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# INTERNATIONAL GROUP FOR CONSULTATION AND TRAINING

**Final Report**  
**under the Contract with UNIDO for Part II**  
**No.16001460 and Amendment 1**  
**UNIDO Project MP/EGY/06/004**  
**National CFCs Phase-out Plan**  
**Phase II**

For provision of equipment, engineering services and technical assistance for conversion of selected groups of enterprises to non-CFC technologies as demonstration sub-projects in Egypt, (Part I)



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Cairo, Egypt

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## Contents

I.	Introduction.....	2
II.	All the activities performed by IGCT in the contract 2007-2010 .....	3
	A. Summary of Progress Report 1 .....	3
	B. Summary of Revised Progress Report 2.....	4
	C. Summary of Revised Commissioning Report .....	4
III.	Summary of the Activities performed by IGCT Part II (groups 7-8) .....	4
IV.	Cluster C- Group 7 (National Egyptian Railways) .....	5
	A. Problems encountered during and after the retrofit and replacement operations in the National Egyptian Railways:.....	5
	B. Lessons learned during and after the retrofit and replacement processes in the National Egyptian Railways.....	6
V.	Cluster C- Group 8 (National Egyptian Buses).....	7
	A. Problems encountered during and after the retrofit and replacement operations in the National Egyptian Buses.....	7
	B. Lessons learned during and after the retrofit and replacement processes in the National Egyptian Buses.....	7

### List of attachments to the Report

- Annex 1 :  
Ten (10) Copies of the final versions instructions and manuals.
  1. Booklet ( Training manual ) refrigeration recovery and recycling group 1 sub group A,B
  2. Booklet retrofit and drop in of Transportation refrigeration units refrigeration units and systems from CFC's R12 to HFC R134a (Carriages)
  3. Booklet retrofit and drop in of Transportation refrigeration units refrigeration units and systems from CFC's R12 to HFC R134a (Buses )
- Annex 2 :  
One (1) CD in Arabic containing all necessary recommendations drawings, technical specifications and instructions sufficient for a team of qualified technicians
- Annex 3 :  
One (1) copy of CD in Arabic to be submitted to EEAA/ PMU for further reprinting and distribution

## I. Introduction

This report summarizes the different stages of implementing the contract in National Egyptian Buses and National Egyptian Railways to clarify the great success that was achieved through carrying out the replacement and retrofit operations to convert cooling units from using CFCs to using HFCs through modern technology and software with minimal costs.

It is worthy of mentioning here that after finalizing the implementation of the contract for both National Egyptian Buses and National Egyptian Railways and after EEAA and UNIDO celebrated finalization of the contract on 22/2/2009, IGCT had worked jointly with both beneficiaries in various technical operations such as provision and supply of spare parts, commissioning and supply of equipment and materials, which all go back to the fruitful cooperation between IGCT and the beneficiaries during the implementation of the contract.

From the initial contacts with PMU of EEAA, IGCT was aware that the main objective of the NPP is to phase out the remaining 217 tons of CFCs for the year 2007-2008 from refrigeration manufacturing and servicing sectors in most technically and commercially efficient manners, including strengthening of relevant legislative and policy measures and the public awareness.

From this stand IGCT would like to express its thanks and appreciation to National Egyptian Buses and National Egyptian Railways for the great efforts exerted during the implementation of the project and for their sincere cooperation in making all the needs and requirements of the Contractor available in time in addition to their helpful staff who provided a great support to our team during carrying out the replacement and retrofit plans all of which was really the main cause behind the great success achieved technically and financially. (Acknowledgement Letters from both entities to IGCT attached to the final report)

Special thanks shall also go to UNIDO and EEAA for their efforts in facilitating the implementation of the project.

## **II. All the activities performed by IGCT in the contract 2007-2010**

In this part we are going to summarize all the reports previously submitted to UNIDO to clarify the positive and negative aspects that faced IGCT during the different stages of the contract implementation.

