SPREP

# Pacific Ozone Depleting Substances (ODS) Project

A close collaboration
between UNEP and the Government of Australia under the Multilateral Fund
Secretariat, SPREP, and the Pacific islands

South Pacific Regional Environment Programme

## Report of the Train-the-Trainers Workshop on Good Practices in Refrigeration Funafuti, Tuvalu

12 - 16 August, 11 November 2003

Public Works Department
Funafuti, Tuvalu

February 2004

**SPREP's Climate Change and Adaptability**

**Key Result Area III (KRA 3)**

# Report on the Train-the-Trainers Workshop on Good Practices in Refrigeration

# Funafuti, Tuvalu

## 12 - 16 August, 11 November 2003
## Public Works Department
## Funafuti, Tuvalu


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## Acronyms & Terms

| | |
|---|---|
| CFCs | Chlorofluorocarbons |
| DTIE | Division of Technology, Industry, and Economics |
| ExCom | Executive Committee of the Multilateral Fund |
| HCFCs | Hydrochlorofluorocarbons |
| HFCs | Hydrofluorocarbons |
| IRHACE | Institute of Refrigeration Heating and Air-Conditioning Engineers (IRHACE) Industry Training Charitable Trust (Inc.), |
| MIT | Manukau Institute of Technology |
| NCAP | National Compliance Action Plan |
| NCC | National Compliance Centre |
| ODS | Ozone Depleting Substances |
| PICs | Pacific Island Countries |
| PWD | Public Works Department |
| ROAP | Regional Office for Asia and the Pacific |
| SPREP | South Pacific Regional Environment Programme |
| UNEP | United Nations Environment Programme |
| UNON | United Nations Office at Nairobi |
| UV-A | Ultraviolet A radiation |
| UV-B | Ultraviolet B radiation |

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## EXECUTIVE SUMMARY

The train-the-trainers programme on "Good practices in refrigeration" is part of a comprehensive approach to reduce the ODS consumption in the refrigeration servicing sector in the Pacific region. Training programmes in "Good practices in refrigeration" were approved for the eight core countries involved in the "Regional Strategy to Comply with the Montreal Protocol (The RS) in Pacific Island Countries". The eight countries in the Regional Strategy are the Federated States of Micronesia (FSM), Kiribati, the Marshall Islands, Palau, the Solomon Islands, Tonga, Tuvalu and Vanuatu. The Regional Strategy was approved at the 36th Meeting of the Executive Committee. The South Pacific Regional Environment Programme (SPREP) is responsible for the implementation of the Regional Strategy in the Pacific region, with the assistance and oversight of United Nations Environment Programme Division of Technology, Industry and Economics (UNEP-DTIE) and United Nations Environment Programme Regional Office for Asia and the Pacific (UNEP ROAP).

The train-the-trainers workshop in Tuvalu was the third workshop of its kind in the PIC region, as part of the implementation of the RS. The main objective of the training programme is to reduce the CFC consumption in the refrigeration and air-conditioning sector in Tuvalu and to assist the country to comply with the phase-out schedule for CFCs under the RS and the Montreal Protocol. The trained participants are expected to train the remaining service technicians in the refrigeration and air-conditioning sector in Tuvalu. The long term expected result of the training programme is to enhance good service and technical practices in the refrigeration sector assisting the sector to switch over to non-CFC equipment in a smooth way without causing any unnecessary burden to the consumers. The training programme drew resources from the Tuvalu Government's Department of Environment, and the South Pacific Regional Environment Programme (SPREP). Due to the delay in arrival of equipment to Tuvalu, the train-the-trainers workshop was held in two parts. The first part (Part 1) consisted of theory and a small amount of practical training and was conducted by a trainer provided by the New Zealand Institute of Refrigeration, Heating and Air-Conditioning Engineers (IRHACE) Industry Training Charitable Trust (Inc.). The second part of the workshop (Part 2) covered practical sessions and was conducted by a trainer provided by Kirby Refrigeration Limited who is the current supplier of equipment to the eight core countries.

