ECO-COOL™

SAVE OUR PLANET FROM CFC

THE QUARTERLY BULLETIN FOR REFRIGERATION TECHNICIANS

NO. 12, DECEMBER 2004

Published under contract with HIDECOR

CONTENTS

Foreword

As Director of the Ozone Cell, Ministry of Environment and Forests (MoEF), it gave me great pleasure to be associated with the HIDECOR project from Sept. 2001. This is the third project, supported by the Governments of Switzerland and Germany, to help India meet its CFC phase-out commitments under the Montreal Protocol. While the earlier projects were geared to provide CFC alternatives to the refrigeration manufacturing industry, HIDECOR focused on the technicians, who are the after-sales service providers. This project offers a good example of public-private and government partnership: industries in the sector and ministries such as Dept. of Science & Technology, Labour, State Govts, and the DGET, in addition to the MOEF, were motivated to participate.

While Refrigeration & Air Conditioning trade is offered in approximately 300 Industrial Training Institutes in the country and generates employment for nearly 3000-4000 people annually, a rough survey indicates that we have a workforce of 70,000 in this sector. HIDECOR has successfully revised the trade syllabi and sensitized policy makers to the urgency for technician training. In a developing country like ours, where the servicing sector generates many employment opportunities, the need to keep pace with the latest technologies cannot be over-emphasized. Also, since a large percentage of the workforce in this sector does not have access to formal training, and picks up the skills by working in the servicing units from a young age, the need to provide training capsules, accessible at the technician's convenience, is essential. HIDECOR has trained 10,000 technicians, in addition to ITI instructors, and supported R&D activities, while also networking nationally and internationally with other partners.

A major concern of the Government has been how to ensure that servicing technicians in the informal sector handle refrigerants carefully. During the implementation of the ECOFRIG project in 1992, which supported Hydrocarbon technology as a replacement for CFC refrigerants and foam blowing agents in the manufacturing industry, the coordinators became aware of the challenges that the RAC servicing sector would have to face to meet India's CFC phase-out targets. In 1998, the HIDECOR pilot phase was initiated targeting the Micro and Small Enterprises (MSEs), who traditionally service refrigeration equipment, and whose livelihoods were at risk unless they were well-equipped to handle non-CFC refrigerant technologies.

In the last lap of CFC phase-out compliance in the consumption sector, NCCOPP takes the baton from HIDECOR. NCCoPP broadens its scope to include high CFC-consuming firms and extends coverage to the whole country. It is funded by the Multi-Lateral Fund, and implemented by UNEP and UNDP, with the support of the Governments of Germany and Switzerland. It aims at enabling India meet its target of total CFC phase-out by December 2009.

The Ozone Cell has been continuously providing the means to implement various policy measures, including the ODS Rules and Regulations 2000, Production Quota System, and Trade Controls and Licensing System, in order to encourage early adoption of alternate technologies and provide necessary information on non-ODS technologies. It has been actively supporting awareness programmes and dissemination of technical information on ODS phase-out through a bi-monthly bulletin, VATIS. In the compliance phase, capacity building of officers of Customs, Coast Guard, Border Security Force, DGFT, and other regulatory functionaries, on the Implementation of the ODS (Regulation & Control) Rules 2000 has been initiated.

The Ozone Cell congratulates HIDECOR's partners and stakeholders on their innovative efforts, while thanking the Government of Switzerland, for their generous and tireless support in implementing the project. It also wishes NCCoPP all success in achieving the targets and ensuring complete CFC phase-out in India by 2010.

Usha Chandrasekhar
Director, Ozone Cell
11 Nov, 2004

Editorial

This is the final issue of *Eco-Cool* under HIDECOR, as the project comes to a close by the end of 2004. But for all those who valued the magazine and the activities conducted by the project, there is no reason to despair. The new project, National CFC Consumption Phase-out Plan (NCCoPP), continues with many of the activities besides initiating new ones. This issue of *Eco-Cool* bids goodbye to HIDECOR and appreciates its contribution, while it welcomes NCCoPP and wishes it strength. Yet, in its efforts to appraise the earlier project on the one hand and delineate the new project's activities on the other, *Eco-Cool* has not sacrificed its useful practical tips section.

At the end of any project, the question that arises is: "What did the project achieve?" Some answers are provided in this issue. In addition, I will share some of my observations on the factors that I think have contributed to HIDECOR's success.

On the upside we find:

- It was to great advantage that many experts from the earlier ECOFRIG project remained on board under HIDECOR. Their rich experience could be harvested for project activities, allowing a speedy start-up. NCCoPP will again be fortunate to gain from HIDECOR's rich learning experience, and has an existing excellent infrastructure to further build on.
- Conceptualization and implementation of the training cell concept was an important contribution. The early start and demonstrated success helped to overcome the initial resistance from many stakeholders to this concept. Except for a few active industries, training cells have been the backbone of the training activities.
- The excellent training resource materials developed and the ability to impart training in local languages has helped the technicians to a great extent to absorb the training sessions.
- Rather than choosing the easy path of importing equipment with the available funds, the project initiated the excruciating task of developing local resources for manufacture, supply, service and testing of equipment. The benefits of this will however only be seen during the coming years.
- The organizational set-up of the project allowed much flexibility for project activities and implementation. Stakeholders from all levels have been actively involved, leading to "ownership" of the project, thus ensuring sustained interest and valuable contributions.

But any appraisal is incomplete if we do not also examine the shortcomings. On the downside we find:

- Marketing of HC refrigerants on a larger scale will only start now with the supply being established by Hindustan Refrigeration Stores as the process of approvals and development of the supply chain has taken too much time. Many of the trained technicians, therefore, did not have a chance to apply what they had learnt. However, these initial problems can easily be overcome.
- HIDECOR could not establish a comprehensive Equipment Support Scheme for technicians to procure essential equipment and tools enabling better servicing practices. However, this activity will be pursued with renewed vigour under NCCoPP.

Overall, the stakeholders, especially the technicians who attended the training programmes, perceive the project as a grand success. This perception is not a matter of routine, but the result of the effort put in by all the stakeholders. I would like to thank all the project participants at this point for their excellent work and their dedication during the last 4 years. Clearly, there is always scope for improvement, but for NCCoPP, with the assets and learnings of the HIDECOR project to build on, scaling new heights will be a comparatively easier task.

I wish the new team under NCCoPP much joy and success in their work. I thank all the readers of *Eco-Cool* for their sustained interest in the newsletter, which I personally find has been a well-designed and fun-to read-magazine.

Manfred Egger,
Project Leader

HIDECOR: A brief history

HIDECOR was initiated by the Swiss Agency for Development and Cooperation (SDC) in India in January 2001. The project sought to enable Micro and Small Enterprises (MSEs) in the manufacturing and servicing sectors and relevant training institutions to cope with the new demands (technologies, skills and market) resulting from the CFC phase-out process under the Montreal Protocol.

ECOFRIG

The forerunner of both HIDECOR and the new project, the National CFC Consumption and Phase out Plan (NCCoPP), was the Ecological Domestic and Commercial Refrigeration (ECOFRIG) project started in 1992. ECOFRIG was initiated with "a view to support ecological and sustainable hydrocarbon technology as a replacement for CFC refrigerants and CFC foam blowing agents" in the Indian domestic and commercial refrigeration sector. The ECOFRIG project was a joint undertaking of the SDC, GTZ and the Ozone Cell of the Indian Ministry of Environment and Forests (MoEF), Government of India. During implementation, the coordinators became increasingly aware that the RAC servicing sector would face a challenge in the wake of India's initiatives to phase out CFC under the Montreal Protocol obligations.

In 1997 MSEs accounted for over 50% of the total consumption of ozone-depleting substances in the RAC sector in India; therefore strengthening the capabilities of this sector was critical. In July 1998, SDC conceived the pilot phase of the HIDECOR project, aimed at testing methods and approaches, identifying the institutional set-up and providing a base for supporting the project objective. The pilot phase ended in December 2000. From January 2001, the main phase of HIDECOR commenced. Conceived as a four-year project, its geo-focus was on the States of Tamil Nadu, Karnataka, Maharashtra, Andhra Pradesh, Gujarat, West Bengal and Greater Delhi.

RATIONALE FOR HIDECOR

The rationale behind HIDECOR was:

1. India will have to phase out CFC in the RAC servicing sector to achieve the Montreal Protocol ODS phase-out targets. Since the average life-span of refrigeration equipment is around 20 years, a significant number of CFC-based refrigerators are likely to be still in use in 2010. CFC use can be reduced (before the complete phase-out in 2010) by better servicing practices (fewer leaks), replacing CFC with alternative refrigerants (retrofitting), and by recovery and recycling of CFC at the workshop level.
2. New non-CFC technologies entail more demanding servicing practices. RAC servicing sector technicians must be trained to correctly handle new technologies (HFC134a and HC).
3. For MSEs in the RAC servicing sector, the most significant channel of information on new products or service practices are suppliers of refrigerants and spare parts. Since there is an urgent need to disseminate information to MSEs, industry networks, public and private vocational training institutions and reputed NGOs need to be involved.

PROJECT COMPONENTS

The main components of HIDECOR are:

1: Training of Service Technicians

Training constitutes the main effort under the HIDECOR project. It seeks to enable service technicians to apply better servicing practices and use non-CFC technologies. Non-CFC technologies require more stringent servicing practices, which must be grasped by the technicians to ensure equipment efficiency and customer satisfaction, on which, in the end, their survival too depends.

Content and Methodology

The training content primarily includes the particular properties of the alternative refrigerants which require specific attention. For the purpose of execution, two training routes were used: (1) through the established network of the RAC manufacturing industry, and (2) through a network of training cells, which were established by HIDECOR in 11 locations. (Some cells will contribute as a resource for future training scheduled under NCCoPP.)