- A. Summary of Progress Report 1
- B. Summary of Revised Progress Report 2
- C. Summary of Revised Commissioning Report

Before starting our summary IGCT would like to note here that one of the main reasons behind the success achieved in Part II of this contract is the sincere cooperation from the side of the EEAA shown in overcoming any obstacles to the implementation of the contract through its letters addressing the technical team or its formal letters to the beneficiaries to facilitate any difficulties that may have faced the technical team during the operations in addition to advising the beneficiaries to form a team in each organization to assist the technical team of IGCT during implementation and also to get the expertise of retrofit and replacement operations from IGCT team, all these efforts resulted into the success achieved and into low conversion costs per carriage in comparison to the previously prevailing costs where the cost of converting one carriage was almost equal to converting 3 carriages.

### **A. Summary of Progress Report 1**

Progress Report 1 summarized the achievement of the following tasks:

- Finalization of the final lists and technical specifications of selected equipment, compressors, components, spare parts, materials and servicing equipment, instrumentation and tools that were purchased and distributed among the selected project beneficiaries
- Describing the main details and methodology of engineering, technical services and assistance provided to these selected end users as well as the training of technicians on the latest technologies of maintenance and servicing, the good practices of refrigeration appliances production, maintenance and servicing.
- Demonstration tasks and nature of the Contract, special attention was given to the training of technical management personnel on the different options of R&R and the drop-in technologies for the air conditioners and chillers, including computer optimization of electrical consumption and cooling parameters.
- Selection of the list of international manufacturing companies and suppliers of refrigeration units, components of Ref. & A/C units, refrigeration materials and tools.
- Selection of the list of the major local companies which import refrigeration equipment from the international manufacturing companies to be sold in the local markets.
- Priorities of addressing the selected project/contract counterparts concerning the size of work presented, engineering services and distribution of equipment to all the participating sectors.
- Specification of executive work plan for each group of each sector of the project/contract.
- A series of meetings was held with the officials of the PMU/EEAA, all participating parties and beneficiaries of the project through the last period of time. All the technical, administrative, financial and other services details needed to guarantee success of the project were agreed upon during the meetings.

- As an integral part of technical and engineering services, it was agreed that 40 engineers from each of National Egyptian Railways and National Egyptian Buses to be trained by IGCT, training concentrated on the following topics:
  1. Training technicians on the use of alternative refrigerants
  2. Training technicians on the different options of R&R
  3. Training technicians on the methods of disassembling the old system and installing the new systems, etc.

### **B. Summary of Revised Progress Report 2**

The Revised Progress Report 2 summarized the achievement of the following tasks:

- Supply of all equipment, refrigeration units and components, instrumentation and materials to the Project Beneficiaries who received the equipment groups 7-8, purchased in accordance to the contract.
- Confirmations of Receipt of Equipment and Materials to the Project Sites Warehouses (client premises)
- Overview of plan of action for installation and commissioning of equipment and retrofitting of CFC based air conditioning units of passengers' railways carriages and buses

### **C. Summary of Revised Commissioning Report**

The Revised Commissioning Report summarized the achievement of the following tasks:

- Finalizing all replacement and retrofit operations in accordance with the technical set by IGCT
- Preparation of conversion guidance or technical instructions/ manuals as a part of engineering services (chapter 4. item 1.10 of the TOR)
- Signing the Certificates of Acceptance in addition to Acknowledgement Letters to National Egyptian Buses and National Egyptian Railways.

## **III. Summary of the Activities performed by IGCT Part II (groups 7-8)**

In accordance with the terms and conditions of the Terms of Reference and the Contract and follow up to the activities summarized in the commissioning report, IGCT had performed the relevant activities that in summary presented in this Final Report.

### **a. Ten (10) Copies of the final versions instructions and manuals**

The training manuals and guidebooks introduce the methodology of applying many operations that were carried out during the implementation of the contract and which should be carried out during maintenance operations, the operations are:

- **Training Manual (Booklet retrofit and drop-in for Carriages)** Retrofit of Transportation refrigeration units refrigeration units and systems from CFC's R12 to HFC R134a (Carriages).

