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EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
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PROJECT PROPOSALS: MALAYSIA

This document consist of the comments and recommendations of the Fund Secretariat on the following project proposals:

Refrigeration:

- Conversion from CFC-11 to HCFC-141b and from CFC-12 to HFC-134a technology in the manufacture of commercial refrigeration equipment at Three Enterprises UNDP
- Replacement of refrigerant CFC-12 with HFC-134a and foam blowing agent CFC-11 with HCFC-141b in the manufacture of commercial refrigeration equipment at Tung Kiong Factories Sdn. Bhd. UNIDO
- Conversion from CFC-11 to HCFC-141b and from CFC-12 to HFC-134a technology in the manufacture of commercial refrigeration equipment at Eleven Small and Medium-sized Enterprises UNDP

PROJECT EVALUATION SHEET MALAYSIA

SECTOR: Refrigeration ODS use in sector (1999): 1,642 ODP tonnes

Sub-sector cost-effectiveness thresholds: Commercial US \$15.21/kg
Domestic US \$13.76/kg

Project Titles:

- (a) Conversion from CFC-11 to HCFC-141b and from CFC-12 to HFC-134a technology in the manufacture of commercial refrigeration equipment at Three Enterprises
- (b) Replacement of refrigerant CFC-12 with HFC-134a and foam blowing agent CFC-11 with HCFC-141b in the manufacture of commercial refrigeration equipment at Tung Kiong Factories Sdn. Bhd.
- (c) Conversion from CFC-11 to HCFC-141b and from CFC-12 to HFC-134a technology in the manufacture of commercial refrigeration equipment at Eleven Small and Medium-sized Enterprises

Project Data	Commercial		Multiple-subsectors
	Three Enterprises	Tung Kiong	Eleven SMEs
Enterprise consumption (ODP tonnes)	37.00	20.20	68.70
Project impact (ODP tonnes)	34.86	18.85	64.85
Project duration (months)	36	30	36
Initial amount requested (US \$)	513,245	276,963	975,268
Final project cost (US \$):			
Incremental capital cost (a)	278,600	104,100	627,000
Contingency cost (b)	27,860	7,910	62,700
Incremental operating cost (c)	204,885	90,065	417,750
Total project cost (a+b+c)	511,345	202,075	1,107,450
Local ownership (%)	100%	100%	100%
Export component (%)	0%	0%	0%
Amount requested (US \$)	505,184	202,075	960,658
Cost effectiveness (US \$/kg.)	14.49	10.72	15.21
Counterpart funding confirmed?	Yes	Yes	Yes
National coordinating agency	Department of Environment		
Implementing agency	UNDP	UNIDO	UNDP

Secretariat's Recommendations			
Amount recommended (US \$)	505,184	202,075	960,658
Project impact (ODP tonnes)	34.86	18.85	64.85
Cost effectiveness (US \$/kg)	14.49	10.72	15.21
Implementing agency support cost (US \$)	65,570	26,270	115,672
Total cost to Multilateral Fund (US \$)	570,754	228,345	1,076,330

PROJECT DESCRIPTION

Sector Background

- Latest available total ODS consumption (1999)	2,364.30 ODP tonnes
- Baseline consumption of Annex A Group I substances (CFCs)	3,271.10 ODP tonnes
- Consumption of Annex A Group I substances for the year 1999	2,010.10 ODP tonnes
- Baseline consumption of CFCs in refrigeration sector	2,342.00 ODP tonnes
- Consumption of CFCs in refrigeration sector in 1999	1,642.00 ODP tonnes
- Funds approved for investment projects in refrigeration sector as of July 2000 (31st Meeting)	US\$11,422,864.00
- Quantity of CFC to be phased out in investment projects in refrigeration sector as of end of 1999	884.00 ODP tonnes

1. The Executive Committee has approved US \$11,422,864 for 15 projects to phase out 884 ODP tonnes of CFC for enterprises manufacturing refrigeration equipment in the refrigeration sector in Malaysia.

