 psi	4. COMPRESSOR SUCTION PRESSURE
250 psi	240 psi	5. COMPRESSOR DISCHARGE PRESSURE

- FOLLOWING COMPLETION OF TEST "A", SWITCH A/C FAN TO LOW SPEED AND LET SYSTEM STABILIZE FOR 10 MINUTES.

- MEASURE AND RECORD ITEMS 1 THRU 5 WITH A/C FAN ON LOW (TEST "B")

- ✓ LEAK TEST A/C SYSTEM

- COMMENTS: good condition ..

(OVER)

- RECOVER REFRIGERANT, AND SAMPLE AS DIRECTED
- REPLACE THE FOLLOWING AS INSTRUCTED:

____	ACCUMULATOR	____	THERMAL EXPANSION VALVE (TXV)
✓	RECEIVER/DRYER	____	OTHER
____	ORIFICE TUBE	____	SCHRAEDER VALVES & CAPS

- EVACUATE UNIT
- ADD LUBRICANT (SEE PROCEDURE)
- CHARGE WITH (CIRCLE ONE): SUVA® MP-52 R-12 HFC-134a

FINAL PERFORMANCE ~~TEST AFTER~~ RETROFIT

(PERFORM AFTER REPLACEMENT OF NEW PARTS AND REFRIGERANT)

- WARM ENGINE TO NORMAL OPERATING TEMPERATURE
- CONTROL ENGINE SPEED AT ABOUT 2,000 RPM
- SET A/C CONTROL TO NORMAL
- CLOSE VEHICLE DOORS AND WINDOWS
- SET A/C FAN ON HIGH (TEST "A"). LET SYSTEM STABILIZE FOR 10 MINUTES
  - VERIFY THAT ELECTRIC COOLING FAN AND CONDENSER FANS ARE OPERATING (IF APPLICABLE)
- MEASURE AND RECORD ITEMS 1 THRU 5 UNDER TEST "A"

	A	B	
	25.2 °c		1. AMBIENT TEMPERATURE
	32		2. RELATIVE HUMIDITY
6.1 (10 min)	7.0 °c		3. AIR TEMPERATURE AT A/C DUCT
	20 psi		4. COMPRESSOR SUCTION PRESSURE
	230 psi		5. COMPRESSOR DISCHARGE PRESSURE

- FOLLOWING COMPLETION OF TEST "A", SWITCH A/C FAN TO LOW SPEED AND LET SYSTEM STABILIZE FOR 10 MINUTES.
- MEASURE AND RECORD ITEMS 1 THRU 5 WITH A/C FAN ON LOW (TEST "B")
- ✓ LEAK TEST A/C SYSTEM
- COMMENTS: good condition

ADDITIONAL DATA TO BE RECORDED DURING RETROFIT

REPAIRS TO A/C SYSTEM BEFORE RETROFIT:

none

CONDITION OF ORIFICE TUBE WHEN INSPECTED:

REFRIGERANT CHARGING (SEE CONVERSION TABLE):

TYPE	OEM SPEC (R12)	AMOUNT CHARGED (LBS, OUNCES)
R-12	0.8kg.	0.7kg
R-12		(OEM SPEC)
MP52		(SEE TABLE)
HFC-134a		(SEE TABLE)

LUBRICANT ADDED:

TYPE	OEM SPEC (MIN OIL)	AMOUNT ADDED (OUNCES)
MINERAL OIL		----
LUBE A	Alkylbenzene	8 ounces.
LUBE B		

COMPRESSOR TYPE AND SERIAL NUMBER:

SANDEN 507 / 32906

A/C HOSES:

	MANUFACTURER	(LENGTH (FT) (OF RUBBER PORTION ONLY)	OUTSIDE DIAMETER (IN)
SUCTION	GY	3'	
DISCHARGE	GY	3'	
LIQUID			

THERMAL EXPANSION VALVE (TXV):

ORIGINAL TXV SUPERHEAT SETTING = ________ °F (IF AVAILABLE)

WHAT ADJUSTMENTS WERE MADE TO THE TXV?