2: Strengthening Vocational Training Institutes

Since many service technicians are ITI trained, it was essential to include non-CFC technology as part of the curriculum. This would ensure that future technicians entering the market were trained in best practices to deal with alternative refrigerants as well as the containment of CFC. Nearly 440 ITI instructors were trained under HIDECOR through two Advanced Training Institutes (ATIs) of the Directorate General of Employment & Training (DGET) at Kolkata and Hyderabad. The project helped revise the syllabus for the RAC craftsmen and apprenticeship training schemes, and supported the development of an Instructional Media Package for this sector. Further, the project sought to raise awareness about alternative technologies among the faculty of engineering colleges and polytechnics through workshops.

3: R&D and International Networking

HIDECOR sought to support R&D "to facilitate development of indigenous service equipment and support measures to make equipment affordable". It also sought to share the learnings from HIDECOR with a wider audience.

In retrospect, HIDECOR has provided an excellent base and support in preparing RAC servicing technicians, vocational training institutes and other stakeholders in India to cope with the challenges of CFC-free markets and technologies.

Contact: Dr. Surinder Batra
Centre for Interactive Management
Email: batra.cimi@vsnl.com

HIDECOR's organizational vision for India

One of HIDECOR's unique features was its vision for dissemination of knowledge through training. An ORG-MARG study in 2002 on the RAC servicing sector estimated that there were about 40,000 RAC servicing firms and a total of about 77,000 skilled RAC service technicians in India. The project's target was to cover 10,000 MSE service technicians—a formidable challenge for anyone familiar with the informal refrigeration servicing sector, for the workshops are generally located in backstreets, sometimes in remote areas. Often, technicians from these workshops have received little formal training, making it all the more essential and challenging to develop their skills. Few firms and technicians belong to the established refrigeration manufacturing industries' networks. Developing a strategy to train these 10,000 MSE service technicians was an important initial step under HIDECOR.

The Training Routes

Of the two training routes: the RAC industry and the training cells, the former has its own network and facilities. The facilities of two domestic refrigerator manufacturers: Godrej and Whirlpool, and that of a compressor manufacturer, Kirloskar Copeland Ltd. are used. The training cells were identified by HIDECOR, with each unit comprising: (a) an organizer, (b) a recruiter, and (c) a training institute. These cells are supported by external trainers in some cases. The State organizer is responsible for conducting the training programmes in the entire state according to the project's guidelines, quality norms and targets.

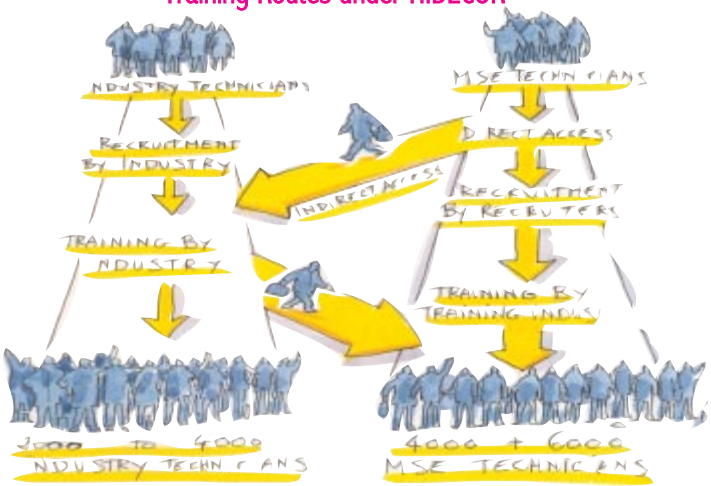
Both the industry and the training cells are under contract with HIDECOR for training activities, and are supported financially. Of the targeted 10,000 service technicians, the training cell route was expected to train approximately 6000 MSE technicians, who would be identified by the recruiters. The industry training route was expected to train approximately 4000 MSE technicians (besides 2000 to 4000 technicians of its own networks), who it was responsible for recruiting.

To ensure the success of the entire training programme, the training cells were carefully selected. A number of prospective organizers, recruiters and training institutes were screened and candidates evaluated according to the defined responsibilities and key attributes laid down for each role. The success of the training programmes conducted by the training cells over the four years of the project vouches for their inherent strength. Industry partners have contributed substantially to the task of skill development of technicians.

Outreach

Based on the premise that technicians in remote places are less likely to be aware of non-CFC technologies than their counterparts in major cities, an important part of the HIDECOR strategy was to impart training to the service technicians in remote towns. Accordingly, the training cells and industry were requested to spread training to outreach locations in all the geo-focus states. More than 60% of the HIDECOR training programmes were conducted in outreach locations.

Training Routes under HIDECOR



Equipment Support

In the early stages of the training, it was recognised that servicing firms would require tools and equipment for adopting correct service practices. Budgetary constraints disallowed such support to a large percentage of the servicing firms. However, some finance was provided through the final-phase budget of the ECOFRIG project. This included a pilot Equipment Support Scheme (ESS), launched in Delhi (November 2002). Under the ESS, tools and equipment kits were provided to 22 Delhi-based servicing firms. Eligible technicians from these firms had undergone training under HIDECOR, and beneficiaries were expected to pay 40% of the total package cost. The equipment offered under ESS included imported and locally manufactured Evacuation & Charging (E&C) units, two-stage nitrogen regulators and swirljet torches for brazing. A follow-up survey carried out by CIMI indicated that the scheme was immensely successful. Other schemes, essentially loan-based, supported by a non-banking financial institution, were pilot-tested in Chennai. Based on the testing, NCCoPP can design schemes that are useful and financially accessible to MSEs.

Capacity Building

HIDECOR has lived up to its name. Although in the context of developing skills in ecological refrigeration for the entire RAC servicing sector of India, the achievements may seem modest, by training over 10,000 service technicians and creating awareness among the faculty of engineering colleges and polytechnics and providing support to ATIs to carry out training of staff from ITIs, the project has contributed substantially to its human development component.

HIDECOR MIS

Information on each technician trained under the project is contained in an interactive database. The MIS can handle comprehensive information on all aspects of the training: training events, participants, MSEs, refrigerant dealers, mailing list for various HIDECOR activities, and draw statistical conclusions.

As for achievements in institutional development, it includes the establishment of viable and sustainable training cells capable of providing specialized training in best environmental practices in refrigeration servicing as well as providing support to curriculum development for the formal vocational training institutes.

By any yardstick, it is a creditable contribution to building the country's capacity to cope with the challenges of non-CFC technologies.

Contact :
Prof. R S Agarwal, IIT Delhi
Email: rsarwal@mech.iitd.ernet.in
Dr. Surinder Batra, CIMI
Email: batra.cimi@vsnl.com

Upgrading ITIs and ATIs

Industrial Training Institutes

ITIs, both government-owned and private ITCs affiliated to DGET, are the backbone for training future technicians. The institutes, set up under the Craftsmen Training Scheme (CTS) of DGET, are a part of the Ministry of Labour, Govt. of India. There are 409 such institutes (285 govt. and 124 private), which offer high-school pass RAC technicians two years' training. All ITIs follow a uniform syllabus, prescribed by the National Council of Vocational Training (NCVT); it is mandatory for them to follow the prescribed syllabus.

Advanced Training Institutes

Several field-level institutes of DGET like the Central Instructional Media Institute, Central Staff Training and Research Institute and ATIs also form part of the government's formal vocational training system. The six ATIs impart short-term training of 1 to 6-week duration for industrial workers to upgrade their technical skills. Only two ATIs, one at Howrah and the other at Hyderabad, offer short-term courses in RAC. The ATI at Howrah also conducts a one-year instructor training programme in RAC for instructors nominated by state governments.

Revision of RAC Trade Syllabus (ITIs)

The revision of the RAC trade syllabus was initiated under HIDECOR in 2001. Based on an exhaustive study carried out by RAC experts, drawn from the industry as well as academic institutions, the syllabus was drafted afresh, and subsequently approved by the NCVT.

Primarily, the syllabus was updated to meet the future technological challenges in RAC servicing due to phase-out of CFCs and HCFCs under the Montreal Protocol.

The revised syllabus now includes:

1. Eco-friendly refrigerants, handling of refrigerants, safety, leak testing, Evacuation and Charging (E&C).
2. Recovery and Recycling (R&R) and good servicing practices with CFCs and alternative refrigerants.
3. Retrofitting of CFC-based appliances with eco-friendly drop-in refrigerants.

Revision of Instructor Training Programme Syllabus

The one-year RAC instructor course curriculum offered at ATI Howrah was also modified. The revisions equip the ITI instructors with the latest technical knowledge to enable them to train future technicians. The revised instruction material, published by CIMI, is available to ITI instructors.

Training of Trainers and ITI Instructors

HIDECOR conducted a 5-day Training of Trainer's (ToT) workshop for senior training instructors. It catered to trainers from the industry and the training cells established under HIDECOR. The training package included both theoretical and practical elements on handling new refrigerants, achieving energy efficiency in serviced appliances and good servicing practices. A number of hand-held sessions were conducted to support ATIs in their training of participants from ITIs throughout India. Approximately, 440 instructors have already been trained.

Equipment Support To ATIs and ITIs

ATIs were supplied with tools and refrigeration appliances, R&R equipment, E&C units, piercing valves, and thermocouple/thermistor-based vacuum gauges of digital type (micron gauges) for training the ITI instructors during the ToT workshops.

There is an urgent need to upgrade the institutes' RAC laboratories by providing equipment/tools. The follow-on project, NCCoPP, has outlined an ESS to equip 120 Government ITIs. Additional support is being sought from the Department of Science and Technology, Govt. of India, for the remaining institutes.

As a result of efforts under HIDECOR, the revised syllabus has been implemented, under notification from DGET in August 2004, for the course which will end in June 2006.

Contact: Professor R S Agarwal, IIT Delhi
Email: rsarwal@mech.iitd.ernet.in

Better Servicing Practices

A series of articles to promote the use of better servicing practices was covered over 6 issues of *Eco-Cool*. The practices, which are applicable to small hermetic systems used in refrigerators and stand-alone commercial appliances like freezers and bottle coolers, were explained step-by-step. (Many of the practices are also applicable to larger RAC appliances.) Technicians wrote in to tell us that they actually share the newsletter with colleagues who have not been trained, especially the good practices outlined in this series.