2. Based on data reported by Malaysia to the Ozone Secretariat, the country is in compliance with both the CFC freeze and the 50% reduction by 2005.

3. All three projects are in the commercial refrigeration sub-sector. Two proposals are umbrella projects covering eleven and three enterprises, respectively, and the third project covers the ODS phase out at Tung Kiong Factories.

Eleven enterprises

4. The eleven small and medium-sized enterprises (Asian Refrigeration, Ban Lee, Kim Refrigeration, Mutiara Refrigeration, Perniagaan Setar, Power Cool, PU Manufacturing, Silver Refrigeration, Speed Electrical, Unicorn and Wan Sun Hin) consumed 52.54 ODP tonnes of CFC-11 and 16.16 ODP tonnes of CFC-12 in the manufacture of commercial refrigeration equipment in 1999. All eleven enterprises are involved in the production of commercial bottle coolers, chest freezers and display cabinets. All enterprises employ hand-mixing techniques for foaming operations in the baseline.

5. The current project will phase out 52.54 ODP tonnes of CFC-11 and 16.16 ODP tonnes of CFC-12 in the manufacture of commercial refrigeration equipment at the eleven enterprises. This will be achieved by converting CFC-11 to HCFC-141b as the foam blowing agent, and CFC-12 to HFC-134a as the refrigerant. Under the current project, the hand mixing of foam chemicals will be replaced by operations using high-pressure dispensers (US \$275,000). The funding level of high pressure dispensers has been determined at US \$25,000 per enterprise. The enterprises will provide the necessary counterpart funding due to the hand-mixing baseline. All enterprises will require charging units (US \$66,000) and vacuum pumps (US \$55,000). Other costs include re-design, testing, trials (US \$110,000), technical assistance (US \$165,000) and training (US \$55,000). Incremental operating costs are requested by the enterprises reflecting the

higher cost of chemicals and an increase in foam density. The total incremental operating cost for the eleven enterprises is US \$417,750.

Three enterprises

6. The three enterprises (SKE Fookmei, Master Shanghai Turnparts and Maltar Industries) consumed 29.02 ODP tonnes of CFC-11 and 7.97 ODP tonnes of CFC-12 in the manufacture of commercial refrigeration equipment in 1999. All three enterprises are involved in the production of commercial display cabinets, reach-in freezers and walk-in coolers. SKE Fookmei and Maltar Industries employ hand-mixing techniques for foaming operations in the baseline, while Master Shanghai Turnparts operates a low-pressure dispenser.

7. The current project will phase out 29.02 ODP tonnes of CFC-11 and 7.97 ODP tonnes of CFC-12 in the manufacture of commercial and domestic refrigeration equipment at the three enterprises. This will be achieved by converting CFC-11 to HCFC-141b as the foam blowing agent, and CFC-12 to HFC-134a as the refrigerant. The project includes incremental capital costs covering partial costs of high-pressure foam dispensers (US \$149,000). Fookmei and Malter will provide the necessary counterpart funding in purchasing high pressure dispensers due to the hand-mixing baseline. The three enterprises will be provided with charging units (US \$18,000), vacuum pumps (US \$15,000) and leak detectors (US \$6,000). Other costs include, re-design, testing, trials (US \$30,000), technical assistance (US \$45,000) and training (US \$15,000). Incremental operating costs are requested by the enterprises reflecting the higher cost of chemicals and an increase in foam density. The total incremental operating cost for the three enterprises is US \$206,785.

Tung Kiong Factories

8. The enterprise consumed 13.8 ODP tonnes of CFC-11 and 7.1 ODP tonnes of CFC-12 in the manufacture of commercial refrigeration equipment (freezers, cold room panels and fishing boxes) on average between 1997 and 1999. The enterprise employs hand-mixing techniques for foaming operations in the baseline.