____

____

CLUTCH CYCLING SWITCH:

ORIGINAL SETTING, CUT-OFF SWITCH (LOW PRESSURE) ________ PSIG

<u>NEW</u> SETTING, CUT-OFF SWITCH (LOW PRESSURE) ________ PSIG

ORIGINAL SETTING, CUT-ON SWITCH (HIGH PRESSURE) ________ PSIG

<u>NEW</u> SETTING, CUT-ON SWITCH (HIGH PRESSURE) ________ PSIG

EVAPORATOR THERMOSTAT SWITCH:

WHAT ADJUSTMENTS WERE MADE? ______________________________

____

____

HFC134a – PRODUCT AVAILABILITY

COMPANY	LOCATION	CAPACITY (tpa)	START – UP
DUPONT	USA JAPAN (JV) USA DODRETCH, NETHERLAND	8000 9000 32000 10000	FEB 1991 NOV 1992 APR 1994 JULY 1994
ICI	UK USA JAPAN (JV)	5000 20000 10000	OCT 1990 DEC 1992 NOV 1993
DAIKIN	JAPAN	5000	DEC 1991
SHOWA DENKO	JAPAN	5000	MAY 1992
ASAHI GLASS	JAPAN	5000	AUG 1992
ATOCHEM	FRANCE	9000	SEP 1992
HOESCHT	BRAZIL GERMANY	1000 6000	JAN 1993 DEC 1994
ALLIED SIGNAL	USA	9000	DEC 1994
TOTAL		134000(tpa)	

DEPARTMENT OF ENVIRONMENT,
MINISTRY OF SCIENCE TECHNOLOGY
AND ENVIRONMENT
12th & 13th FLOOR WISMA SIME DARBY,
JALAN RAJA LAUT,
50662 KUALA LUMPUR

Telephone: 2938955
Telex: MOSTEC MA 28154
Telefax: 603-2931480
Cable: SEKITAR

Our Ref: AS 91/120/004/006 Jld.1 (70)
Your Ref:
Date: 3 May 1993

Mr. Frank Pinto
CFC Consultant for UNDP
United Nations Plaza
New York
NY 10017

Dear Sir,

AUTOMOBILE RETROFITTING DEMONSTRATION PROJECT

I would like to refer to the discussion held in our office on April 8, 1993 concerning the above-mentioned subject. The Government of Malaysia would like to officially appoint UNDP as the Implementing Agency for its project. Attached (*) herewith is the project proposal for your further action in next EXCOM Meeting.

2. With regard to the 1991 UNDP Work Programme for MAC Training, attached herewith is the preliminary project activities for your consideration. This activities should be stared in the early September 1993 and expected completed the end 1994.

Thank you.

Yours sincerely,

(ISMAIL ITHNIN)
for Director-General of Environment
Malaysia

* - by mailing.

FRANK.WP1 III-11 II/86/030593

Attachement I

1. MAC Training Materials

Preparation of MAC training materials in three local languages (Bahasa Malaysia, English, Chinese)

Estimated cost

(Translation, editing and printing) : US$8,000

2. MAC Local Languages Training

Implementation of three MAC recycling operators training in three local languages (Bahasa Malaysia, English and Chinese)

Estimated Cost:

Target	:	25 participants and would be charged US$50 each
Rental	:	US$7,000
Management Fees	:	US$2,000
Lunch	:	US$2,000
Others	:	US$1,000 @ US$12,000 x 3 local languages = US$36,000

3. ODS Training Materials

Preparation of training materials (Bahasa Malaysia only) in related ODS sectors as part of the national ODS public awareness campaign.

Estimated Cost = US$6,000

United Nations
Development Programme

World Development

TO: FRANK PINTO

FROM: CLINTON NORRIS
UNDP CONSULTANT

DATE: 13 MAY, 1993

SUBJECT: PROJECT TECHNICAL REVIEW

I have reviewed the Demonstration Project, "Automobile Retrofitting Demonstration Project with Alternates to CFC12" based on the submitted detailed project document and on supplier discussions.

Information Provided

The information provided shows the developing need to retrofit in Malaysia, describes the issues to be addressed in order to satisfy that need, and gives details on how the issues will be addressed. It focuses primarily (76%) on training and training facilities, a campaign to achieve citizen action via awareness of the alternatives to limited supplies of recycled CFC12. Approximately 24% involves a 200 car test of retrofit technologies -150 with two HFC 134a retrofit alternatives, and 50 with HFC/HCFC blend. The technical detail and data/experience of HFC134a retrofit are included as well as some data on the experience of retrofit with blends.