Good Servicing Practices—The Final Step

The seventh and last step in the series of better servicing practices covers:

Test Running for Performance

After charging the refrigerant, test whether the appliance is functioning properly. During the performance test, make sure that:

1) the appliance is pulling down from the ambient temperature to the expected temperature within a reasonable time, using Indian standards as a guide to the time expectation. The temperature should be measured with a thermometer, whose sensor is placed in the air inside the cabinet or freezer.
2) the current drawn by the appliance at the voltage prevailing at the site is monitored. Any abnormally high or low current needs investigation after correcting the voltage.
3) there are no abnormal or loud noises emanating from the compressor.
4) the suction and discharge pressures during and after pull down have stabilized. Any abnormally low or high suction or discharge pressure is a cause for concern. Pressure readings will also provide clues to the existence of any chokes or leaks in the system or undercharge or overcharge of refrigerant.
5) after testing, the service/process tubes on the compressor and filter drier are pinched (preferably twice) with a crimping tool/plier, the isolation valves disconnected and the process tube ends brazed.
6) you carry out a final check for leaks with an electronic leak detector, if available.

A Summing-up of all Good Servicing Practices covered in *Eco-Cool*

Let us now recapitulate the remaining six steps of good servicing practices:

Recovery of Refrigerant

Recover the refrigerant using the passive or the active method (see *Eco-Cool*, March 2003). Use good quality piercing valves. Do not vent the refrigerant (CFCs, HFCs & HCFCs) into the atmosphere.

Preparation for Repairs

Prepare for repairs with brazing kits, double-mouthed filter driers, extra lengths of process tubes, hand shut-off valves/ball valves or process tube adaptors and couplers, and cut off/debraze the components that need replacement. Filter driers should always be replaced. Cap all the open ends of tubes.

Flushing & Cleaning

Flush and clean the system with nitrogen of purity of at least 99.995% and -40C Dew Point at 5 bar pressure. Use trichloroethylene to clean the components if the compressor has suffered a motor burnout. After using trichloroethylene, remember to heat the components with high watt bulbs or a heat gun to vaporize and remove all traces of liquid trichloroethylene.

Ensure the use of two-stage regulators when using nitrogen, to prevent accidents.

Re-assembling

You can re-assemble the system with new or repaired components. When re-assembling the capillary, ensure that it is correctly placed inside the filter drier end. Use electrodes with at least 45% silver when brazing the steel tubes of the condenser to the compressor discharge tubing or the filter drier, both being made of copper to avoid brittle joints. Once the brazing is done, check for brazing chokes, particularly at the capillary ends using nitrogen (see *Eco-Cool,* Dec. 2003).

Leak Testing and Evacuating

Leak test the re-assembled system with pure dry nitrogen at 10 bar pressure. Then evacuate the system using:

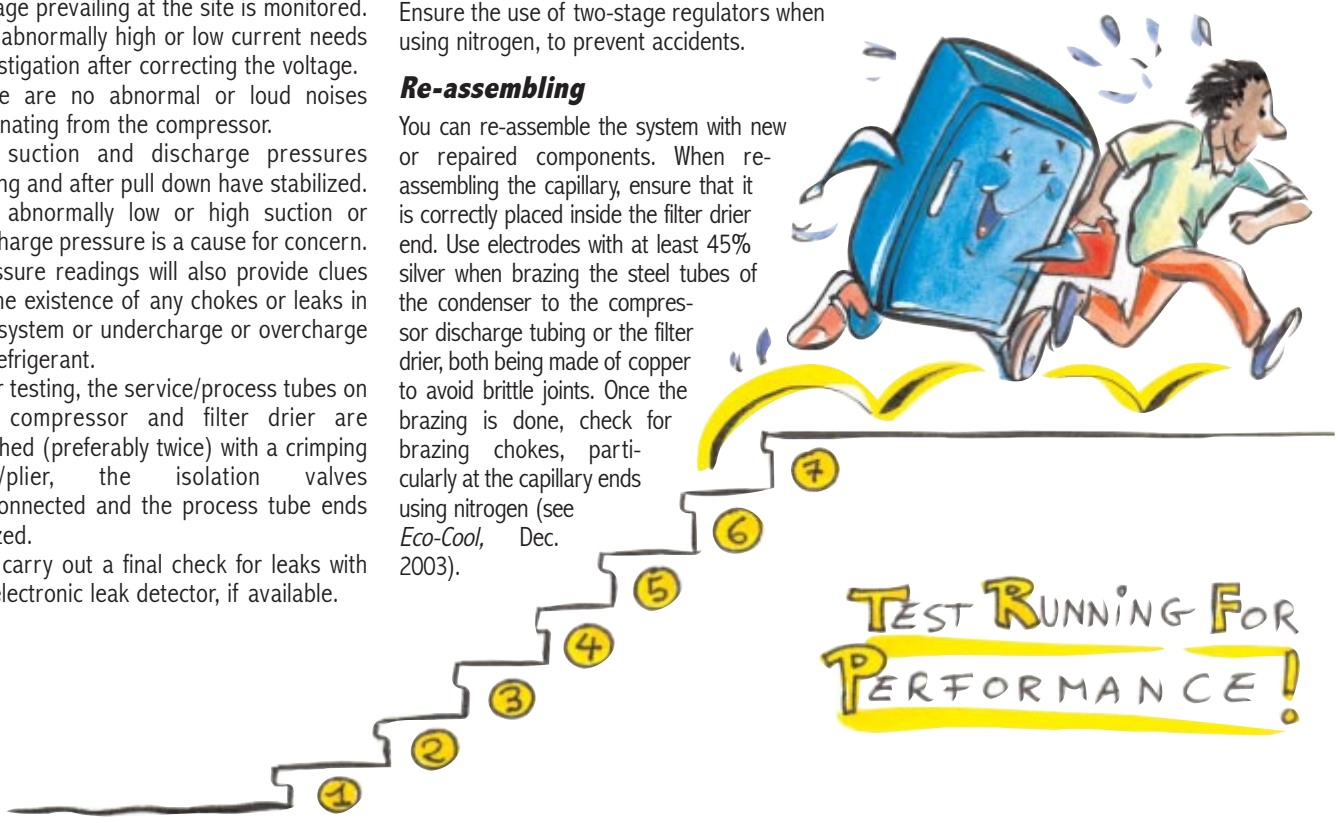
- A two-stage, rotary oil, sealed vacuum pump with a two or four-way manifold or with a composite E&C unit comprising the vacuum pump, manifolds, gauges, interconnections and charging hoses.
- An electronic vacuum gauge that can read vacuum in microns of Hg. Ensure that vacuum is pulled down to 500 microns or lower and then have the system tested for its ability to hold vacuum. The upper level of acceptance for the holding test is 1500 microns. The lower the level, i.e. the closer to 500 microns, the better is its vacuum-holding or leak-prevention capacity (see *Eco-Cool,* Sept. 2004).

Accurate Charging

After the evacuation of the system, it has to be charged with the refrigerant, preferably of the same weight mentioned by the OEM of the appliance on the nameplate (see *Eco-Cool* Sept. 2004).

(The last step is 'Test Running for Performance', which has been discussed in the preceding section.)

Contact R.S. Iyer
Email: iyerus@vsnl.com



Partnering for Progress: Godrej & Boyce/HIDECOR

As a trainer with Godrej, I joined the pilot-phase of the HIDECOR programme in September 1999. Many RAC technicians in India are ill-equipped to work even on simple and familiar refrigerants like CFCs. But, my belief is that these technicians can be motivated to make changes in their work practices if they are trained in Good Servicing Practices and know the safety rules.

I had the opportunity under HIDECOR to work in many capacities: associate or lead faculty for Training of Trainers (ToT) workshops; organizer-cum-conductor of MSET training workshops; author of training materials; supervisor of MSET training workshops; technical expert for testing demonstration apparatus and member of Project Technical Advisory Committee (PTAC).

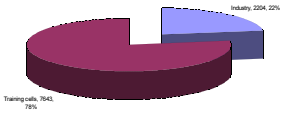
In the first two years, we trained all the refrigeration technicians and supervisors at Godrej on HFC and HC technologies adopted for our domestic refrigerators. So far, we have trained over 1700 technicians from the project target group and an almost equal number of company technicians, or dealer/franchisee-employed technicians.

At the same time, we developed tools/equipment–a portable gas-charging station, cans for easy use of refrigerants–and carried out vacuum pump testing. We developed a recovery unit for our internal use. We built the Company's capacity to support HIDECOR project developments. Our twelve technical trainers engaged in the Company's transition from CFC to alternate refrigerants are experts–three are now competent enough to monitor the MSET training workshops and conduct demonstration-cum-practice sessions of ToTs. All these trainers will join me in implementing the new project, NCCoPP.

The Godrej trainers: A R Thampi, P G Bhat, M S Bhaskar, S U Navalkar, K A Kazmi, G I Gajjar, S N Adhikary, M M Paul, K Dakshinamoorthy, Habib Hameed and others.

Contact: S A Juvekar
Email: saj@godrej.com

Whirlpool India, Electrolux and KCL also contributed to the industry effort to provide training. Each of these industries trained technicians from the MSE workshops at their own facilities, while simultaneously training their own staff and franchisees.



Industry Trained 22%; Training Cells 78%

R&D: Focus on Indigenous Equipment and Quality

Initially, HIDECOR conducted surveys and special studies to fully comprehend the practices followed by service technicians. These examined the constraints to sustain better practices caused by the non-availability of the right equipment and tools at affordable prices. From 2001 onwards, direct feedback was available from the technicians who participated in the workshops. There were clear indications of the need to develop indigenous, affordable equipment.