9. The current project will phase-out 13.8 ODP tonnes of CFC-11 and 7.1 ODP tonnes of CFC-12 in the manufacture of domestic refrigeration equipment at Tung Kiong Factories in Malaysia. This will be achieved by converting from CFC-11 to HCFC-141b as the foam blowing agent and from CFC-12 to HFC-134a as the refrigerant. Under the current project, the hand-mixing techniques will be replaced by a low-pressure foam dispenser (US \$75,000). The enterprise will require refrigerant charging units (US \$30,000), vacuum pumps (US \$7,500) and a leak detector (US \$6,000). Other costs include testing, trials, training (US \$5,000) and technical assistance (US \$15,000). Incremental operating costs are requested by the enterprise reflecting the higher cost of chemicals and an increase in foam density.

Justification for the use of HCFC-141b

10. The enterprises in all three projects have selected HCFC-141b technology to replace CFC-11 in their foam blowing operations. It is an interim solution until non-CFC systems (different from hydrocarbons) are commercially available. A letter advising the Government decision to use HCFC technology has been received by the Secretariat in accordance with the Executive Committee Decision 27/13 and is attached to this evaluation together with a justification from the implementing agency.

SECRETARIAT'S COMMENTS AND RECOMMENDATIONS

COMMENTS

1. The Secretariat has discussed with UNDP and UNIDO the incremental capital and operating costs and the requirements of Decision 31/45 on the new sub-sector for assembly, installation and servicing. Part of the production of the three enterprises (SKE Fookmei, Master Shanghai Turnparts and Malter Industries) (UNDP) and Tung Kiong Factories (UNIDO) have been identified to be under the new sub-sector. Subsequently, part of the incremental operating costs have been recognized as ineligible.
2. The level of funding of the high pressure dispenser in the Tung Kiong Factories project has been reduced to reflect the hand-mixing baseline at the enterprise.
3. The Secretariat and UNDP agreed that the cost of training and technical assistance will be reduced in two umbrella projects through providing training and technical assistance to groups of enterprises at a time.

RECOMMENDATIONS

1. The Fund Secretariat recommends blanket approval of the three refrigeration projects, two for UNDP and one for UNIDO, with the level of funding and associated support cost as indicated below.

	Project Title	Project Funding (US\$)	Support Cost (US\$)	Implementing Agency
(a)	Conversion from CFC-11 to HCFC-141b and from CFC-12 to HFC-134a technology in the manufacture of commercial refrigeration equipment at Three Enterprises	505,184	65,570	UNDP
(b)	Replacement of refrigerant CFC-12 with HFC-134a and foam blowing agent CFC-11 with HCFC-141b in the manufacture of commercial refrigeration equipment at Tung Kiong Factories Sdn. Bhd.	202,075	26,270	UNIDO
(c)	Conversion from CFC-11 to HCFC-141b and from CFC-12 to HFC-134a technology in the manufacture of commercial refrigeration equipment at Eleven Small and Medium-sized Enterprises	960,658	115,672	UNDP

Annex

Additional Justification for use of HCFC technology (UNDP)

The implementing agency expert appraised the prospective eleven recipient enterprises prior to the preparation of this project document (August 2000) and had detailed discussions with the technical and managerial personnel of the enterprises, regarding the choice of technology for replacing the existing CFC-based technology, under the project. The enterprises were briefed in detail about the following:

1. An overview of the available interim (low ODP) and permanent (zero ODP) replacement technologies.
2. The techno-economic impact of each technology on the products manufactured, and the processes and practices employed by the eleven enterprises.
3. The possible implication of each technology, in terms of its known impact on environment, health and safety, such as ozone depleting potential, global warming potential, occupational health, fire and explosion hazards.
4. It was emphasized to the eleven enterprises, that HCFC technologies are interim in nature due to their residual ODP and therefore may continue to adversely affect the environment, though at a lower scale than CFCs.
5. It was further explained that HCFCs may become controlled substances under present or future international conventions and will therefore also need to be phased out at a future date, and any investments required for their phase-out and for conversion to safer technologies, may have to be borne by the enterprises.