Mr Bill P Teo, the Acting Senior Assistant Secretary for the Office of the Prime Minister for Tuvalu opened the workshop on behalf of the Tuvalu Government. During the train-the-trainers workshop, twelve professionals from industry and service workshops were trained on "Good practices in refrigeration". The participants represented all refrigeration workshops in Funafuti.

The participants in the workshop were trained on "Good practices in refrigeration" during the course. The workshop included lectures on the harmful effects of ozone layer depletion and the resulting increase of UV-A and UV-B radiation, the Montreal Protocol and its Amendments as well as lectures on CFC, HCFC, HFC and non-Fluorocarbon refrigerants, recovery equipment and preventive maintenance practices. Lectures on retrofitting and future technological developments in the refrigeration sector were also included. Although held at a later date, hands-on demonstrations with recovery equipment using actual refrigeration units in need of recharge and maintenance were conducted as part of the training workshop. During the sessions, time was allocated to encourage discussion and feedback of the content, technological changes and methodology used. This was later formally reviewed through an evaluation sheet indicating the acceptance of the methodology and content of the training.

After the successful completion of the workshop, all participants passed a written examination and will receive a Certificate of Participation and an Identification Card from IRHACE and the Government of Tuvalu.

## Contents

# 1 Introduction

Tuvalu is comprised of nine small islands, six of them being atoll islands (with lagoons) namely Nanumea, Nui, Vaitupu, Nukufetau, Funafuti, and Nukulaelae. The remaining three, Nanumanga, Niutao and Niulakita are raised limestone reef islands. None of the islands are more than three metres above sea level, with the biggest island, Vaitupu, having a land area of just over 1000 acres. The total land area is approximately twenty-six square kilometres with a sea area of 900,000 square kilometres. During the pre-independence period, 1938 – 1978, Tuvalu was a British Colony called the "Gilbert and Ellice Islands Colony (GEIC). The islands are located between latitudes 5 degrees and 11 degrees south of the equator and between longitudes 176 degrees and 179 degrees east of Greenwich. To the north, about 1400 km is the Republic of Kiribati and to the south, 1100 km is the Republic of Fiji.

The dispersed nature of the islands, its isolation from markets, its tiny landmass, a small population and a narrow resource base are the major constraints that have restricted Tuvalu's economy. Despite all these economic disadvantages, government is funded through aid money, revenue collected from direct taxes, custom duties, philatelic sales, licensing fees for foreign fishing vessels plus revenue generated from the Tuvalu Provident Fund (TPF). During 1994, the Gross Domestic Product (GDP) stood at AUD $15.6 million and is slowly increasing at 1.3% per annum.

About 80 % of the total population aged 15 years and over are involved in subsistence agriculture, fishing and other home activities. The remaining 20% of the population are government and private business employees.

Most inhabitants of Funafuti, which is the location of the capital and the most developed of the islands, have electricity in their houses. Domestic refrigerators are reasonably common, but chest freezers are preferred and are more common. Air-conditioners of any kind are rare outside of the only hotel and government office buildings. Because of the small size of the islands that make up Tuvalu the vehicle fleet is very small for the size of the population. As with many other countries in the region, most of the vehicle fleet are second-hand Japanese vehicles. Most vehicles have air-conditioning in them when they arrive.

Because Tuvalu is a small group of islands, with fairly constant trade winds, corrosion from salt air is a severe problem. Accordingly steel products, such as cars, but also refrigerators and air-conditioners, suffer from corrosion problems. The average life of a car in Tuvalu is in the order of three to five years after arrival in the country because of the corrosion.

# 2 Background

The most important sector in Pacific Island Countries (PICs) in which ozone depleting substances (ODS) are used is the refrigeration sector. Yet, poor servicing procedures such as flushing and venting can lead to the release of significant quantities of chlorofluorocarbons (CFCs) directly into the atmosphere. Training programmes in "Good practices in refrigeration" and associated training programmes for customs officers were approved for the eight core countries involved in the "Regional Strategy to Comply with the Montreal Protocol in Pacific Island Countries". The eight countries in the Regional Strategy are the Federated States of Micronesia (FSM), Kiribati, the Marshall Islands, Palau, the Solomon Islands, Tonga, Tuvalu and Vanuatu. The Regional Strategy was approved at the 36$^{th}$ Meeting of the Executive Committee. The South Pacific Regional Environment Programme (SPREP) is responsible for the implementation of the Regional Strategy in the Pacific region, with the assistance and oversight of United Nations Environment Programme Division of Technology, Industry and

Economics (UNEP-DTIE) and United Nations Environment Programme Regional Office for Asia and the Pacific (UNEP ROAP).