The R&D component of HIDECOR looked at the following equipment:

Air-LPG Brazing Torches

Many mechanics use either kerosene blow lamps or air LPG torches for brazing instead of oxy-acetylene or oxy-LPG equipment. However, kerosene blow lamps do not provide the necessary temperatures for brazing, while the air LPG torches produce a flame that is too thick and wide, and of inadequate temperature for quality brazing. HIDECOR experts made a study of imported propane-air torches, which indicated that a swirl imparted to the flame narrowed and directed the flame to the targeted area and did not heat-up adjoining areas unnecessarily. This refinement was introduced in one of the Indian-made air-LPG torches. The resultant temperature was sufficiently high and, in addition, the flame concentrated on the targeted brazing area with much better results than blow lamps or the normal air-LPG torches. These torches have been affordably priced at Rs 1500, and have been demonstrated at the HIDECOR workshops.

Evacuation and Charging Stations

A complete E&C unit, which evacuates and charges a refrigeration system in one sitting, is extremely useful. The heart of the unit is the vacuum pump. Considerable efforts were put in by HIDECOR to:

1. Locate and evaluate the manufacturers of light and economical two-stage, oil sealed, vane rotary vacuum pumps close coupled to two-pole electric motors. Two such sources were identified and their pumps used.
2. Develop portable E&C stations incorporating the above-mentioned vacuum pumps. The stations must include isolation valves, manifolds, compound, pressure and vacuum gauges (Bourdon type), charging stills or electronic weigh scale, and the vacuum pump. The stations can use HFC134a or Hydrocarbons. The entire station is contained in a steel frame, totally weighing about 18 kg. Three such designs were developed and the E&C units were successfully used in HIDECOR workshops. The E&C stations are priced at approximately Rs 15,000 to Rs 18,000.

Apart from developing these units, HIDECOR held special workshops for trainers to demonstrate how to inspect and maintain these units.

Although imported components could improve the performance and quality of the equipment, these have not been incorporated to date. For, by and large, the indigenous equipment has functioned efficiently and provides value for money.

Recovery & Recycling Machines

During the early phase, HIDECOR encouraged mechanics to make their own rudimentary recovery machines. Subsequently, a more sophisticated machine that could also perform single-pass recycling was developed. The new machine had oil separators with heat exchangers (distillators) and oil return arrangements for the compressor oil, apart from solid core driers for particulate filtration and acid and moisture removal. This unit was also demonstrated in the HIDECOR workshops.

Instruments were developed under HIDECOR to demonstrate the measurement of vacuum during training. Moisture and non-condensable gases must be thoroughly evacuated, which cannot be done using conventional Bourdon or bellows-type vacuum gauges. HIDECOR has assisted in the development of a thermocouple-based vacuum gauge that can read in microns of mercury and guide the mechanic to the desired level of vacuum in microns. Initially, it was developed as an analog type gauge; subsequently digital read-out gauges, with the sensing element located inside the instrument (to prevent damage), have been developed. The price of the gauge is approximately Rs 4500.

HIDECOR's Contribution to R&D and Quality Enhancement

Apart from the specific pieces of equipment developed, HIDECOR has served as a catalyst in improving the quality of equipment. The use of components like leak-proof ball valves in lieu of hand shut-off valves is encouraging. Vacuum pumps and E&C units were laboratory tested as per IS 6849, which is not the normal practice followed by most manufacturers of vacuum pumps. HIDECOR also helped in sourcing good piercing valves, pure dry nitrogen and nitrogen regulators, and has attempted to raise the quality of servicing technology to international standards. On the software front, the practices recommended and demonstrated in the workshops have all contributed to enhancing quality.

Contact: RS Iyer
Email: iyerus@vsnl.com

Alternative Refrigerants and HC Servicing

From January 2003, all new domestic refrigerators as well as stand-alone plug-in commercial refrigeration appliances are non-CFC based. However, there are a large number of CFC-based appliances still in use in the country, which need to be either serviced with CFC12 or retrofitted using drop-in zero Ozone Depletion Potential (ODP) refrigerants like Hydrocarbons, blends, etc.

Alternative Refrigerants to CFC12

Numerous refrigerants have been assessed as a replacement for CFC12 in domestic refrigerators and small capacity commercial refrigeration appliances. The main options fall into two categories: Hydrofluorocarbons (HFCs) and Hydrocarbons. (Training offered by HIDECOR to MSE servicing technicians focused on the use of both these refrigerants, as well as the safe handling of CFC12.)

HFC Refrigerants: HFC134a

HFC134a is non-flammable and has zero ODP. It was selected as an alternative to CFC12 for various applications globally. The volumetric capacity of HFC134a is about 12% below CFC12 at the standard rating conditions (-23.3^{o}C evaporator, 55^{o}C condenser) used by compressor manufacturers for performance measurements. All major compressor manufacturers offer models optimized for use with HFC134a. Recent energy consumption tests in refrigerator-freezers show that HFC134a is approximately equal in optimized units to the performance of CFC12.

Several types of synthetic polyolester oils have been developed for use with HFC134a as the refrigerant is immiscible with napthenic mineral oil generally used with CFC12. The oil is however highly hygroscopic. To ensure low moisture, servicing requires the use of efficient two-stage vacuum pumps to obtain a vacuum of the order of 500 microns or less. Molecular sieve filters/dryers of higher grades like HX7 or HX9 are recommended.

Due to the relatively high Global Warming Potential (GWP) of HFCs, (GWP of HFC134a is 1300) there has been serious re-thinking about the use of HFCs. Under the Kyoto Protocol, HFCs are included in the basket of Green House Gases and their emissions have to be controlled. As a result, many countries are making a second conversion from HFC134a to Hydrocarbons like R600a (Isobutene) when manufacturing new appliances. Some Japanese companies have modified their manufacturing facilities to use R600a in their appliances.

Hydrocarbon Refrigerants

Hydrocarbons are environment-friendly refrigerants due to their zero ODP and negligible GWP. Their efficiency is slightly better, especially in the case of HC600a, than other leading alternative refrigerants, and they are fully compatible with the lubricating oils conventionally used with CFC12 appliances. The latent heat of vaporization of hydrocarbon refrigerants is very high in comparison to CFC12 and HFC134a. The density is approximately one-third that of CFC12, making these refrigerants attractive because of their low charge requirements (about 40% of the CFC12 charge). The active efforts, in Europe, to encourage application of HC refrigerants are rapidly expanding to other regions of the world. Today, approximately 25-30% of the appliances produced globally use hydrocarbons. The HC refrigerants commonly adopted are HC600a and a blend of HC600a/R290.

Due care must be taken during manufacturing and servicing of hydrocarbons-based appliances because the refrigerant is flammable.

Development of HC Technologies under ECOFRIG

The earliest efforts to promote hydrocarbon technology were made by ECOFRIG. Phase I of the project focused on the conversion from CFCs to HCs (Cyclopentane) as the foam blowing agent for polyurethane foam, which is used for insulation. Two industrial-sized pilot foam blowing plants were installed at two different locations, one at Godrej, Mumbai and the other at Voltas, Hyderbad. This aroused interest in cyclopentane as a foam blowing agent. Today, a large number of industrial plants in developed as well as developing countries use cyclopentane as a foaming agent for domestic refrigerator manufacture.

Figure 1. Cyclopentane foam pilot-plant

Phase II introduced HC refrigerants as working fluids. In close co-operation with the industry, research institutions undertook R&D projects to develop HC blend-based systems for domestic as well as commercial refrigeration appliances. Godrej made its entire production facility HC-refrigerant compatible. Many medium-sized commercial refrigerator manufacturers also tried to adopt HC blend as the refrigerant. Efforts are being made to develop Isobutene hermetic energy efficient compressor technology, thus promoting HC600a as a future refrigerant for the domestic refrigeration sub-sector.

Figure 2: A manufacturing facility which uses HC blend for its frost-free refrigerators

Servicing of Domestic and Commercial Refrigeration Appliances using HC Refrigerant

HC-based appliances use servicing practices which are very similar to those of CFC12-based units, but they differ in that the HC refrigerant is highly flammable and therefore requires greater care in handling. The working area needs to be well ventilated. In addition, use a simple LPG gas alarm to monitor the HC concentration in the working area when venting and charging the system.

HIDECOR training covered, among other things, the safe practices to be adopted when servicing HC equipment.

To service HC refrigeration appliances properly and safely, adopt the following steps:

- *Safe venting of HC refrigerant from the system:* Run the compressor before using the piercing valve to open the system for venting. Make sure that the area in which the gas is to be vented is not close to an ignition source.
- *Removal of remaining HC refrigerant:* The system must be evacuated to remove the remaining HC refrigerant after venting. Preferably use a vacuum pump for this purpose. The evacuation should be done in a well-ventilated area.
- *Flushing of refrigeration system:* The refrigeration system should be flushed with dry nitrogen at a pressure of 5 bar. If wet cleaning is required, use Tetraethylene.
- *Replacement of refrigeration system components:* The methods used to service HC and CFC systems are very similar. The components can be unbrazed and brazed as required after ensuring no HC refrigerant remains in the system.
- *Use the appropriate electrical components:* If the electrical components are faulty and need to be replaced during servicing, they must be replaced with similar type of components (only sealed, or solid state, non-sparking components to be used).
- *Pressure testing:* The system should be pressure tested using dry nitrogen at a pressure 10 bar.
- *Leak testing:* This procedure can be carried out using soap solutions.
- *Evacuation:* The system must be evacuated to remove moisture and non-condensable gases such as air. Use of a two-stage rotary vacuum pump for evacuation is recommended. The vacuum should be a minimum of 500 microns or less.
- *Charging:* The HC refrigerant should be charged by weight. A weighing scale of minimum 2g least-count should be used for this purpose. Accurate charging improves the performance of the serviced equipment.
- *Sealing the process tube:* Pinch the process tube using pinching pliers or a pinch-off tool. Braze the tube keeping the pinching tool in position as is done in the case of CFC12 units.

