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Addendum

PROJECT PROPOSALS: IRAN

Please insert the attached Annex I at the end of document UNEP/OzL.Pro/ExCom/28/32.

Annex I

JUSTIFICATION FOR THE USE OF HCFC-141B
(Extracts from the Project Documents)

(a) Conversion from CFC-11 to HCFC-141b and from CFC-12 to HCFC-134a technology in the manufacture of commercial refrigeration equipment at Behsarma Co.

The implementing agency expert appraised the prospective recipient enterprise, Behsarma Co. prior to the preparation of this project document during February 1999, and had detailed discussions with the technical and managerial personnel of the enterprise, regarding the choice of technology for replacing the existing CFC-based technology, under the project. The enterprise was briefed in detail about the following:

An overview of the available interim (low ODP) and permanent (zero ODP) replacement technologies.

The techno-economic impact of each technology on the products manufactured, and the processes and practices employed by Behsarma Co.

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.

It was emphasized to Behsarma Co. 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.

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 Behsarma Co.

Behsarma Co. preferred selection of HCFC-141b based technology, in their manufacture of commercial refrigeration equipment offering the following reasons:

a) Hydrocarbon technology (pentanes) requires extensive and stringent safety precautions & investments and compliance with local safety regulations, in view of fire and explosion hazard due to their flammability. They will require a complete re-design and re-layout of the factory, which was not designed for using flammable substances. This would mean very high investments and recurring expenses for maintaining a safe operation. It is not economically feasible for them to undertake such expenses.

b) The operators and other personnel would need constant training for safe use of hydrocarbons. The present level of awareness and training for using hazard substances among their operators is negligible and would therefore mean commitment of additional resources.

c) The products and process would need to extensively redesigned and adapted for using hydrocarbons. This would mean further investments and recurrent costs.

d) The dependable availability and technical support for hydrocarbons and their use, is still not developed.

As compared to Hydrocarbons, Behsarma Co. feels that HCFC-141b technology is well proven, efficient and easy to implement, without additional recurring investments or costs and without a major redesign of their products and processes. Therefore they prefer HCFC-141b technology.

(b) Conversion from CFC-11 to HCFC-141b technology and from CFC-12 to HFC-134a technology in the manufacture of commercial refrigeration equipment at Foroughmanesh Co.

Foam Operation

The presently available/emerging CFC-phase-out technologies, for rigid polyurethane insulating foams are:

CLASSIFICATION	LIQUID TECHNOLOGY	GASEOUS TECHNOLOGY
Low ODP technologies (Interim)	HCFC-141b, HCFC-141b + water	HCFCs (22, 22 + 142b, 22+141b)
Zero ODP technologies (Permanent)	Water, Pentanes (n,iso,cyclo), HFC-245fa	HFCs (134a, 152a)

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

a) Proven and reasonably mature technology.
b) Cost effective conversion.
c) Availability of the systems at favorable pricing.
d) Critical properties that have to obtained in the end product (in this project - thermal conductivity, dimensional stability, closed cell content, surface properties and strength)
e) Compliance with established (local and international) standards on safety and environment.

Interim Technologies

HCFC-22 (independently or in combination with HCFC-142b and more recently with HCFC-141b) based systems, due to the low boiling point of HCFC-22, cannot be supplied preblended and will require investments in full-fledged in-house blending facilities. HCFC-22 also has residual ODP.

HCFC-141b has a boiling point near ambient temperatures. HCFC-141b based systems are technically mature and commercially available. They also provide relatively the most acceptable

insulation value and energy efficiency, and the lowest investment and operating costs vis-a-vis other options. No major changes in the auxiliary equipment/tooling in the production program are needed. However, HCFC-141b has residual ODP and is also an aggressive solvent.

The implementing agency expert appraised the prospective recipient enterprise, Foroughmanesh Co. prior to the preparation of this project document during February 1999, and had detailed discussions with the technical and managerial personnel of the enterprise, regarding the choice of technology for replacing the existing CFC-based technology, under the project. The enterprise was 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 Foroughmanesh Co.
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 Foroughmanesh Co. 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 Foroughmanesh Co.

Foroughmanesh Co. preferred selection of HCFC-141b based technology, in their manufacture of commercial refrigeration equipment offering the following reasons:

e) Hydrocarbons are flammable and constitute a fire, explosion, safety and security risk. The factory premises of Foroughmanesh Co are not equipped or designed for handling such hazardous chemicals, as it is located in a densely populated industrial area. To implement this technology they may even have to move the factory. This is not commercially viable to them as it would be very expensive and time-consuming.

f) Their factory workers are not familiar with use of flammable chemicals and it would be extremely expensive to re-train them and change their mindset.

g) The product specifications would change and lot of investments would be needed for this changeover.

Foroughmanesh Co. thus prefer HCFC-141b technology, which would be relatively much cheaper, easier and quicker to implement without making major changes in their manufacturing activities.