Technical Soundness

The analysis of trends appears sound, and the conclusion that there will be a recycled shortfall of CFC 12 also is sound . Because forecasts such as this generally have a number of uncertainties, the exact date is probably not predicted accurately (1997). It should be considered a valid indicative number for planning purposes, however, and it does not change the conclusion as to the actions needed. As the analysis shows, it will occur within a few years. As far as the test goes, there is a growing list of OEMs who are accepting the retrofit technology associated with HFC134a, although the high cost path shown in the project is the most popular. There is also a need to obtain the data for lower cost retrofits in developing countries where populations of drivers have limited funds for retrofit of their vehicles. This project addresses that need to a limited degree, and the evaluator was informed that OEMs were involved in the design of this project

Safety

The safety issues are discussed adequately in the document, and the plan to Involve the blend supplier,DuPont (which has a world wide reputation for good safety standards), will ensure that the most knowledgable and experienced trainers re this blend are involved in the demonstration project.

Cost Effectiveness

The project addresses cost effectiveness, since that will be a major concern within the country. It shows that there is significant justification for assessing lower cost retrofit alternatives.

Environmental

While the absolute environmental impact of the project is minimal, (it will phase out a small quantity of ODS - appx 200kg), it could lead to earlier phase out of ODS, a reduction in the shortage of recycled CFC12, and an attendant reduction in early obsolescence cost. This also could be translated into making more resources available to do other phase out activities, which could have significant impact on the amount and rate of ODS phased out.

Other Factors

If successfully demonstrated, the use of "drop ins" could greatly assist countries where recycling compliance and cost are very difficult.

Recommendations

It is recommended that this demonstration project be approved.

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Tentative Programme

NATIONAL ODS CONFERENCE

Date : 20-21 July 1993

Venue : Equatorial Hotel

Official Opening Ceremony: Y.B. Minister of Science, Technology and the Environment

Closing Ceremony : Secretary General Ministry of Science, Technology and the Environment

SUGGESTED PAPER AND PANEL TOPICS

DAY I: 20 July 1993

Session I	:	**GENERAL-POLICY**	SPEAKER	TIME (MIN)
Session Chairman:		(Ministry of Finance)		
1.		Latest Developments of MP	DOE/MITI	30
2.		Government Role and Control Measures	DOE/MITI	30
3.		Questions and Answers	-	30

Session II : **SOLVENT-CLEANING**

Session Chairman: (DOE)

1.	Current Status-Overview and Industry View Point on Available Alternatives and Technologies	En. X.Yoong	45
2.	Panel Discussion: WESTECH, EXXON, 3M, NAGASE, ST CHEMICALS		45

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Session III : **MOBILE AIR CONDITIONING**

Session Chairman: (FMM)

1.	Current Status-Overview and Industry View Point on Available Alternatives and Technologies	En. H.E. Kwi	45
2.	Panel Discussion: ICI, WESTECH, DANCOM, SITT TATT, NAGASE, HOECHST		45

DAY II: 21 July 1993

Session IV : **COMMERCIAL, INDUSTRIAL AND HOUSEHOLD REFRIGERATION**

Session Chairman: (MITI)

1.	Current Status-Overview and Industry View Point on Available Alternatives and Technologies	En. K.S. Leong	45
	Panel Discussion: ICI, WESTECH, HOECHST, DANCOM, SITT TATT, NAGASE		45

Session V : **AEROSOL AND FOAM**

Session Chairman: (ASRHAE)

1.	Current Status-Overview and Industry View Point on Available Alternatives and Technologies: AEROSOL	En. P. Kumar	45
2.	Current Status-Overview and Industry View Point on Available Alternatives and Technologies: FOAM	-	45
3.	Panel Discussion: WESTECH, ICI, SITT TATT, MFPA, 3M		45

Session VI : **METHYL BROMIDE (MB)**

Session Chairman: (MIDA)

1.	Current Status-Overview and Industry View Point on Available Alternatives and Technologies	En. Azmi Mohd (ASEAN PLANTI)	45
2.	Panel Discussion: BAYER, WESCO, FRC, MACA, FLICK PEST., BEHN MEYER		45

Session VII : **HALON**

Session Chariman: (ASRHAE)

1.	Current Status-Overview and Industry View on Available Alternatives and Technology	En. M. Chelliah	45
2.	Panel Discussion: STEELCON, EVERSAFE, MFPA, FEDERAL IRON, WILLIAM JACK CO.		45

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NATIONAL ODS CONFERENCE
20-21 JULY 1993

ORGANISING AND ADVISORY COMMITTEE

Chairman	:	Ir. Tan Meng Leng Department of Environment
Co-Chairman	:	Puan Hajjah Rosnani Ibarahim Department of Environment
Secretary	:	Mr. Ismail Ithnin Department of Environment
Members	:	Mr. Joseph Doraisamy Ministry of International Trade and Industry
		Mr. K.S. Leong ASHRAE (Malaysia) Chapter
		Mr. Ong Ewe Hock Dupont/Westech Sdn. Bhd.
		Mr. Steven Liew ICI (M) Sdn. Bhd.
		Cik Ummi Kalthum Arshad FMM