SPREP has engaged the New Zealand Institute of Refrigeration Heating and Air-Conditioning Engineers (IRHACE) Industry Training Charitable Trust (Inc.) to carry out "Train-the-Trainers" Workshops on "Good practices in refrigeration" in the eight core countries. All of the eight countries have developed and approved individual ODS phase-out strategies known as National Compliance Action Plans (NCAPs). The NCAPs identified the need to train workers in the refrigeration sector to ensure they have the skills to manage the phase-out of CFC refrigerants.

The skills required by the technicians to ensure the phase out is successful and sustainable include:
- The knowledge of how to keep existing equipment functioning by reducing leakage through better maintenance;
- Retrofitting existing equipment to utilise low- or non-ozone depleting refrigerants; and
- The use of recovery and recycling equipment, especially for mobile air-conditioners.

The training workshop in Tuvalu was the third training workshop carried out in the region under the Regional Strategy and was held at the Public Works Division complex. The trainer of the first part of the workshop, Mr Murray Butler, is currently the Chairman of the Refrigeration and Air-Conditioning Company Association in New Zealand (RACCA). Mr Butler is a qualified technician with a Trade and Advanced Certificate in Refrigeration and Air-Conditioning, and also holds an Electrical Service Technician Trade Certificate. He has had 28 years of experience in the air-conditioning and refrigeration trade and is based in Hamilton, New Zealand. The second part of the workshop was conducted by Mr Andrew Sekula from Kirby Refrigeration Limited. Mr Sekula is the export manager for Kirby Refrigeration and is also the immediate Past Chairperson of RACCA. The equipment required for the training was supplied from New Zealand suppliers, Kirby Refrigeration Limited, after a competitive tender and was paid for by funds approved under the strategy for the training.

This training in the PICs has a high priority in the Regional Strategy because of the current, largely un-met, demand in the region for CFCs to service the mobile air-conditioners (MACs) in imported second-hand vehicles. While imports of CFCs remain uncontrolled in PICs, this trade in second-hand vehicles poses a great risk to all countries' ongoing compliance.

In the commercial refrigeration sector, selection of inappropriate refrigerants and poor maintenance may also increase energy consumption, resulting in unnecessary increases in energy demand.

Good practices are easy to follow methods to achieve an early reduction of the CFC consumption in the refrigeration sector. These "good practices" include activities such as preventive maintenance and inspection, record-keeping, appropriate training, recovery & recycling as well as the safe handling of refrigerants.

It is essential for the CFC users to be able to reduce and subsequently phase-out their consumption in a co-ordinated, planned and cost-effective manner. Containment practices such as recovery and recycling are expected to ease the economic consequences of the phase-out. Therefore, training on "Good practices in refrigeration" and an effective recovery and recycling programme combined with prudent retrofitting and timely replacement are part of the overall phase-out strategy. The training and skills will assist Tuvalu to meet the phase-out target of 2005 set out in the Regional Strategy and the control measures under the Montreal Protocol such as the freeze in consumption of Annex A CFCs in 1999 and subsequent reductions in 2002, 2005, 2007 and 2010.

Few of Tuvalu's refrigeration technicians have received formal training in technical training centres. There are no training facilities in Tuvalu that teach practical refrigeration skills and few technicians have the financial resources to travel off-island for advanced training in Australia, Fiji, Japan, Thailand, and Tonga from as early as the 1980s to 2003. However, such trainings could be improved with more time allocation and continual follow-up. Most technicians in Tuvalu have learned their trade "on the job" or through "passed-on" methods.

