

Project Proposal Review

ANNEX 3

Country: **Thailand**
 Exec. Firm: **EGAT (Electricity Generation Authority Thailand), Thailand**
 Type: **Replacement of CFC-11 and CFC-12 Chillers**
 Date: **September 1998**

RTU-UNWB-LK-98424-dl

Scope

The project under review covers the replacement of CFC-11 and CFC-12 chillers in Thailand. First part will be a demonstration project involving 24 chillers; second part will be a conversion project of 420 chillers, being one third of the CFC based inventory of chillers in Thailand.

1. Key issues**1.1 Project Description**

The project proposal appropriately describes the set up of the Thai energy situation and the Thai strategy concerning the installing of new chillers. The main role here is for the Electricity Generation Authority of Thailand, EGAT, which overlooks the project, which sets up an ESCO, and which administers a revolving fund for the replacement of additional chillers.

The presentation of a demonstration project with e.g. 24 chillers is clear; the description how this will be done requires the following comments to be made:

- It is mentioned that the majority of chillers in Thailand is between 5 and 7 years old, which implies that they have been installed between 1991 and 1993. It is questionable whether all these chillers will consume 30% more energy than the most modern ones, vintage year 1997-1998, which ones are still being further optimised and do not offer the full advantages future HCFC-123 and HFC-134a chillers will offer (annex 2 mentions that the 1997-1998 chillers do NOT constitute the international state of the art -*which cannot be understood*-, why are they then considered ?).
- It is questionable whether the Thai EGAT Authority should concentrate first on the youngest CFC chillers (5-7 years old) which should actually not be disposed of (capital destruction). These chillers should be retrofitted if the need for phasing out CFC equipment exists and if the efficiency of the chiller is acceptable for another 10-15 years of operation.
- Actually, it would have been very useful if a graph would be included in the proposal which gives the chiller efficiency in kW/ton capacity for chillers manufactured during the years 1976-1998, either world-wide or for the ones specifically sold in Thailand.
- This project proposes to replace 24 chillers (the number is actually arbitrary and based upon investments required) and proposes to do this in Bangkok. The proposal presents the possibility that EGAT -via contractors- identifies the chillers in Bangkok regarding lifetime and capacity after that the project has been approved. It would have been interesting to annex to the project proposal a distribution of the chillers in Bangkok as a function of their lifetime, but it can be understood that this cannot be done at this stage. Once the project will start, one should identify, in a first instance, 30-35 chillers; it should

Project Proposal Review

subsequently be discussed with the manufacturers of these chillers which 24 chillers are the "best" to be replaced.

- The project proposal presents the possibility that the majority of the 24 chillers that will be replaced is 5-7 years old but that also chillers should be replaced which are older. In fact, this should not be aimed at making a pessimistic estimate for the project proposal, but it should aim at the energy supply situation in the Thai society; it is therefore required to replace older chillers first (in the proposal these chillers could remain in operation until 2009, when efficiency values have improved, and would contribute very negatively to the carbon emissions).
- Building owners that have old chillers should be convinced of the advantages in energy efficiency (and in operating costs) that new chillers offer. Therefore the 24 chillers that are planned to be replaced should for the larger part be the older ones (e.g. 20-22 chillers and only 2 or 3 should be "vintage 1991-1993").
- An extra way to convince building owners that changes should be made all over Thailand would be if the 24 chillers would be distributed over Thailand (and not only in Bangkok). However, it is acceptable to choose Bangkok first since the installing of the chillers has to be carried out in 1999 already and the monitoring would be easier from the point of logistics.
- (many of the data in the project proposal still need to be verified once the project has been approved. It would have been advantageous if more concrete data would have been available at this stage of the process).

1.2 Technical soundness

The proposal mentions the replacement of chillers (CFC-11 and CFC-12 based ones) by HCFC-123 and HFC-134a ones. It is correct to replace the majority by HCFC-123 if the vast majority of the existing chillers is using CFC-11. Another argument is that low pressure chillers on HCFC-123 can be found in the 350 to 5000 kW input range, and that the larger capacities (350 to 25000 kW) are HFC-134a chillers (information UNEP TOC 1998 draft report).

The proposal mentions the average capacity being 400 to 500 tons (which equals 350-450 kW input); this represents the low end (the lowest capacities) of chillers for both the refrigerants HCFC-123 and HFC-134a. It may well be true, but has it been checked whether a certain amount of chillers in Bangkok is operated on HCFC-22 (specifically for these capacities the 22 equipment is manufactured using scroll or screw compressors -non-centrifugals-) ?

In the project proposal the amount of CFCs contained in the average chiller is given as 500 kg. The information available on the average refrigerant charge of CFC-11 and HCFC-123 would be 0.25 and 0.22 kg/kW (UNEP TOC 1998 draft report). This implies that the average CFC-11 chiller contains 100 kg of refrigerant (the average charge for CFC-12 is given as 0.35 kg/kW which would imply that the average CFC-12 chiller contains 140 kg). Older chillers (vintage 1970's and 1980's) have higher charges but it is difficult to give a figure. It seems reasonable to stick to an average of 100 kg per chiller so that the demo

Project: Chiller Replacements **EGAT**, Thailand

Project Proposal Review

project would withdraw 2400 kg from the market. The leakage assumptions would also result in lower emissions than given, at 10% leakage per year the annual CFC consumption would be 240 kg, the majority being CFC-11 (this would also affect Table 2 in annex 2).

