



**United Nations
Environment
Programme**



Distr.
Limited

UNEP/OzL.Pro/ExCom/28/26/Add.1
28 June 1999

ORIGINAL: ENGLISH

EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Twenty-eighth Meeting
Montreal, 14-16 July 1999

Addendum

PROJECT PROPOSALS: CHINA

Please insert the attached annexes to document UNEP/OzL.Pro/ExCom/28/26 as follows:

Sector: Foam

Annex I: Please insert after page 15.

Sector: Refrigeration

Annex I: Please insert after page 19.

Sector: Foam

Annex I**JUSTIFICATION FOR SELECTION OF ALTERNATIVE TECHNOLOGY
(HCFC-141B)**

(Extract from the Project Document)

NOTE FROM THE SECRETARIAT:

Seven rigid foam projects to be converted to HCFC-141b were submitted by UNDP and the World Bank. Three of the projects (Hengfeng, Jiaying and Penglai) were submitted by UNDP, while four (Heilongjiang, Jiangsu Taizhou, Guandong Zhujiang and Wuhan) were submitted by the World Bank. Although the analyses and justification for use of HCFC-141b were similar in all the six project documents, there were some differences in presentation between the UNDP and World Bank projects. Consequently, the texts from two projects (one from the UNDP group of projects (Penglai) and the other from the World Bank group (Heilongjiang)) are provided below as samples.

Phase out of CFC-11 by conversion to HCFC-141b technology in the manufacture of rigid polyurethane insulation foam at Heilongjiang Commercial Installation Corporation

The ODS phase-out technologies for *rigid PU foams for thermal insulation applications* are:

CLASSIFICATION	LIQUID TECHNOLOGY	GAS TECHNOLOGY
LOW ODP TECHNOLOGIES ("INTERIM")	HCFC-141b HCFC-141b/HCFC-22	HCFC-22
NON-ODS TECHNOLOGIES ("PERMANENT")	(CYCLO)PENTANE, WATER, LIQUID HFCs (-365,-245fa)	HFC-134a

The selection of the alternative technology is governed by the following considerations:

- a) Proven application and reasonable maturity of the technology
- b) Cost effective conversion, in view of one-time as well as recurrent costs
- c) Local availability of substitute, at acceptable pricing
- d) Support from the local systems suppliers
- e) Critical properties to be maintained in the end product
- f) Meeting established standards on environment and safety

Following is an overview of the technologies in view of these criteria specifically applied for the operations of Heilongjiang:

HCFC-141b has an ODP of 0.11. Its application is proven, mature, relatively cost-effective, and systems that fit Heilongjiang's applications are locally available. HCFC-141b can, however, be destabilizing in higher concentrations, being a strong solvent, which would lead to the need to increase the foam density. As an interim option, its application would only be recommended if permanent options do not provide acceptable solutions.

HCFC-22 has an ODP of 0.05 and is under ambient conditions a gas. It is not offered in the applicable regional area as a premixed system and would require an on-site premixer.

HCFC-141b/HCFC-22 blends can reduce the solvent effect of HCFC-141b alone and therefore allow lower densities while maintaining acceptable insulation values. The blends are, however, not available in China or neighboring countries. On-site multi-component blending would significantly increase the one-time project costs. Being an interim option, the same restrictions as for HCFC-141b would apply.

The use of hydrocarbons is a preferred solution only when feasible from a safety and cost effectiveness standpoint. The relatively high investments for safety costs tend to limit pentane use to relatively large CFC users. In addition, the use of pentane is limited to those enterprises whose facilities can be adapted to meet safety requirements, and can be relied on to maintain safe operations.

WATER-BASED systems are an alternative in cases where pentane is not feasible due to safety concerns, cost efficiency or availability. Water-based systems are, however, more expensive (up to 50%) than other CFC-free technologies due to reductions in insulation value (requiring larger thickness) and lower cell stability (requiring higher densities). Water-based formulations tend to be most applicable in relatively less critical applications, such as in situ foams and thermoware. Water based systems are not currently commercialized in China.

LIQUID HFCs do not currently meet requirements on maturity and availability.

HFC-134a is under ambient conditions a gas. It is not offered in the applicable regional area as a premixed system and would require an on-site premixer. It is also less energy efficient, and expensive compared to most other technologies.

The enterprise has been fully informed of the available technical options, and that HCFCs are transitional substances. They have also been informed that under the present rules of the Multilateral Fund, they will not be able to seek additional funding from MPMF at a later date to convert to a zero-ODP technology.

Heilongjiang has done its own research on selection of phase out technologies between HCFC-141b and water blown technology. Heilongjiang has compared the information available on the performance of foam using different substitutes. It has also compared the financial impact (capital investment and operational costs) of the different solutions available. The selection of hydrocarbon was not considered feasible for the type of operation. Financially, the incremental costs of using water blown technology is calculated as US\$683,683 compared to US\$461,724 using HCFC-141b. Thus Heilongjiang has selected HCFC-141b as a transitional substances.

With its location in northern China, another important factor in selecting the substitute was high insulation performance requirements by its customers.

Phase out of CFC-11 by conversion to HCFC-141b technology in the manufacture of rigid polyurethane insulation foam at Penglai Polyurethane Industry Co.