There is currently very little CFC in Tuvalu. Some CFCs are in domestic refrigerators and freezers but most units are nearing the end of their useful lifetime. The decision to scrap a refrigerator is usually made when the refrigerant has been lost. Therefore, the phase-out of CFCs in Tuvalu in terms of imports will be uncomplicated.

# 3 Objectives

The main objective of this train-the-trainers workshop was to reduce the CFC consumption in the refrigeration and air-conditioning sector in Tuvalu and to assist the country to comply with the phase-out schedule under the Montreal Protocol by:

- Increasing participants' awareness about ozone depletion, the Montreal Protocol, the environmental and economic benefits of good servicing practices and refrigerant containment;
- Introducing and demonstrating procedures that eliminate refrigerant emissions during preventive and unscheduled maintenance including recovery and recycling;
- Disseminating information on CFC-free technologies available today and retrofitting of existing equipment;
- Stimulating the development of a network for information sharing throughout the sector; and
- Helping the country to achieve the planned phase-out in a co-ordinated, planned and cost-effective manner, allowing existing CFC equipment to operate until the end of its economic life.

# 4 Expected Results

The expected long-term result of the training programme is to enhance good servicing and business practices in the refrigeration sector, assisting the sector to switch over to non-CFC equipment in a smooth way without causing an unnecessary burden to the consumers. While the train-the-trainer workshop in Tuvalu is seen as a positive move, there needs to be an improvement on the basic knowledge of majority of the participants on the course so that they are able to effectively train other technicians. More specifically, the main expected results are the following:

- Training at least one technician from all of the known servicing workshops so that they can train the remaining technicians;
- Raising awareness in the general public regarding the harmful effects of ozone layer depletion through reporting in the media;
- Minimisation and elimination of uncontrolled emissions of ozone depleting refrigerants through better maintenance practices, leak prevention, and CFC recovery and recycling through training of refrigeration service technicians;
- Elimination of venting of CFC during purging and flushing;
- Increased use of non-CFC equipment and technology and non-CFC coolants; and
- Reduction in CFC demand once prudent retrofitting and replacement of refrigeration and air-conditioning equipment begins.

# 5 Participants

The course participants were selected by the Department of Environment in consultation with SPREP and the trainer. There were twelve participants who attended the first part of the workshop and from this six attended the second part. The remaining six were not available at the time and thus, five additional participants attended the second part of the workshop. The participants included representatives from all major refrigeration and air-conditioning service organisations as well as the Public Works Department. Representatives from the Departments of Environment and Energy also attended certain sessions to increase their awareness of the Montreal Protocol. The level of skills was mainly low except for one or two participants, ranging from approximately six months experience in the industry to 15 years practical experience. Few of the technicians had a good grasp of the basic principles of refrigeration and this is an area that may need to be addressed separately. One participant was fully qualified having received training in both Australia and Fiji. This knowledge needs to be "tapped into" and offered to others. One or two other participants had a reasonable knowledge and need to be encouraged to share as role models or trainers.

The list of participants is attached as Annex 11.2.

The trainer for the first part of the workshop was Mr. Murray Butler of the IRHACE Industry Training Charitable Trust (Inc) and was assisted by SPREP. Tuvalu's Ozone Officer, Ms Pepetua Latasi of the Department of Environment was responsible for the local organisation. The second part of the workshop was conducted by Mr Andrew Sekula of Kirby Refrigeration Limited and assisted by Mr Mataio Tekinene, the Director of Environment, who was responsible for the local organisation. The varied age and experience of participants assisted the communication of new technologies to people at all levels within the Tuvalu work place.

None of the refrigeration-repair workshop in Tuvalu had any form of CFC-recovery equipment. During the course, three recovery cylinders were discovered at the Public Works Department but their existence and use were unknown to the participants. The very high levels of corrosion and very poor condition of roads meant that most equipment failures were catastrophic and little if any refrigerant remained in vehicles or refrigeration and air-conditioning equipment when it was repaired. Planned maintenance is rare. The difficulties of servicing equipment are also compounded by limited access to spare parts in Tuvalu. These must be ordered from off-island and may take many months to arrive.