The eleven enterprises preferred selection of HCFC-141b based technology, in their manufacture of commercial refrigeration equipment for the following reasons:

- a) The only zero-ODP technology alternative available for this application is hydrocarbon-based systems (for the foam operation).
- b) The eleven enterprises are small/medium-sized with their factory premises located in congested industrial or commercial areas. The implementation of elaborate safety, monitoring and fire mitigation systems, to counter the fire and explosion hazards involved with using hydrocarbons, cannot be effected in their current premises. Furthermore, it is extremely expensive to install such systems and will not be a long-term economic option for them, given their production levels. The adaptation of the product design and processes for using hydrocarbons is complex and expensive.

The eleven enterprises have therefore selected HCFC-141b based systems as the interim conversion technology, as this technology would ensure early and cost-effective phase-out of their CFC-11 based foaming technology, with no safety hazard, while maintaining the product and processing characteristics at acceptable levels.

Additional Justification for use of HCFC technology (UNIDO)

During the formulation mission in December 1999, the expert discussed in detail with the enterprise the different technology options described above. In its evaluation of the technology options to replace CFC 11, Tung Kiong Factories considered the following criteria:

- Environmental acceptability
- Physical properties
- Maturity of the technology
- Safety and applicability in the enterprise factory environment
- Price, product availability, and cost-effectiveness
- Energy efficiency impact
- CFC-11 replacement technology selected by competitors
- Multilateral Fund Executive Committee decisions relating to HCFC and hydrocarbon technologies.

To assist the enterprise in the selection of a CFC-11 replacement technology, separate project budgets were prepared for the HCFC-141b, and cyclo-pentane, technology options.

Whilst recognising the environmental benefits of cyclo-pentane versus HCFC-141b, Tung Kiong Factories selected HCFC-141b as a first stage, interim, replacement for CFC-11. The decision in favour of HCFC-141b were based on the better insulation value, lower investment and operational costs, and the fact that it is more appropriate to the existing skill levels of the work forces at the company.

Tung Kiong Factories understands the implications of the selection of HCFC-141b technology, and the potential cost of subsequent replacement of HCFC-141b at an undetermined future date. They accept and commit to a future change from HCFC-141b to a zero-ODP technology, and that they will have to bear all of the associated costs.

Other factors also influenced the enterprise decisions in favour of HCFC-141b technology:

- HCFC-141b is the technology adopted by most of their existing, or potential, competitors in Malaysia and South East Asia. With no local supplies, no other local demand, and their own very small requirements, the enterprises were concerned about both product availability, and the price of pentanes in Malaysia.
- Whilst Multilateral Fund Executive Committee decisions relating to CFC-11 replacement technology selection may "presume" against the use of HCFCs, such HCFC based technologies are not prohibited and may still be considered eligible for Multilateral Fund assistance. Department of Environment (DOE), the responsible Malaysian Government counterpart, supports the selection of HCFC-141b as an "interim" CFC replacement technology at Tung Kiong Co.
- Tung Kiong Factories expressed concerns regarding the longer-term safety issues related to the introduction of a flammable blowing agent technology into their factory environment and their choice at the present time is a non-flammable CFC replacement.

Water blown foam formulations do not yet represent a commercially available option and technically this technology does not meet the Tung Kiong Factories' requirement on insulation value/energy efficiency for Cold Room insulation applications. At the present time, liquid HFC technology does not meet the criteria on maturity and commercial availability of the technology. However, liquid HFC technology is considered a likely zero-ODP candidate to replace HCFC-141b in the time frame of 2003 – 2005 subject to successful results from ongoing toxicological and environmental impact studies.

The selection of HCFC-141b technology by the enterprises in this project as the immediate replacement for CFC-11 is a realistic and sensible choice under the prevailing circumstances. The enterprises understand that HCFC-141b is an interim solution that will require a change to an appropriate zero-ODP technology at some future date. Based on the present status of non-flammable zero-ODP technologies, they expect to utilise HCFC-141b technology until approximately 2005.