Contact : Professor R S Agarwal, IIT Delhi
Email: rsarwal@mech.iitd.ernet.in

Update from Hindustan Refrigeration Stores

Following up on the Hindustan Refrigeration Stores (HRS) announcement that they have started importing Hydrocarbon refrigerants into India, clients are informed that the range offered in India is being sold under a different name. This is to avoid confusion during the importation of Hydrocarbons. The new names also describe the capability of each refrigerant:

- HR12, now called MINUS30, is used in the Pentacool range of refrigerators manufactured by Godrej. It is a direct replacement for R12 and R134a in most refrigeration systems and in auto air-conditioners. It is available in disposable cans of 170 gm, and will soon be available in 200 gm cans.
- HR22 now called MINUS50
- HR600A now called MINUS10
- HR290 now called MINUS40

HRS is also introducing the ERG range of lubricants, which can be used in all refrigeration systems—CFC, HCFC, Hydrocarbons, Ammonia, 134a, 404. These lubricants are virtually non-hygroscopic. In addition, HRS will also introduce a flushing agent, ERG UFA, which is compatible with all refrigerants and can be used for internal cleaning of refrigeration and air-conditioning systems.

HRS is also seeking applications from persons interested in the stocking and marketing of Hydrocarbon refrigerants. Interested applicants can approach HRS directly through:

Contact: Jaspal Singh
Email: higrop@ndb.vsnl.net.in

Mr COOL Tips

A Summary of all Tips published by Eco-Cool

Issue No. 2: March 2002
Charge the correct quantity of refrigerant by weight to optimize power consumption.

Issue No. 3: June 2002
HFC134a cannot be used to charge a CFC12 appliance - it would involve the replacement of compressor, filter drier and capillary.

Issue No. 4: Oct 2002
CFC refrigerators do not add to environmental pollution if functioning properly. Before dumping an old refrigerator, CFC gas must be recovered by a trained technician.

Issue No. 5: Dec 2002
For quality servicing practice, an accurate weighing balance must be used—ideally select LC of 0.5g.

Issue No. 6: March 2003
To save time and prevent wastage of refrigerant, after brazing, check for chokes in the system before evacuation and gas charging.

Issue No. 7: June 2003
When replacing capillaries in motor burn-out systems, insert a capillary of min. 1 inch length into the drier end. Make a small kink on the capillary end to ensure that only the required length is inserted to prevent choking.

Issue No. 8: Sept 2003
Flux is essential in brazing ferrous metals: it cleans the surface chemically and prevents oxide formation. Apply just enough flux on the male connections only. Otherwise, being corrosive, flux can cause leaks in joints.

Issue No. 9: Dec 2003
Before replacing a compressor for an oil pumping problem, check whether the defect is caused by contaminants due to bad service practices.

Issue No. 10: May 2004
Capillary Tubes if purchased from reputed manufacturers as per specification, and installed and maintained properly, can give optimum capacity in domestic refrigerators. *Eco-Cool* additional comments referred to the fact that refrigeration systems should operate at temperatures less than 300°F/150°C to avoid accelerating the chemical reactions, irrespective of the refrigerant used.

Issue No. 11: Sept 2004
Use a separate set of charging hoses, measuring still and refrigerant cylinders for each type of refrigerant to avoid cross contamination in a sealed system. If CFC12 and HFC134a are mixed, the discharge pressure will be much higher than that of either refrigerant individually, seriously affecting the appliance's performance. When using the same E&C and R&R units for different refrigerants, evacuate equipment before reuse.

Contact: Mr C.J. Mathew, Organizer for TC, Karnataka, Email: Cjmathew@vsnl.com

HIDECOR Achievements

HIDECOR trained more than 10,000 Micro and Small Enterprises (MSEs) technicians from the Refrigeration and Air-Conditioning sector to adapt to new, environment-friendly refrigeration technology by December 2004. The trainees were from the MSE domestic and commercial refrigeration service-sector.

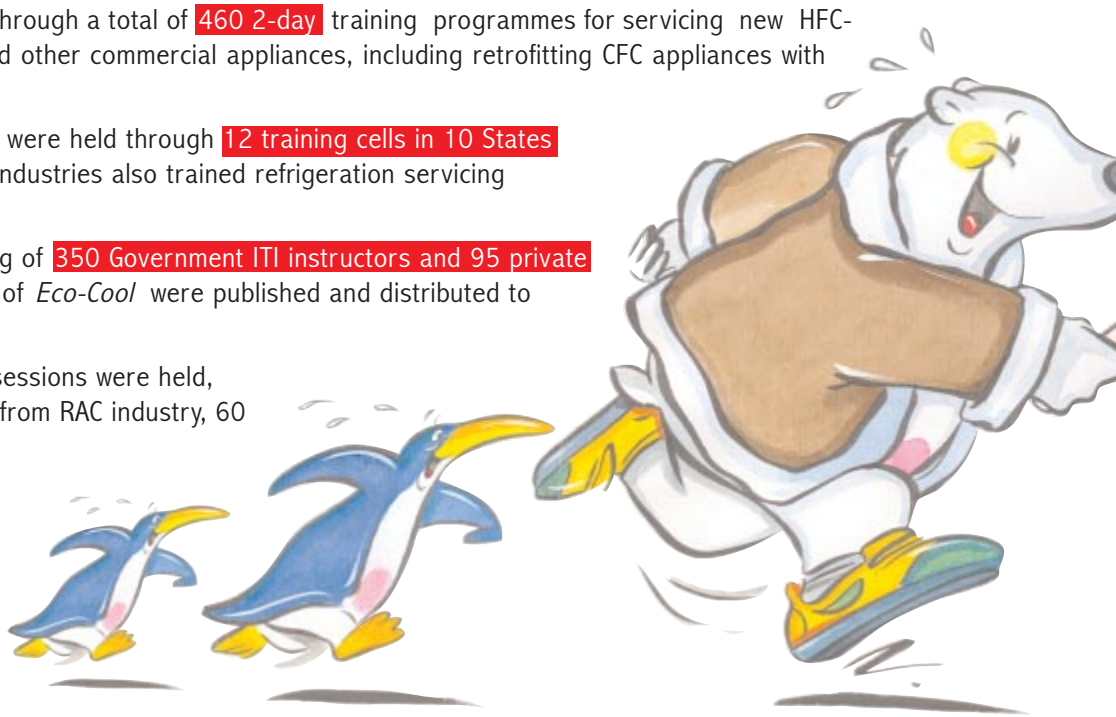
Information was disseminated through a total of 460 2-day training programmes for servicing new HFC- and HC-based refrigerators and other commercial appliances, including retrofitting CFC appliances with the new refrigerants.

HIDECOR Training programmes were held through 12 training cells in 10 States and 2 metropolises. Four RAC industries also trained refrigeration servicing technicians.

HIDECOR supported the training of 350 Government ITI instructors and 95 private ITI instructors. Twelve editions of *Eco-Cool* were published and distributed to more than 10,000 readers.

Six Training of Trainers (ToT) sessions were held, encompassing 91 trainers: 31 from RAC industry, 60 from training cells.

The Indigenous equipment developed included: E&C Unit by DewPoint Frigtools Recovery Unit by Dew Point.



HIDECOR operations were managed from the following office:

No. 6 & 8, Romain Rolland Street, Pondicherry
Tel: 0413-2227811, 2342488 E-mail: hidecor@itpi.co.in
Project Leader: Manfred Egger; Training Manager: Smita Vichare; Technical Resources: Butchaiah Gadde and Admin. Assistant: Amita Tiwari

Training partners under HIDECOR:

Chandigarh: Mr. Daya Singh, National Institute of Technology, C-22 Industrial Estate Phase II, Mohali/ Chandigarh - 160051, Punjab, Tel: 0172-390513 / 229468 Email: chandigarhozone@yahoo.co.in

Gujarat: Mr. Naranbhai M. Patel, Kirti Freeze, Kirti House, Ashirwad Complex (Opp. Bata Showroom), Ashram Road, Ahmedabad- 380009, Tel: 079-2658 04 66 Mobile: 94263 01242, E-mail: zeelpower@satyam.net.in

Maharashtra: Mr. Abraham Mathew, Maxcool Engineering, 2, Butte Patil Residency 363/5, Shivaji Nagar, Pune - 411005, Tel: 020-25534737, Mobile: 94220 11095 E-mail: maxcoolengg@yahoo.com

Electrolux Kelvinator Limited, Mr Ajay Mahajan, Global Buisness Park, 2nd & 3rd Floor, Mehrauli-Gurgaon Road, Gurgaon-122002, Tel: 0124-280 3250 E-mail: ajay.mahajan@notes.electroluxindia.com

Of the 12 TCs established under HIDECOR,

Andhra Pradesh: Mr. T. Veerender Nath, Maega Services, 3-3-780/B, Kuthbiguda, Esamia Bazaar Hyderabad - 500027, Tel: 040 - 24653602 Mobile: 98492 03750 E-mail : tvnath@rediffmail.com

Delhi: Mr.Jaspal Singh, Hindustan Refrigeration Stores, 2,4 & 5 Nethaji Subhash Marg, Darya Ganj, New Delhi -110002, Tel : 011- 23271898/ 23259650 Mobile: 98100 19794 E-mail : higrop@ndb.vsnl.net.in

Karnataka: Mr. C. J. Mathew, Dewpoint Services 808 10th A main, 1st stage, Indira Nagar, Bangalore - 560038, Tel: 080-25299325 Mobile: 98450 70594 Email: cjmathew@vsnl.com

Kerala: Mr. D. Sivaprasad, Essem Engineers, 28/890-A S.A. Road, Kadavanthra, Kochi - 682020, Tel: 0484 - 2305788 Mobile: 94473 25455 E-mail: essemcochin@sify.com

Uttar Pradesh: Mr.Rajesh M. Misra, Isha Enterprises B-1/56, Sector - B, Aliganj, Lucknow - 226024 Tel : 0522 - 2330578 Mobile: 94150 24423 E-mail : rajeshm@kircop.com

Rajasthan: Mr.Surendra Bohra, Bohra Services 60 Gem Enclave, Pradhan Marg, Malviya Nagar Jaipur-302017, Tel: 0141-2522400 Mobile: 94140 66848 E-mail: bohra@bohraappliances.com

National CFC Consumption and Phase-out Plan (NCCoPP)

Aims to:

- encourage good servicing practices for CFC-based appliances;
- target high CFC-consuming firms (more than 50 kg of CFC/annum);
- cover other sub-sectors besides domestic and commercial refrigeration;
- extend the geographical coverage for training (moving from the South and West to include the North and East regions).