Coordinator/Secretariat: FMM

SESSION CHAIRMAN (PROPOSED)

Session I	:	**GENERAL AND POLICY** Dr. Hadenan Jalil Ministry of Finance
Session II	:	**SOLVENT CLEANING** Mr. Tan Meng Leng Department of Environment
Session III	:	**MOBILE AIR CONDITIONING** FMM
Session IV	:	**COMMERCIAL, BUILDING AND HOUSEHOLD REFRIGERATION** Mr. Joseph Doraisamy Ministry of International Trade and Industry

<u>Session V</u> : **AEROSOL AND FOAM**
ASHRAE (M) Chapter

<u>Session VI</u> : **METHYL BROMIDE**
MIDA

<u>Session VII</u> : **HALON**
ASHRAE (M) Chapter

SPEAKERS

<u>Session I</u> : **GENERAL AND POLICY**

1. Latest Development of the Montreal Protocol
DOE/MITI

2. Government Role and Control Measures
DOE/MITI

<u>Session II</u> : **SOLVENT-CLEANING**

1. Current Status-Overview and Industry View Point on Available Alternatives and Technologies

EN. XAVIER YOONG
Chairman WG 1-Solven
NS Electronic, Penang

<u>Session III</u> : **MOBILE AIR CONDITIONING (MAC)**

1. Current Status-Overview and Industry View Point on Available Alternatives and Technologies

EN. HAW EN. KWI
Chairman WG 2A-MAC
Nippondenso Sdn. Bhd. Petaling Jaya

<u>Session IV</u> : **COMMERCIAL BUILDING AND HOUSEHOLD REFRIGERATION**

1. Current Status-Overview and Industry View Point on Available Alternatives and Technologies

MR. KAM S. LEONG
Chairman WG 2B-Refrigeration
York Sales & Services
Damansara Utama

11/12

Session V : **AEROSOL AND FOAM**

1. Current Status-Overview and Industry View Point on Available Alternatives and Technologies: AEROSOL

   MR. P. KUMARASAMY
   Chairman WG3 - Aerosol
   Kontrak Manufacturing Service, Shah Alam

2. Current Status-Overview and Industry View Point on Available Alternatives and Technologies: FOAM

Session VI : **METHYL BROMIDE**

1. Current Status-Overview and Industry View Point on Available Alternatives and Technologies

   MR. MOHD AZMI RAMLI
   ASEAN-Planti, UPM

Session VII : **HALON**

1. Current Status-Overview and Industry View Point on Available Alternatives and Technologies

   MR. M. CHELLIAH
   Former Fire Service Officer

12/12

PANEL DISCUSSION

Session	Penal Discussion	Session Chairman
Session I General - Policy	Question and Answers	Ministry of Finance
Session II Solvent - Cleaning	EXXON Chemical (M) Sdn. Bhd, 3M (M) Sdn. Bhd., DOW Chemical Pacific Ltd., Westech Sdn. Bhd./Dupont ST Chemicals Sdn. Bhd.	Department of Environ-ment
Session III Mobile Air Conditioning (MAC)	ICI Chemical (M) Sdn. Bhd., Westech Sdn. Bhd./Dupont, Hoechst (M) Sdn. Bhd., Life Science Technologies, Powermatic Dancom Sdn. Bhd. SITT TATT	FMM
Session IV Household, Commercial and Building Refregeration	Hoechst (M) Sdn. Bhd. ICI Chemical (M) Sdn. Bhd. Westech Sdn. Bhd./Dupont Perusahaan Kimia Gemilang Sdn. Bhd. Dancom Sdn. Bhd. SITT TATT	MITI
Session V Aerosol and Foam	SITT TATT Westech Sdn. Bhd./Dupont ICI Chemical (M) Sdn. Bhd. 3M Malaysia Sdn. Bhd.	ASHRAE
Session VI Methyl Bromide	Benn Meyer (M) Sdn. Bhd. Wesco, FRC, MACA, Flick Pest MFPA	MIDA
Session VII Halon	Westech Sdn. Bhd./Dupont Steelcon Fluid Sdn. Bhd., Eversafe Extingulsher Sdn. Bhd., Malaysia Fire Protection Association (MFPA) Eversafe Federal Iron William Jack Co. 3M Malaysia Sdn. Bhd.	ASHRAE