(c) Conversion from CFC-11 to HCFC-141b and from CFC-12 to HFC-134a technology in the manufacture of commercial refrigeration equipment at Movaledsarma Co. (Zagross 1)

Foam Operation

The presently available/emerging CFC-phase-out technologies, for rigid polyurethane insulating foams are:

CLASSIFICATION	LIQUID TECHNOLOGY	GASEOUS TECHNOLOGY
Low ODP technologies (Interim)	HCFC-141b, HCFC-141b + water	HCFCs (22, 22 + 142b, 22+141b)
Zero ODP technologies (Permanent)	Water, Pentanes (n,iso,cyclo), HFC-245fa	HFCs (134a, 152a)

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

a) Proven and reasonably mature technology.
b) Cost effective conversion.
c) Availability of the systems at favorable pricing.
d) Critical properties that have to obtained in the end product (in this project - thermal conductivity, dimensional stability, closed cell content, surface properties and strength)
e) Compliance with established (local and international) standards on safety and environment.

Interim Technologies

HCFC-22 (independently or in combination with HCFC-142b and more recently with HCFC-141b) based systems, due to the low boiling point of HCFC-22, cannot be supplied preblended and will require investments in full-fledged in-house blending facilities. HCFC-22 also has residual ODP.

HCFC-141b has a boiling point near ambient temperatures. HCFC-141b based systems are technically mature and commercially available. They also provide relatively the most acceptable insulation value and energy efficiency, and the lowest investment and operating costs vis-a-vis other options. No major changes in the auxiliary equipment/tooling in the production program are needed. However, HCFC-141b has residual ODP and is also an aggressive solvent.

The implementing agency expert appraised the prospective recipient enterprise, Movaledsarma Co (Zagross 1) prior to the preparation of this project document during February 1999, and had detailed discussions with the technical and managerial personnel of the enterprise, regarding the choice of technology for replacing the existing CFC-based technology, under the project. The enterprise was 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 Movaledsarma Co.

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 Movaledsarma Co. 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 Movaledsarma Co.

Movaledsarma Co. preferred selection of HCFC-141b based technology, in their manufacture of commercial refrigeration equipment offering the following reasons:

a) The fire, explosion and security hazard involved in the implementation of hydrocarbon technology (pentanes) requires extensive and stringent safety precautions & investments and compliance with local safety regulations, in view of fire and explosion hazard due to their flammability. The present factory premises and the layout of the plant and equipment were not designed for handling hazardous substances. To adapt the layout for handling hydrocarbons would involve enormous expenses and time. The operators and other personnel would need intensive and continuous training for safe use of hydrocarbons. Thus hydrocarbon technology would not be cost-effective in the medium or long term.

b) Movaledsarma Co. has reservations regarding the availability and convenience of procurement of the required grades of pentanes at acceptable prices.

c) Movaledsarma Co. has selected HCFC-141b based systems as the conversion technology, as this is technically quite similar to the current technology. Moreover, it is quite cost-effective and will ensure elimination of substantial ODP in a short time.

(d) Conversion from CFC-11 to HCFC-141b technology and from CFC-12 to HFC-134a technology in the manufacture of commercial refrigeration equipment at Tahvieh Garm va Sard Co.

The enterprise will convert to CFC-free systems for their rigid polyurethane foam operations. Until the commercial introduction of mature CFC-free systems (up to 3-4 years at the earliest) HCFC-141b based systems will be selected as an interim technology, to maintain product standards and acceptability.

The implementing agency expert appraised the prospective recipient enterprise, Tahvieh Garm va Sard Co. prior to the preparation of this project document during February 1999, and had detailed discussions with the technical and managerial personnel of the enterprise, regarding the choice of technology for replacing the existing CFC-based technology, under the project. The enterprise was 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 Tahvieh Garm va Sard Co.
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 Tahvieh Garm va Sard Co. 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 Tahvieh Garm va Sard Co.

Tahvieh Garm va Sard Co. preferred selection of HCFC-141b based technology, in their manufacture of commercial refrigeration equipment offering the following reasons:

a) Because of the safety hazards involving the implementation of hydrocarbon technology due to their flammability, they expect the following:

- The factory would need to be entirely re-laid, perhaps even relocated, to meet the stringent norms for ensuring safety, as the present premises are unsuitable for implementing this technology
- The workers and staff would need to be completely re-oriented for handling hydrocarbons
- The products/processes would need extensive design modifications

The above steps would involve very high costs and a long time, including investments and recurring expenses, which they would not be able to afford and would affect the viability of their business.

b) HCFC-141b technology is relatively much more cost-effective, familiar and easy to phase-in and significantly reduces ODP in a short time.

It is for these reasons that Tahvieh Garm va Sard prefer HCFC-141b technology.

(e) Conversion from CFC-11 to HCFC-141b and CFC-12 to HFC-134a technology in the manufacture of domestic and commercial refrigeration at the Sherkate Sanayee Emerson (Emerson Co).