Training needs:

- best practices in servicing of Mobile Air-Conditioning (MAC);
- retrofitting for large commercial appliances using open-type compressors;
- retrofitting for domestic and small commercial appliances;
- "Recovery & Recycling" (R&R) of CFC refrigerants

Training will focused on the following groups:

- railways as a key institutional user of CFC refrigerants in retrofitting of CFC-based equipment.

Ms Usha Chandrasekhar, has relinquished her position as Director of Ozone Cell and handed over charge to Dr A Duraisamy. NCCoPP acknowledges Ms Chandrasekhar's contribution and welcomes the new Director.

Dr A. Duraisamy, Director (Ozone Cell), Ministry of Environment & Forests, Government of India, Tel : 91-11- 2464 2176, Fax: 91-11-2464 2175
Email: ozone@del3.vsnl.net.in

Southern and Western Regional Management Organization:
IT Power India Pvt. Ltd., Ms. Smita Vichare, No. 6 & 8, Romain Rolland Street, Pondicherry - 605 001, Phone: + 91- 413 - 2227811, 2342488, Fax: 2340723
Email: nccopp@itpi.co.in Website: www.nccopp.info

Northern and Eastern Regional Management Organization:
Quest Consulting and Training, Mr. V. Subramaniam, E9, Vasanth Apartments, 100 ft Velachery Bypass Road, Velachery, Chennai - 600 042, India
Phone: + 91-44 - 55469764, 22591942 Fax: 22591764, Email: questvs@vsnl.net

the following will provide training under NCCoPP

Tamilnadu: Mr. Sabapathi Kanaga, Siva Refrigeration 94M/11- C.M.-D.A. Manali New Town, Chennai 600103, Tel: 044-25930842 E-mail : skssaba@yahoo.co.in

West Bengal: Mr.Navin Lamba, Crystal Refrigeration Company 7, A.J.C Bose Road, Kolkata - 700017
Tel: 033 - 22476488 Mobile: 98308 20848
E-mail: nl@vsnl.net

Industry Training Partners:

Godrej & Boyce Mfg Co. Ltd. (Appliance Division): Mr S A Juvekar, L.B.S.Marg, HO Service, Plant 11, Pirojsha Nagar, Mumbai - 400 079,
Phone: 022-55966603/23 Email: saj@godrej.com

Kirloskar Copeland Ltd., Mr.V. G.Sardesai, 1202/1, Ghole Road, Pune - 411005 Maharashtra,
Tel: 020 - 25520802 / 25521860 E-mail: sardesai@kircop.com

Whirlpool of India Limited Mr. A. Natarajan, 28, N.I.T., Faridabad - 121001, Haryana
Tel: 0129 - 2231781 / 2441331
Mobile: 98100 14504
E-mail: a_natarajan@email.whirlpool.com

New NCCoPP Training Partners:

Assam: Mr. D.Talukdar, Kuwality Coolers, Das Complex, R.G.Barua Road Guwahati - 781024, Tel: 0361-2202229 Mobile: 98640 17889
E-mail : kuwalitycoolers@ rediffmail.com

Bihar: Bro. S.G Sebastian Joseph, Principal - Loyola Industrial School, Kurji, Patna - 800010, Tel: 0612 - 2262746 Mobile: 94310 21743
E-mail: loyaliti@sancharnet.in

Chandigarh: Mr. A Kumar, Anant Enterprises, 5397/1, Modern Residential Complex, Manimajra, Chandigarh -160101, Tel: 0172 - 2735163
Mobile: 94173 33569, E mail: chandigarhozone@yahoo.co.in

Madhya Pradesh: Mr Arun Mishra, Divyansh Services, LG 6, Mourya Centre, 16 Race Course Road, Indore - 452008 Tel: 0731 - 5069881/5069882
Mobile: 98931 21261 E-mail: arunmishra71@ hotmail.com

Orissa: Mr L. N. Dash, B-12,BJB Nagar, Bhubaneswar-751014
Tel: 0674 - 2435280 Mobile: 94370 82401, E-mail: lndash@rediffmail.com

Awareness and Policy Support for Refrigeration Technicians

In most developing countries, domestic refrigerators and airconditioners are not easily discarded, but remain in use in the households for many years. India is no different. Today, India has an estimated 20 million CFC-based refrigerators that will potentially need servicing. Refrigeration service technicians play a crucial role in ensuring the usability and longevity of these appliances. They are particularly important players in the fight to preserve the ozone layer.

UNEP, in collaboration with partner organizations and the Ozone Cell, is leading the way in communicating the message of ozone protection and raising awareness of refrigeration service technicians in India. Technicians for servicing household refrigerators and airconditioners in India now have in UNEP and their national partner IT Power India (ITPI), a friend to assist them in raising their awareness levels and thereby support India's compliance with the Montreal Protocol.

In March 2004, the Multilateral Fund approved a project for the Government of India, as a final step, to complete the phase-out of CFC consumption, especially in the refrigeration servicing sector, by 2009. Working together to meet this target, the Governments of Germany and Switzerland, and UNDP, UNIDO and UNEP designed a strategy to include training of technicians in good practices, provide support for new equipment to allow upgrade of service shops, increase awareness to ensure their commitment, and guarantee strong policies to enforce the phase-out with government support.

Three workshops have already been completed in Hyderabad, Bangalore and Chennai to present a scheme to assist service technicians in accessing new equipment (see p.13). A total of over 230 refrigeration servicing firms participated. The first of nine meetings with dealers was recently held in Chandigarh with sixty participants, followed by a meeting in Jaipur and Indore. These workshops publicize the training programmes and request the support of dealers, considered a vital link to recruit technicians for training, and spread the word about ozone protection.

The awareness raising element of the project also informs dealers that it makes good business sense to move towards ozone-friendly service equipment. UNEP and the national partner will work with the general public to broaden the constituency needed for India's full compliance with the Montreal Protocol.

Meanwhile, to respond to concerns raised on the quality of regulatory enforcement in the country to support these phase-out measures, UNEP has also put in place a mechanism to train customs and enforcement officers. This will strengthen the regulatory support for the Government of India. This component advocates training as an approach to build capacity of local stakeholders, Government and customs officers through regulations enforcement and policy training. One innovative characteristic of this project is the development of an online training system, which will allow a broader audience to participate in the programmes developed.

Working hand-in-hand with the technicians and the dealers is the only way this project will be successful. Through this communication and policy programme, it is hoped that the initial enthusiasm generated by HIDECOR's work will be sustained.

Contact: Cecilia Mercado,
Programme officer, UNEP ROAP, Bangkok
Email: mercadoc@un.org

Five implementing agencies share the responsibility for implementation of the National CFC Consumption Phase out Plan (NCCoPP) for India. The Government of Germany as the lead agency, through GTZ, is responsible for the overall project management, including monitoring and evaluation and management support to the Government of India. They will also look after the development of a website for the project. Currently, a Project Management Unit (PMU) for the project has been established, which manages the daily project activities. The PMU is based in New Delhi.

The Government of Switzerland, through INFRAS, ensures that the training of service technicians through the training cells established in thirteen states runs smoothly. Benefiting from the experiences of the recently completed HIDECOR project, INFRAS has identified four new training cells, and will commence the training programmes in early 2005.

The equipment investment aspect of the project is being handled by UNDP, who oversees the procurement under the Equipment Support Scheme (ESS), which provides a grant to accredited and qualified service technicians of up to forty percent of the cost of new equipment required to meet better servicing standards.

Transport refrigeration is also a big CFC user in the country. UNIDO's experience with the industrial sector makes them the ideal partner for supporting activities in this sector.

UNEP is assisting with the awareness and policy and customs training component. These activities will support the efforts of the other partner organizations.

Training under NCCoPP: An Overview

Scope of Training under NCCoPP

Both HIDECOR and NCCoPP share the common objective of strengthening the national RAC service sector's capabilities to cope with the CFC phase-out. However, certain important features will distinguish training under NCCoPP from that of its predecessor, HIDECOR. Training under HIDECOR was primarily aimed at the skill development of smaller CFC consumers of MSEs, and focused on non-CFC technologies in the domestic and commercial refrigeration service sector.

The training under NCCoPP will focus on:

- good servicing practices for CFC-based appliances;
- high CFC-consuming firms (more than 50 kg of CFC/annum);
- other sub-sectors besides domestic and commercial refrigeration;
- extending the geographical coverage for training to maintain equity between States and regions (primarily moving from the Southern and Western regions to include the Northern and Eastern regions of the country).

Under HIDECOR, the training is mainly oriented towards best practices in servicing, which include aspects such as brazing/debrazing, flushing, leak testing, evacuation and charging of refrigerants using proper tools and equipment. While a substantial part of the target group requires this training, the following additional training needs and groups have been identified to be covered through NCCOPP:

a) best practices in servicing of Mobile Air-Conditioning (MAC);
b) retrofitting for large commercial appliances using open-type compressors;
c) railways as a key institutional user of CFCs in retrofitting of CFC-based equipment;
d) retrofitting for domestic and small commercial appliances;
e) "Recovery & Recycling" (R&R) of CFC refrigerants.