The presently preferred ODS phase-out technologies for rigid insulating foams are as follows:

Low ODS Technologies (Interim) > HCFCs (22, 141b, 22+142b)

ODS free Technologies (Long term) > All Water blown

> HFCs (HFC-134a, HFC-245fa and HFC-365mfc)

> Hydrocarbons (n-, cyclopentane)

The selection of the alternative technology would be governed by the following considerations:

- Proven and reasonably mature technology;
- Cost effective conversion;
- Easy availability of substitute blowing agent;
- Support from local system suppliers;
- Critical properties that have to be obtained in the end product; and
- Operational safety.

Among these technologies, HCFC-22, HCFC-142b, and HFC-134a have never been selected by Chinese enterprises because they are either not available in China or have very low cost effectiveness. Liquid HFCs are still in development and may be available in 2003 or 2004. So most Chinese companies select phase out options among HCFC-141b, hydrocarbon and water blown technologies. For spray foam plants, the selection is between HCFC-141b and water blown.

The potential incremental costs of adopting water blown technology in Penglai calculated based on MLF principles could be around US\$798,742, including US\$617,242 incremental operating cost for two years. The incremental cost for HCFC-141b amounts to US \$612,690, including US \$430,890 incremental operating cost for two years.

Penglai has done its own research of selecting phase out technology. The plant is also fully informed by UNDP mission of the available technical options, and that HCFCs are transitional substances. They have also been informed that under the present rules of the Multilateral Fund, they will not be able to seek additional funding from MPMF at a later date to convert to a zero-ODP technologies. Based on the above, the enterprise has decided to convert to HCFC-141b because of its maturity and high cost effectiveness. Government's review and endorsement of using HCFC-141b is also attached.

Sector: Refrigeration:

Annex I

JUSTIFICATION FOR THE USE OF HCFC-141B

(Extracts from the Project Documents)

- (a) **Replacement of CFC-12 refrigerant with HCFC-22 in the manufacture of small open type compressors at Wuhan Commercial Machinery Factory.**
- (b) **Replacement of CFC-12 refrigerant with HCFC-22 in the manufacture of semi-hermetic compressors at Yueyang Hengli Air-Cool Equipment Co. Ltd.**
- (c) **Replacement of CFC-12 refrigerant with HCFC-22 in the manufacture of small and medium sized open type compressors at Zhejiang Commercial Machinery Factory.**

The following justifications were provided for the three above projects.

There are four possibilities for CFC substitute technology:

- HCFC-22
- HFC-134a
- Non ODS blends
- Ammonia, R-717

Following careful evaluation, HCFC-22 has been selected as the substitute refrigerant for this category of system. The reasons are as follows:

- i) HCFC-22 substitution technology is well developed. Foreign companies are willing to transfer this technology to China at a reasonable price. HCFC-22 is available from Chinese sources at a reasonable price.
- ii) HFC-134a is the latest CFC-12 replacement technology. Though widely used in Western countries, HCFC-22 still remains an option for both medium and low temperature applications in commercial and industrial refrigeration and air conditioning sector.
- iii) HFC-134a has zero ODP compared to the ODP of HCFC-22 of 0.05. However both HFC-134a and the ester-based lubricants required are not yet produced in China. Even when in full production, the price of HFC-134a is likely to be higher than HCFC-22. Refrigerant charges are larger in commercial and industrial refrigeration and air conditioning equipment than in household appliances. Relatively insignificant in the case of household appliances, this price difference would lead to a considerable incremental cost that has to be borne by the end user. Also, the high levels of moisture and contaminant control would not be generally achievable considering the low standards of service and maintenance.

- iv) China does not produce non-ODS azeotropic blends. It would have to be imported. Their current price of around 30 USD/kg makes their use impossible in China at present.
- v) Ammonia, R-717, is widely used in large industrial refrigerating systems - also in China. Though it is a trend in Western countries to apply ammonia in also smaller systems, it is rejected for China, because: a) designs for compressor and refrigerating appliances need extensive modifications; b) usage of ammonia requires special skills both during installation and servicing; and c) ammonia is not generally applicable due to its especially high toxicity.
- vi) HCFC-22 is a transitional substance with an ODP of only 0.05. Its use is allowed in China under the terms of the Montreal Protocol for a long period (until 2040). It can be assumed that by then a more environmentally friendly alternative may have been developed and might provide a more suitable substitute technology. Although possessing an ODP of zero, HFC-134a has nevertheless a considerable global warming potential.
- vii) The substitution technologies introduced by this project are suitable for HCFC-22, HFC-134a and other zero-ODP refrigerants with operating pressures comparable to those of HCFC-22, except ammonia. Once the problems of supply and service are solved, minimal investments will be required to convert production to zero-ODP refrigerants.

The conversion of these enterprises is consistent with the strategy adopted for the commercial refrigeration sector in China. The use of HCFC as a refrigerant was carefully evaluated when the sector plan was developed. The sector strategy also foresees conversion to a non-ODS substitute in the future. This is reflected in the choice of equipment and machinery requested for the conversion of the enterprise and has been accounted for as a technical upgrade in the funding request.

The enterprises have been fully informed of the available technical options. They have also been informed that HCFC-22 is a transitional substance and that under the present rules of the MLF, they will not be able to seek additional funding from MLF at a later date to convert to a zero-ODP technology. Based on the above, the enterprises have decided to convert to HCFC-22.

This project will utilize the existing production facilities at WCMF, YYHL and ZCMF to the extent as possible. This technology is well suited to the production facilities at WCMF, YYHL and ZCMF, and meets the requirements for replacing existing product range. Except for the replacement of refrigerant used, there is no production capacity increase foreseen.

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