Note from the Secretariat:

This justification also applies to the project **"Conversion from CFC-11 to HCFC-141b and CFC-12 to HFC-134a technology in the manufacture of domestic and commercial refrigeration at the Sherkate Broudati Ghandil Iran (Ghandil Co.)"**which has an identical text.

FOAM OPERATION

The presently available/emerging CFC-phase-out technologies, for rigid polyurethane insulating foams are:

CLASSIFICATION	LIQUID TECHNOLOGY	GASEOUS TECHNOLOGY
Low ODP technologies (Interim)	HCFC-141b, HCFC-141b + water	HCFCs (22, 22 + 142b, 22+141b)
Zero ODP technologies (Permanent)	Water, Pentanes (n,iso,cyclo), HFC-245fa	HFCs (134a, 152a)

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

a) Proven and reasonably mature technology;
b) Cost effective conversion;
c) Availability of the systems at favorable pricing;
d) Critical properties that have to be obtained in the end product (in this project - thermal conductivity, dimensional stability, closed cell content, surface properties and strength);
e) Compliance with established (local and international) standards on safety and environment;

HCFC-22 (independently or in combination with HCFC-142b and more recently with HCFC-141b) based systems cannot be supplied preblended due to the low boiling point of HCFC-22 and will require investments in full-fledged in-house blending facilities. HCFC-22 also has residual ODP.

HCFC-141b has a boiling point near ambient temperatures. HCFC-141b based systems are technically mature and commercially available. They also provide the most acceptable insulation value and energy efficiency, and the lowest investment and operating costs vis-a-vis other options. No major changes in the auxiliary equipment/tooling in the production program are needed. However, HCFC-141b has residual ODP and is also an aggressive solvent.
Pentane (n-, iso-, cyclo) based systems require extensive safety related provisions/investments due to their flammability. Due to safety considerations, the use of pre-blended systems is not viable and additional investments for in-house pre-mixing are required. Cyclopentane has miscibility limitations with polyols. The molded densities and insulation values are still inferior to those obtained with HCFC-141b. The advantages are their relatively lower unit costs, they are environmentally friendly (no ODP/GWP or health hazards) and constitute a permanent technology. Hydrocarbons are therefore the preferred conversion technology for large and organized users, where the safety requirements can be complied with and investments can be economically justified. In case of this enterprise, implementation of hydrocarbon based technology will require enormous investments for changing the plant layout completely (as the current layout is not suitable for handling hazardous substances consistent with local regulations), which are not justified by the level of their production.

Gaseous HFCs have been used successfully in some cases but have not been applied widely due to cost, technical and/or availability factors.

For water-based systems, the insulation values and density are unsatisfactory at present. However, these systems have acceptable processing characteristics and are expected to be mature and commercially viable in the near future, especially for applications where insulation values are not critical. They are environmentally friendly and safe (zero ODP/GWP, no health or safety hazards) and constitute a permanent technology.

Chemical and systems suppliers and the appliance industry are extensively evaluating liquid HFC-based systems. Preliminary trials with non-optimized formulations indicate lower molded foam densities, insulation values comparable to HCFC-141b and no solvent action. However, issues such as the time frame for commercial availability of liquid HFCs, their costs and their impact on climate change, need to be addressed satisfactorily. On the whole, liquid HFCs are considered to be the only potential zero-ODP alternatives to hydrocarbons.

Based on the above, the enterprise will convert to CFC-free systems for their rigid polyurethane foam operations. Until the commercial introduction of mature CFC-free systems (up to 3-4 years at the earliest) HCFC-141b based systems will be selected as an interim technology, to maintain product standards and acceptability.

(g) Phasing out of CFC-11 by conversion to HCFC-141b and CFC-12 to HFC-134a in manufacture of commercial refrigeration at the second group of Iranian Commercial Refrigerator Manufacturers

Foaming Agent	Ozone Depleting Potential (ODP)
HCFC-141b	0.11
HCFC 142b	0.065
HCFC 142b + HCFC 22	0.06
HFC-134a	0
Cyclopentane	0

Although cyclopentane is widely used for the production of insulating foam in the domestic refrigerator sector, it is much less widespread in the manufacture of commercial equipment. All US and many European manufacturers still use HCFC-141b, though it is a transitional substance under the terms of the Montreal Protocol.

Cyclopentane would be a technically suitable foaming agent to replace CFC-11 at the companies which currently produce polyurethane insulation foam, were it not for the safety and related cost issues brought about by the flammability of cyclopentane. The use of this substance would require considerable investment in new foaming equipment since the companies possess only

low pressure machines; equipment would have to be entirely replaced, making the project not cost effective.

Furthermore rigorous training in handling this flammable substance would be needed to ensure its safe introduction in factories where no flammable substances have been used before. The cultural and operational changes needed are considered to be too great in this situation.

The companies concerned have therefore decided to avoid Cyclopentane technology and will adopt HCFC-141b as a replacement for foam blowing.