Training Approach: Standard Case

The HIDECOR model of training will be used for the standard training for best servicing practices in the domestic and small commercial refrigeration sub-sector with requisite adaptations. The existing training cells under HIDECOR are being transferred to NCCOPP, and additional training cells have been identified in the new States. An important difference from HIDECOR is that priority will be given to large CFC-consuming firms. To reflect this important difference, the term MSET (Micro and Small-Enterprise Training Institute) used under HIDECOR has been re-designated as RSET (Refrigeration Service Enterprise Training Institute). In the HIDECOR geo-focus area, "brush-up" training programmes will be organized in selected cities to provide an opportunity to large CFC-consuming firms, which were not eligible or did not participate in the HIDECOR training programmes earlier. New training cells have been established in the States of Assam, Bihar, Madhya Pradesh and Orissa; some of these cells will also cover training in Jharkhand, Chhatisgarh and Uttaran-chal. A majority of the programmes in each state under NCCOPP will be outreach programmes.

Best Practices for MAC

The MAC sub-sector was not covered by HIDECOR, although the 1992 ORG study provided information on the sector. A pilot phase for MAC training will be taken up, in which two dedicated training cells for MAC will be established, one at Jaipur and the other in one of the metros. The training cells located in the larger metros (Delhi, Mumbai, Kolkata, Chennai) may be required to prepare themselves to impart training in MAC. On the cards, is a manual on servicing practices and retrofitting of CFC-based MAC with HFC134a, from which the training material will be adapted. Trainers for MAC will be identified and trained through a ToT.

Retrofitting for Large Commercial Appliances using Open-Type Compressors

Best practices in retrofitting appliances using non-CFC refrigerants, and servicing of the retrofitted equipment will be covered in the training. Some pilot training activities will be initiated with the support of manufacturers of open-type compressors. In due course, a dedicated training cell may be established to train only for refrigeration systems based on open-type compressors.

Railways as a Special Category of Institutional Users

Institutional users like the railways consume CFC to service existing air conditioning equipment for railway carriages. It is proposed to conduct training programmes for railway servicing technicians in retrofitting of such equipment with alternative refrigerants. The training package will be specially designed for the railways.

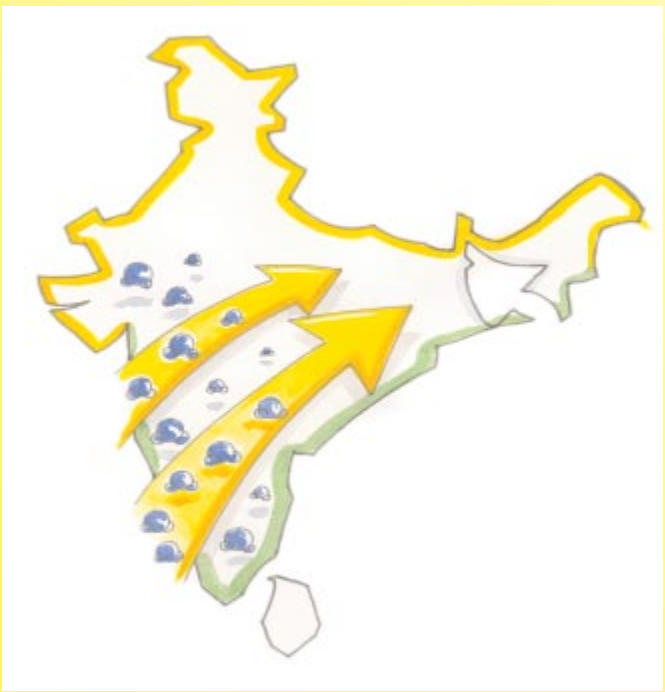
Retrofitting of Domestic and Small Commercial Appliances

The training programme also covers retrofitting of domestic and small commercial appliances with alternative refrigerants. However, owing to easy availability of CFCs at present, the servicing firms need to do very little retrofitting work. But from 2006 onwards, retrofitting is likely to become an important area of business for such firms. It is estimated, for example, that there will be 19 million CFC refrigerators left still in use in 2010, which will need retrofitting. Refresher training in retrofitting may well be taken up by the training cells and/or industry from 2010 onwards for selected service technicians who had earlier undergone standard training.

R&R of CFC Refrigerants

R&R will be relevant for sub-sectors in which the charge quantity of CFC refrigerants is quite substantial, and/or where large quantities are handled at one location. Training in R&R will therefore be an option from 2006 onwards for MAC and large commercial appliances.

Contact: Dr. Surinder Batra, CIMI
Email: rsarwal@mech.iitd.ernet.in



What future for training cells in the south?

Training under NCCoPP is progressively moving towards the Northern and Eastern States. As a result, there is some concern that technicians in the South will not have ready access to training as was available under HIDECOR. In order to exploit the already existing resources and capacity which has been built in the Southern and Western States, some training cells may continue to provide the standard training to RAC servicing workshops in the States covered under HIDECOR. The technicians would have to pay the full cost of training; the trainers would be those trained under HIDECOR; training material and certificates would be provided; and the monitoring of such programmes would also be undertaken.

One such workshop 'CFC Phase-out and Handling HFC/HC Refrigerants' was successfully conducted by HIDECOR trainers on 6 November 2004 at Anna University, Chennai, jointly with ISHRAE. Eighteen participants registered, by paying a registration fee of Rs.1250 each. The 2-day HIDECOR programme was compressed into a single day to meet the trainees' requirements. The sessions (including practicals) covered HFC and HC refrigerants. HIDECOR provided copies of the Handbook in Tamil.

NCCoPP: New Training Partner

A new Regional Management Organization (RMO) has been put in place to manage all training cells dispensing training to the North and East of India. The RMO is Quest Consulting & Management based in Chennai, and managed by Mr V. Subramaniam, ex Godrej Vice President & Business Head. Mr Subramaniam will be managing the training cells in the following States: Assam, Bihar, Chandigarh, Delhi, Madya Pradesh, Orissa, Rajasthan, Uttar Pradesh, West Bengal. They will be providing training under NCCoPP over the next 5 years.

Contact: Quest Managing & Consultant Email: questvs@vsnl.net

Contact: Dr Mohan Lal, Assistant Professor, R & A/C Division, Dept of Mech. Engg., Anna University, Chennai
E-mail: dmlalcryo@hotmail.com

First ToT for NCCoPP

The first Training of Trainers (ToT) under NCCoPP was held from 6th to 10th Dec. 04. There were 12 participants from the 4 new states covered under NCCoPP: Assam, Bihar, Madhya Pradesh and Orissa. The lead faculty was Mr Iyer with Mr Juvekar and other trainers from Godrej & Boyce. The programme was held at Godrej & Boyce Mfg Co. Ltd. Mumbai.

The ToT was conducted on similar lines to that of HIDECOR. An NCCoPP certificate was issued to all trainers to certify their ability to facilitate at future training programmes organized at their training cells. These programmes will be monitored by the project.

Contact: S A Juvekar, Godrej & Boyce Ltd: Email: saj@godrej.com

Equipment Support Scheme

For CFC phase-out in the servicing sector, it is critical that selected Refrigeration Service Enterprises have access to service equipment. A dedicated Equipment Support Scheme (ESS) has been put in place to facilitate RSEs to adopt good servicing practices through upgrading their tools and equipment. Selected RSEs will receive subsidy benefits up to 60% supported by the project. The call to refrigeration service enter-prises is a part of a public process mandated to IT Power India. Initially, this scheme is applicable only to RSEs in the States of Andhra Pradesh, Karnataka, Tamilnadu and Pondicherry, but later in the project will become available in all States where training is offered.

Equipment & Cost

The following equipment packages will be made available to selected firms on a first-come-first-served basis. UNDP will be the lead agency for this activity.

Package	Description of the items included in the package	Estimated cost (Rs)	Amount to be paid by the RSE (Rs)
A	E & C unit with weighing scale + Hoses and 2 piercing valves	20,000	8,000
B	E&C unit having 4-way manifold and gas ballast on vacuum pump, with weighing scale + hoses and other accessories/spares + 2 piercing valves	32,000	13,000
C	Same as B above + a simple recovery unit	48,000	20,000

Eligibility

The applicant who submitted an Expression of Interest had to:

- be an RSE servicing CFC12-based domestic and commercial refrigeration appliances.
- not have received ESS benefits under any other scheme.
- have already undergone training under HIDECOR or ensure participation in training under NCCoPP.

No firm consuming less than 50 kg of CFC12 annually could be considered for the scheme.

To publicize and promote the scheme, three workshops were held in Chennai, Hyderabad and Bangalore in November 2004, during which the scheme was explained to RSEs. They could either sign up for the scheme at the workshop or send their EoI to the State Facilitator (SF).

Summary of the Three Workshops

Despite heavy rains, which delayed the start of the programme, a total of 41 EOIs were received at the Chennai workshop by the SF, Kanaga Sabapathy. The participation at the at the Bangalore workshop was less encouraging, with only 30 participants. The SF totally received only 20 EOI forms at the end of the workshop. The Hyderabad ESS workshop was preceded by a press meeting. The event received fairly good coverage in the regional and national press. Around 170 participants attended the workshop, with 80 of them submitting EoI forms.

Subsequently, the SF validated the EoIs with each interested party, and solicited further interest in individual interviews. As a result, by 20 November, EoIs had been registered for 188 firms from Andhra Pradesh, 136 from Tamil Nadu and 43 from Karnataka.

All information on present and future ESS can be obtained from IT Power India Pvt Ltd on behalf of the Ozone Cell MoEF, GTZ and UNDP.

Contact: Butchaiah Gadde,
IT Power India Private Limited
Email: nccopp@itpi.co.in
Website: www.nccopp.info

Alternative Refrigerants—The future scenario

CFCs and HCFCs have been used in refrigerators and air conditioners as working refrigerants as well as blowing agents in foam. These man-made chemicals harm the environment through ozone depletion and global warming. A large number of alternatives have been developed to replace these refrigerants. Most of them are derived from the HFC family. Table 1 shows the environmental characteristics of commonly used CFCs and their alternatives. HFCs, with relatively high GWP, constitute only a temporary solution; extensive research and innovation are under way to identify permanent solutions. Appropriate solutions may be found through further research into low GWP fluids like natural refrigerants, and improved energy efficiency of the refrigeration appliances and equipment.