The replacements themselves are in principle OK. Where it concerns calculations involving GWP, there is a substantial difference between HCFC-123 and HFC-134a. Calculations give the correct ratio where it concerns the percentage of CFC-12 compared to the percentage of CFC-11.

It is mentioned that EGAT will set up an ESCO. It has not been mentioned in the proposal whether the "older" chillers (older than vintage year 1990) are currently serviced by Thai companies or by international, manufacturer controlled service companies. This would also be determining the way the ESCO has to be set up by EGAT. The project proposal correctly mentions that international ESCO companies will be involved in the second phase of the process.

1.3 Environmental impact / benefit

One of the refrigerants proposed, HFC-134a, has no ODP and a global warming potential of 1300, the GWP of the other refrigerant, HCFC-123, is 93 and the ODP equals 0.02.

From the point of view of global warming the refrigerant HCFC-123 is 15 times better. This has correctly been included in environmental impact calculations, using the percentage of CFC-11 chillers also for the percentage that will be operated on HCFC-123.

Table 2 in annex 2 calculates the climate change benefit. Using the data given, one can calculate a saving of 159.9 tC for 24 chillers during 17 years per kg inventory. This would yield different figures for the inventory assumed in the proposal than the ones mentioned (a 100 kg inventory would also yield different figures).

1.4 Project costs

It is clear that 24 chillers will cost in the order of US\$ 5 million. However, more data on the different capacities of the chillers that will be replaced would have been desirable; so far it will be assumed that there will be enough chillers with the correct lifetime in Bangkok that have a capacity between 400 and 500 tonnes.

It is proposed that both the GEF and the MLF will give an interest free loan of US\$ 2.5 million. This has been suggested by one member of the Executive Committee of the MP Multilateral Fund (has this project proposal been discussed with the MLF Secretariat ? So far the recommendations by the Secretariat on this type of projects have never been positive). If the Multilateral Fund should invest in the demonstration phase of the project, it probably would like to see a sort of cost effectiveness for the amount of CFC emissions which are reduced per year.

For this cost effectiveness in retrofit/replacement projects no calculation method has been developed and it needs to be agreed upon with the Secretariat of the Multilateral Fund (the conservative way of calculations would yield figures in the order of 1000's of dollars per kg phased out; however it cannot be compared since it concerns a loan and no grant)

Project Proposal Review

Once the project has been approved by the GEF part it may certainly have positive consequences for an approval by the Executive Committee of the Multilateral Fund.

If the demonstration phase of the project is financed by loans, one would like to see how the cash flow from the savings to the fund administered by EGAT will be, on an annual basis, this implies for a certain year *(a) investments (b) cash flow back, maybe with a certain interest in order to study whether interest free loans are required.* So far the flow of money is not made very clear. This will be crucial in the decision process, i.e. whether the demonstration phase of the project should be carried out.

The project proposal mentions a next phase of 420 chillers (in principle the two parts of the project could be more separated, however, it is correct to assume that the radiation effect from a positive conclusion of the demonstration phase is of direct importance for the success of the second phase of the project; it is in fact the building owner who will determine whether his "chiller" will be replaced).

A comment should be made regarding the way the financing for the second phase is presented in the project proposal.. "the initial resources plus additional US\$ 25 million which EGAT could borrow from either the IBRD or any other sources..." Since it does not concern interest free loans here and furthermore, since there is a balance of 59 million (from the total of 84 million) that is proposed to be covered by the savings returned to the revolving fund, it would not only be useful but rather required to present a cash flow scheme per chiller installed in the second phase of the project (investments, interest, cash flow back to the fund assuming 30 % energy saving etc.). This scheme may include increasing chiller prices and increasing efficiencies over the period 2001-2009.

The two parts of the project are in so far well separated so that one can resolve possible uncertainties in the second phase of the project at a later stage.

2.1 Degree of involvement of stakeholders

It can be assumed that by presenting the demonstration phase of the project first, there can be a sufficient degree of involvement of stakeholders in the second phase of the project. Should this be different than currently assumed, the second phase can always be adjusted (since it concerns investments in chillers on a case by case basis from the revolving fund).

2.2 Capacity building

The set up of an ESCO in Thailand and the involvement of ESCOs from abroad in the second phase guarantee adequate capacity building.

Recommendations

The replacement project as proposed **is supported**, provided that
(a) a more precise definition of the chillers in the demo-project is given (where installed, capacity etc.);

Project Proposal Review

- (b) chillers that will be replaced in the demo-project are for the larger part older chillers, only
 - a small part should be vintage "1991-1993");
- (c) a picture (flow scheme, table per year) of the cash flow during the demonstration phase is given (and, if possible, also for the second phase);
- (d) adequate figures for the refrigerant contents of CFC-11 and CFC-12 chillers are given (maybe as a function of the lifetime of the chiller), which may influence the calculation of the climate change benefit.

Eindhoven, 98 09 08

LJM
Kuipers,
Janssen,

c:\text\wbank\wbre228.doc
MJP