***Opening Statement***
Mr. Bill P Teo, from the Office of the Prime Minister welcomed the participants and thanked SPREP and the IRHACE Training Trust for organising the workshop. The workshop is important to ensure Tuvalu achieves its obligations under the Montreal Protocol. He stressed the need to improve and upgrade the existing skills used in the servicing and maintenance of equipment in the refrigeration sector. He wished the participants success, and that as trainers, will go out and train novice technicians around Tuvalu.

# 6 Methodology

Appropriate training on "Good Practices in Refrigeration" including containment, recovery, recycling, leak detection, repair, preventive maintenance, retrofitting and new technologies is crucial in order to run existing equipment until the end of its economic life. This approach will help reduce the emissions of ODS such as HCFCs, HFCs, and the small amount of CFCs on Tuvalu and achieve the planned phase-out in a co-ordinated, planned and cost-effective manner. The five-day training was modelled on

the train-the-trainers approach, where in a first phase a number of trainers were trained on good practices in refrigeration. However, in this case as there are no training facilities in Tuvalu, it is expected that workers will pass on their knowledge to their workmates.

Due to the late arrival of equipment, the first part of the training workshop did not run as smoothly as the trainer would have preferred. The first part consisted of theoretical presentations and very little practical "hands-on" demonstrations. UNEP's "Training Manual on Good Practices in Refrigeration" was used as resource document. The second part of the workshop was held in Funafuti on Tuesday 11 November 2003 and covered practical "hands-on" demonstrations.

A "Trainer's Presentation Guide" has been prepared by the IRHACE Industry Training Trust, based on the above training materials and taking into account the specific training needs in Tuvalu and new technology developments. Along with copies of the course notes, the participants were given copies of the "Air-Conditioning and Refrigeration Industry Refrigerant Selection Guide". This Australian produced booklet contains extensive information needed to use the new refrigerants.

As stated earlier, CFC emissions are low on Tuvalu. The current problem is to deal with HCFCs and in the near future HFC training must be provided. New blends of HFC refrigerant that will replace HCFC-22 in future will be dangerous on Tuvalu due to increased pressures unless prior training is provided. In addition, training on awareness of "safety at workplace" must be provided.

# 7 Contents

7.1 Part 1 (Theory)

During the five-day workshop, the participants learned about the importance of ozone layer protection and the harmful effects of an increased UV-A and UV-B radiation. The training included information about the related international agreements such as the Montreal Protocol and its amendments covering the progress, early phase-out dates, and effects on Refrigeration and Air-Conditioning. The difference between the Montreal and Kyoto Protocols were also explained where the former covers ozone depletion and controls the phase-out of CFCs and HCFCs, and the latter covers global warming and the control of carbondioxide emission. The lectures also reviewed the basic principles of refrigeration, refrigerant identification by pressure/temperature charts, and types of refrigerants (R134a, R404A, R507).

In addition, participants also learned about retrofitting, oils and their miscibility sets for different types of refrigerants, leak detection, evacuation and charging systems. The processes for recovery and recycling were only covered in theory. The course also covered topics on superheat, good piping practices, practical workshops on servicing both refrigeration and electrical items, and an open discussion on all topics.

On the last day, all participants successfully obtained their "No Loss" cards by passing a written examination covering topics such as: Safe Handling of Refrigerants, Montreal and Kyoto Protocols, Ozone Depletion, and gases controlled by both Protocols. In addition to the Certificates, the participants will also receive photo ID cards.

The workshop agenda is attached as Annex 11.1.

**Figure 1: Theory session with the course participants.**

**Subjects Covered**

- Ozone Depletion;
- Global Warming – Green House Gases;
- Basic Refrigeration Cycle;
- Refrigerant identification by pressure/temperature charts;
- Retrofitting;
- Oils, miscibility sets for different types of refrigerants;
- Leak detection, fault finding and retrofitting;
- Superheat;
- Good piping practices;
- Practical workshops on servicing both refrigeration and electrical; and
- Refrigerant recovery, recycling, and reclaim (theory only).