This part explains the retrofit operations for a cooling unit in rolling stock using R-12 to use R-134a through critical technical procedures in order to achieve a success of about 90%

- **Training Manual (Booklet retrofit and drop-in for Buses)** Retrofit of Transportation refrigeration units and systems from CFC's R12 to HFC R134a (Buses )

This part explains the different options of retrofitting a cooling unit of a bus using R-12 to a cooling unit using R-134a through critical technical procedures to achieve a success of about 95%

- **(Training Manual) Booklet refrigeration recovery and recycling**

This part explains the procedures of using R&R units and the optimum methods of vacuuming and recharging the system without causing refrigerants into escape into the atmosphere

- **CD: Film on maintenance and servicing operations of buses A/C**

- b. **One (1) CD in Arabic containing all necessary recommendations drawings, technical specifications and instructions sufficient for a team of qualified technicians, includes the following:**

- Conversion and drop in from CFC ( R12)to HFC (R134a) for Buses
- Conversion and drop in from CFC (R12) to HFC (R134a) for Carriages

- c. **One (1) copy of CD in Arabic to be submitted to EEAA / PMU for further reprinting and distribution**

This CD includes a copy ready for print of all the guidebooks and manuals agreed upon according to the terms and conditions of the contract of Part II (groups 7-8)

#### **IV. Cluster C- Group 7 (National Egyptian Railways)**

##### **A. Problems encountered during and after the retrofit and replacement operations in the National Egyptian Railways:**

1. Weak technical level of the technicians responsible for the maintenance operations of the air conditioning units
2. There was no time schedule set for the periodical maintenance of the railway carriages.
3. Lack of ozone friendly equipment, tools or materials.
4. All of the maintenance tools and equipment were CFC-based equipment (using R-11, R-12, R-502)
5. The weak financial conditions of the Egyptian National Railways concerning the procurement of materials and equipment lead to the following:
  - No periodical maintenance was carried out for the air-conditioned carriages.
  - Procurement of materials without any check or examination whether refrigerants or oils.
  - There were about 800 air-conditioned carriages in the National Egyptian Railways, only 140 carriages out of them have been replaced through the past 10 years, and the rest will be replaced by the year 2015. All the replacement and retrofit operations were carried out through the procurement and installation of new compressors using R-134a instead of the old compressors using R-12.
  - No training courses were held to rehabilitate the technicians in the sector of Maintenance and servicing.
  - Lack of R&R equipment.

- Unawareness of the officers of the National Egyptian Railways of the negative impacts of CFCs on the Ozone Layer.
6. The frequent breakdown of the air conditioning units and the deterioration in its technical conditions especially that they are considered old models, resulted from the inefficient and speed maintenance they receive, since that the trains have to leave at certain points.
  7. The under recognition of technicians and engineers concerning the importance of the replacement and the retrofit process being afraid of delaying the train appointments.

**B. Lessons learned during and after the retrofit and replacement processes in the National Egyptian Railways**

1. The following was achieved after holding the training program for about 40 engineers and specialized technicians (out of 180 engineers and technicians responsible for the maintenance and servicing operations):
  - Defining the ozone layer and its importance
  - Training on how to use the alternatives
  - Training on how to use the R&R equipment
  - Distributing guidebooks and brochures about the best practices of replacement and retrofit operations
2. Carrying out the retrofit operations for 30 carriages without procurement of new compressors except in critical circumstances had a significant effect on retrofitting the rest of the Egyptian National Railways carriages.
3. Technicians were trained on the chemical analysis of refrigerants and resembling it the universal standards.
4. Technicians were trained on chemical analysis of the new oils and resembling it to the universal standards.
5. Technicians were trained on examining the purity of the oil after the retrofit operation to ensure the success of the operation.
6. It was agreed upon between IGCT and the National Egyptian Railways to hold monthly training programs to rehabilitate and qualify the technicians on the different options of conversion from R-12 to R-134a.
7. The National Egyptian Railways listed its requirements in the next stage:
  - Chemical gas analyzer
  - Refrigerant identifier
8. The National Egyptian Railways reached an agreement with the Petroleum Research Institute to carry out the following operations:
  - Analyzing the new refrigeration oils
  - Analyzing and measuring the oil examination after the conversion operation
  - Analyzing the new refrigerants R-134a
9. The authorized people concerned of the importance of the reduction of using R12 and the easiness of using R134a instead, especially after recognizing the temperature difference resulting from this replacement and the saving of the refrigerants quantities.
10. An executive work plan was set by the National Egyptian Railways to retrofit the rest of the carriages by the year 2012.