Table 1: Environmental characteristic of commonly used refrigerants

Refrigerant		Atmospheric Lifetime (Years)	ODP	GWP (100 Years)
CFC	CFC-11 (Baseline ODP)	50	1	4000
	CFC-12	102	1	8500
CFC Blend	R-502		0.33	5260
HCFCs	HCFC-22	13.3	0.055	1700
	HCFC-123	1.4	0.02	93
	HCFC-141b	9.4	0.11	630
HFCs	HFC-134a	14.6	0	1300
	HFC-245fa	7.3	0	820
Natural	HC-290 (Propane)	-	0	3
Fluids	HC-600a (Isobutene)	-	0	3
	Ammonia (R717)		0	0
	Water (R718)		0	<1
	CO2	-	0	<1
HFC Blends	R-404A	-	0	3260
	R-407A	-	0	1770
	R-407C	-	0	1530

Note: *ODP: Ozone Depleting Potential. GWP: Global Warming Potential. Natural Refrigerants: Potential Low GWP*

In recent years, the R&D institutions and industry have been looking for engineering solutions to utilize natural fluids as refrigerants.

Some of the efforts are described in the following paragraphs.

HC Refrigerants

Isobutene and Propane

Of the HC refrigerants, Isobutene and propane have the most potential. In spite of their flammable characteristics, these refrigerants are acceptable in various applications, in both developed and developing countries, as an alternative to CFC12 in domestic refrigeration and stand-alone commercial refrigeration appliances. Their use has also resulted in increasing the energy efficiency of the appliances.

Ammonia (R717)

Ammonia is an excellent, environmental-friendly refrigerant due to its favourable thermodynamic, thermo-physical and environmental properties. Although toxic and flammable, considerable R&D has helped develop low-charge ammonia technology, which is quite safe and can be used even in applications like comfort air-conditioning. Its uses in cold storage and food processing systems are known to be more efficient than similar systems with CFCs or HCFCs. However, ammonia is not suitable for small systems, such as household appliances.

Carbon Dioxide (R744)

Carbon dioxide is one of the most promising environment-friendly, natural working fluids in refrigeration systems since it has zero ODP and negligible GWP (1). The refrigeration cycle based on CO_2 is operated as a trans-critical cycle, where the heat is absorbed at constant temperature in a traditional evaporator, but rejected at a pressure above the critical point. There is no phase change during heat rejection, so a gas cooler is used instead of a condenser. The volumetric refrigerating capacity of CO_2 is about five times that of R22, which allows smaller system components. As CO_2 has relatively high vapour pressure due to its low critical temperatures, it leads to higher compressor efficiency and heat transfer coefficients.

The main disadvantage of CO_2 as a refrigerant is its inherent high working pressure, which would require more robust system components.

Recently, this cycle has been applied to small commercial refrigeration appliances like vending machines and double-door bottle coolers. Initial feedback shows that energy saving is of the order of 37% in the case of the vending machines and 18% in the case of the bottle coolers compared to HFC134a.

Challenges Ahead

Environmental concerns dictate the selection of a refrigerant: for it to qualify, the refrigerant should have zero ODP and low GWP. The global warming effect is produced for two reasons: (1) directly, due to emission of refrigerants; and (ii) indirectly, due to emission of CO_2 linked to energy generated through combustion of fossil fuels. Indirect global warming depends largely on the efficiency of the refrigeration systems and the electricity production methods. Table 2 displays the direct and indirect global warming contributions of some of the refrigeration sub-sectors.

As can be seen, the indirect effect is greater than the direct, in particular with refrigerators and commercial refrigeration appliances. The challenge before the industry is therefore to improve the energy efficiency of appliances and equipment while adopting/converting the manufacturing facilities to alternative refrigerants. India is actively considering implementation of the energy labelling system, which will enable industry to improve product quality.

Contact:
Prof. R S Agarwal, IIT Delhi.
Email: rsarwal@mech.iitd.ernet.in

Table 2: Direct and Indirect GWP in Different Applications (%)

Application	Refrigerator	Automotive	Commercial A/C	Unitary A/C	Water Chiller
Direct GWP	4	30	44	10	1
Indirect GWP	96	70	56	90	99

(Source IIR conference, Delhi 1998, pp 16-27)

Book Post

NCCoPP Training Events

Training Cell	Scheduled Dates	State	Location
Whirlpool	1 - 2 Dec 04	Madhya Pradesh	Indore -
RMO North	11 -12 Dec 04	Rajasthan	Jaipur
Godrej	14 -15 Dec 04	Madhya Pradesh	Indore
Whirlpool	15 -16 Dec 04	Uttar Pradesh	Gaziabad
KCL	19 -20 Dec 04	Uttar Pradesh	Lucknow
RMO South	16 -17 Dec 04	Kerala	Calicut
Godrej	17 -18 Dec 04	Madhya Pradesh	Bhopal
RMO South	18 - 19 Dec 04	Andhra Pradesh	Cuddappah
RMO South	11 - 12 Dec 04	Andhra Pradesh	Hyderabad
RMO North	11 -12 Dec 04	Rajasthan	Jaipur
Godrej	20 - 21 Dec 04	Chhattisgarh	Raipur
RMO North	24 - 25 Dec 04	Uttar Pradesh	Kanpur
RMO South	28 - 29 Dec 04	Kerala	Calicut
RMO South	08 - 09 Jan 05	Karnataka	Bangalore
RMO North	08 - 09 Jan. 05	Punjab	Mohali
RMO North	08 - 09 Jan 05	Rajasthan	Ajmer/Alwar
RMO North	09 - 10 Jan 05	Delhi	Delhi
RMO North	09 - 10 Jan 05	West Bengal	Malda
RMO North	13 - 14 Jan 05	Uttar Pradesh	Bareilly
Godrej	14 - 15 Jan 05	Rajasthan	Jaipur
RMO North	15 - 16 Jan 05	Madhya Pradesh	Indore
Godrej	17 - 18 Jan 05	Rajasthan	Ajmer
RMO North	17 - 18 Jan 05	Assam	Guwahati
Godrej	20 - 21 Jan 05	Rajasthan	Kota
RMO North	22 - 23 Jan 05	Uttar Pradesh	Allahabad
RMO North	22 - 23 Jan 05	Bihar	Patna

Training Cell	Scheduled Dates	State	Location
RMO North	25 - 26 Jan 05	Uttar Pradesh	Varanasi
RMO North	29 - 30 Jan 05	Rajasthan	Bilwara/ Bikaner
RMO North	29 - 30 Jan 05	Orissa	Bhubaneshwar
RMO North	29 - 30 Jan 05	West Bengal	Siliguri
RMO North	05 - 06 Feb 05	Delhi	Delhi
RMO North	05 - 06 Feb 05	Madhya Pradesh	Bhopal
Godrej	05 - 06 Feb 05	W Bengal	Siliguri
RMO North	05 - 06 Feb 05	West UP/Uttranchal	Dehradun
RMO North	08 - 09 Feb 05	West UP/Uttranchal	Haridwar
Godrej	08 - 09 Feb 05	W Bengal	Malda town
RMO South	12 - 13 Feb 05	Tamilnadu	Chennai
RMO North	12 - 13 Feb 05	Bihar	Patna
RMO North	12 -13 Feb 05	Rajasthan	Bharatpur
RMO North	14 - 15 Feb 05	Uttar Pradesh	Jhansi
RMO North	19 - 20 Feb 05	Assam	Guwahati
RMO North	19 - 20 Feb 05	Orissa	Cuttack
RMO North	19 - 20 Feb 05	West Bengal	Burdwan
Godrej	23 - 24 Feb 05	Orissa	Bhubaneswar
Godrej	26 - 27 Feb 05	Orissa	Rourkela
RMO South	26 - 27 Feb 05	Pondicherry	Pondicherry
RMO North	26 - 27 Feb 05	Madhya Pradesh	Indore
Godrej	05 - 06 Mar 05	Uttar Pradesh	Lucknow
Godrej	08 - 09 Mar 05	Uttar Pradesh	Kanpur
Godrej	11 - 12 Mar 05	Uttaranchal	Dehradoon
RMO North	19 - 20 Mar. 05	J & K	Jammu

Dates for NCCoPP training programmes for 2005 will be available at http://www.nccopp.info or can be obtained by emailing nccopp@itpi.co.in

Published by HIDECOR. For all correspondence write to: ECO-COOL™, IT Power India Pvt. Ltd.
No. 6 & 8, Romain Rolland Street, Pondicherry 605001. Tel: 0413-2227811 or 2342488. E-mail: tpm@itpi.co.in

HIDECOR PARTNERS & MEMBERS

- Ministry of Environment and Forests, (MoEF), Govt of India
- Directorate General of Employment and Training (DGET)
- Swiss Agency for Development and Co-operation (SDC)
- Indian Institute of Technology, Delhi (IIT D)
- National Chemical Laboratory (NCL)
- Appliance Manufacturing Industry, (Godrej/Whirlpool/Electrolux)
- Compressor Manufacturing Industry (Kirloskar Copeland/Tecumseh Products India Ltd.)
- Government and Private ITIs
- Universities and Engineering Colleges
- Financial Institutions
- Consultants (CIMI, R.S. Iyer)
- Organizers and Recruiters for training
- The target group: MSE Technicians

Managed and Facilitated by
The Swisscontact - IT Power India Consortium
Supported by Swiss Agency for Development and Co-operation in collaboration with Ozone Cell, Ministry of Environment and Forests, Government of India

ECO-COOL NEWSLETTER TEAM

Editorial direction & materials compilation: Maurice Shukla, Padmini Menon & Teresa Marston
Technical advisors and editorial committee: Prof. R.S. Agarwal, IIT Delhi, Mr Raghavan, Kirloskar Copeland, Mr R.S. Iyer, Mr C.J. Matthew
Produced by: IT Power India Pvt. Ltd.
Illustration: Emanuele Scanziani
Layout and design: IT Power India, Pondicherry
Translations: Shakthi Laser Graphics, Chennai
Revisions managed by: Maurice Shukla, Padmini Menon
Printed by: Aaral Graphics, Chennai