Tung Kiong Factories will phase-out the use of CFC-11 in all its PU foaming operations by replacement with HCFC-141b. This is recognised as an interim step to an ODS-free system. The enterprise justification for the technology selection is provided.

The present production of the rigid PU foam for insulation purposes is based on manual mixing system, which is not sufficient for HCFC-141b technology and not acceptable due hygienic point of view.

The project includes the purchase of one low-pressure foaming machine with chiller of 100 kg/min for the HCFC-141b duty at a cost of approx. US\$ 75,000, two charging boards suitable for 134a with a cost of US \$30,000, a production leak detector at a cost of US \$6,000 and three vacuum pumps at a cost of US \$7,500. Funds are also requested for "General Consultancy Services/Technology Transfer" (US \$15,000), "Model redesign and testing" (US \$10,000) and "Contingencies" (US \$11,850).

The purchase of Foaming Machine is necessary for the required foam quality, in terms of uniform cell structure, homogeneity and long term dimension stability especially for insulation purposes.

Incremental Operating Costs of US \$121,104 associated with the technology change from CFC-11 to HCFC-141b and CFC-12 to HFC-134a are requested for a period of TWO YEARS. These Incremental Operating Costs are calculated for the discontinuous rigid PU panels and for the redesign of the cooling circuit components and the compressors.

HCFC-141b is a non-flammable liquid (no flash point), but it is moderately flammable in the gaseous state. The flammability limits are 7.6 - 17.1% by volume in air. The usually recommended PEL (Permissible Exposure Limit) is 500 ppm based on an eight-hour time-weighted average. In the intended application, the use of HCFC-141b should not pose a significant risk. Should additional extract ventilation be judged necessary to ensure the adherence to safe worker exposure levels following commissioning of the new HCFC-141b equipment then Tung Kiong Factories undertakes to install such additional extract ventilation at its own cost.

Formulation changes will be needed to optimise the insulation value, structural stability, and density of the PU foam produced with HCFC-141b.

Based on the present status of the development of non-flammable zero-ODP replacement technologies for CFC-11 for PU insulation foam blowing operations, Tung Kiong Factories expects to utilise the interim HCFC-141b technology only until 2005.



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Jld. 8 (2)

Date: 4 October 2000

Dr. Omar El-Arini
Chief Officer
Multilateral Fund Secretariat
1800 Mc Gill College Ave, 27th Floor
Montreal
CANADA

Dear Dr. Omar,

HCFC 141b JUSTIFICATION FOR PROJECT PROPOSALS ON COMMERCIAL REFRIGERATION/FOAM

Reference is made to the commercial refrigeration/foam sector projects prepared for the submission to the 32nd ExCom as follows:

Group 1:

1. Asian Refrigeration Engineering Sdn. Bhd.
2. Ban Lee Refrigeration Works
3. Kim Refrigeration Industries
4. Mutiara Refrigeration
5. Perniagaan Setar
6. Power Cool Equipment (M) Sdn. Bhd.
7. PU Manufacturing
8. Silver Refrigeration And Air-Cond Trading Sdn. Bhd.
9. Speed Electrical
10. Unicorn
11. Wan Sun Hin

Group 2:

1. SKE Fookmei
2. Master Shanghai Turnparts
3. Malter Industries

Please be advised that we recognize that the technology choice is HCFC-141B even though this alternative is considered to be an interim one. Indeed at the time being we have no other choice due to the many national and global factors prevailing the technology selection, among them are:

- Commercial availability of HCFC-141B
- Low conversion costs of hydrocarbon technology

The counterparts have acknowledged that they would convert to ODS free technology if regulations request them to do so and this is understood and endorsed by us as well.

This justification complies with ExCom's decision 27/12. Thank you and best regards,

Yours sincerely,



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for Director General of Environment, Malaysia

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