11. The availability of the technical equipments, oils and refrigerants lead to a decrease in the frequent reoccurring breakdowns.
12. Carrying out theoretical and practical trainings of retrofit process and distributing booklets and posters illustrating that caused an increase in the technicians' qualifications especially during the practical experiments made on train carts of different designs and models.
13. The mechanical technicians have carried out some technical adjustments to the different types of compressors whether sealed or semi hermetic in order to be compatible with R-134a
14. Providing engineering and technical consultations and providing technical and engineering support to engineers and technicians of the National Egyptian Railway and also providing financial subsidy incase of changing any part of the mechanical and the electrical circuits to ensure efficient guidance models for train carts of different designs and models.

## **V. Cluster C- Group 8 (National Egyptian Buses)**

### ***A. Problems encountered during and after the retrofit and replacement operations in the National Egyptian Buses***

1. No training courses were held on frequent basis to get the Egyptian National Buses staff acquainted with the new technology of maintaining and servicing the refrigeration and air conditioning units.
2. Bad economic conditions of the Egyptian National Buses in procuring the equipment and materials used for the maintenance and servicing operations.
3. Lack of advanced ozone friendly equipment.
4. Lack of R&R equipment.
5. The unawareness of the Egyptian National Buses officers of the negative impact of CFCs on the Ozone Layer.
6. The difficulty of carrying out the retrofit process in the air conditioning system from R-12 to R - 134a of the National Egyptian buses since the buses should be in service within few hours which forced the working team to work on this retrofit process late after mid-night.
7. Speedy and inefficient maintenance of air conditions will not prevent future unexpected breakdowns.
8. The poor technical level of technicians and lack of the advanced technical equipment has lead to the deterioration of the air conditioning systems.
9. The increase of the air conditioning units' breakdown due to the decline in number of the companies supplying the buses air conditions' spare parts and due to its price increase.

### ***B. Lessons learned during and after the retrofit and replacement processes in the National Egyptian Buses***

1. The following was achieved after holding the training program for about 40 engineers and specialized technicians responsible for the maintenance and servicing operations:
  - Defining the ozone layer and its importance
  - Training on how to use the alternatives

- Training on how to use the R&R equipment
  - Distributing guidebooks and brochures about the best practices of replacement and retrofit operations
2. The technicians were introduced during the training program to carrying out the retrofit process without procurement of new compressors for the retrofitted units. The model of the National Egyptian Railways was presented to the National Egyptian Buses as an example. The National Egyptian Buses agreed with IGCT that the latter will supervise the conversion operations in the next stage **without procurement of new compressors** for the retrofitted units. The National Egyptian Buses had about 1000 buses using CFC-12.
  3. Technicians were trained on the chemical analysis of refrigerants and resembling it the universal standards.
  4. Technicians were trained on chemical analysis of the new oils and resembling it to the universal standards.
  5. Technicians were trained on examining the purity of the oil after the retrofit operation to ensure the success of the operation.
  6. The engineering department in the Egyptian National Buses will establish a comprehensive retrofit plan for its buses without procurement of new compressors; this retrofit plan will be finalized and achieved by the year of 2012.
  7. The technicians and engineers concerned became acquainted with using the most recent environment-friendly alternatives by carrying out training courses as soon as possible through CDs, posters, booklets and theoretical and practical lectures on the recent equipment submitted to the National Egyptian Buses
  8. The reduction in the frequency of the unexpected air conditioning units' breakdowns used to reoccur, due to using advanced equipments and methods in the maintenance and retrofit process.
  9. Project heads of departments' concern especially after realizing the importance of carrying out retrofit processes and also their provision of equipments, units' parts, recovery equipments and all the engineering and technical consultations needed, for free and in no time.
  10. Huge financial savings for the National Egyptian Buses due to the reduction in the consumption of the refrigerants quantities as a result of using the recovery units.
  11. Overcoming the common technical problems such as the leakage or the blockage due to the increased use of Nitrogen in flushing the cycle specially that the Nitrogen absorbs all the humidity out of the cycle and it has no harms if escaped into the atmosphere in addition to its low price.

**General Manager**

**Eng. Galal Galal**