7.2 Part 2 (Practical)

This second course specifically covered the use of the equipment supplied by Kirby Refrigeration for the course. The following equipment was used:

- 1 x recovery unit
- 2 x recovery cylinders
- 1 x vacuum pump
- 1 x vacuum gauge
- 1 x charging scales
- 1 x electronic leak detector
- 1 x ultrasonic leak detector
- 1 x UV dye kit

The training was “hands-on” and focussed on the safe use of the equipment and the safe handling of refrigerants using the equipment.

# 8 Results, Conclusions, Recommendations and Lessons learned

8.1 Part 1 (Theory)

During the first part of the training course on Funafuti, the following observations were made:

- Absence of cool rooms/freezer rooms on Funafuti (There is one freezer room at the wharf, but this has not been in operation for over 12 months);
- Each island has a fish freezer room and an ice-making machine;
- Hotels, shops, and restaurants rely on domestic fridges and freezers;
- Air-conditioning systems are of single-phase mounted on windows/walls or split-type ceiling units up to 12-15kW. Most air-conditioning units are reverse cycle and operating on R22;
- The island freezer rooms are operating R570C, but it is not known what refrigerant is being used to operate the ice-making machines;
- Majority of car air-conditioning systems operate on R134-A and upon arrival, all second-hand cars have working air-conditioning systems;
- Due to high salt content from sea sprays and humidity, majority of refrigeration systems fail within four to six years. Condenser fans corrode, compressor and suction accumulators rust as well as condensing unit covers. Copper tubes are corroding. Many systems do not have insulation on either refrigerant line; and
- No regular maintenance appears to be carried out on any refrigeration systems. A shortage of water supply restricts the regular cleaning of condensers.

After the training workshop, the trainer was confident that there was an improvement and an increased awareness on the topics covered. During the course, the trainer continually emphasised the importance of leak detection, safe methods, and the recovery and reduction of emissions of CFCs, HCFCs, and HFCs into the atmosphere. Although the CFC use in Tuvalu is very low, there is a possibility that there is a small amount of R12 available as was recorded in 2001.

The objectives of the workshop have been met and the main results are:

- Training of twelve service technicians on “Good Practices in Refrigeration” including recovery and recycling of refrigerants;
- Distribution of participation certificates to each participant from the IRHACE Industry Training Trust after passing the examination;
- Exchange of information and experiences between the participants and development of a network of personal contacts; and
- Trainer’s Presentation Guide to be used for the further training of technicians.

The following conclusions, recommendations and lessons learned could be drawn from the train-the-trainers workshop:

- The local organisation was good. The classroom was well suited to the task. A nearby refrigeration company’s workshop was used for two practical sessions and was appropriate for the practical hands-on sessions; and
- Lunch for the participants was organised at the training institute and nearby restaurant, which saved time and avoided local transport into Funafuti town.

Firstly, the trainer recommended to the participants against attempting to convert any air-conditioning systems using HCFC to an alternative refrigerant. Secondly, since the manufacturers are currently phasing out R22 units in favour of R410A, the trainer feels that Tuvalu’s Department of Environment

should set a date to stop instalment of R22 systems without prior consent. Some small window wall air-conditioners may still use R22 for two to three years. The trainer recommends that Tuvalu persuade against these units. Thirdly, the trainer also recommends that a levy could be placed on all incoming refrigerants that are controlled by the Montreal Protocol to cover costs of shipping and destruction of these refrigerants. Lastly, the trainer also recommends that the Government of Tuvalu compile a minimum standard for all air-conditioning and refrigeration covering the following:

- Refrigerants;
- Regular servicing including washing of condensers and epoxy coating on an annual basis;
- Where possible, outdoor unit covers should be manufactured from non-corrosive materials;
- All external heat exchange services and fans be cooled with epoxy resin to enhance longer installation;
- All exposed copper tube should be coated with epoxy resin at installation;
- Both liquid and vapour lines should be insulated and ends sealed with silicon-type material;
- All ferrous material (compressor, accumulator, fan shafts etc) to be coated with high quality rust-proof paint to withstand the high salt-content environment.
- Units need to meet Minimum Efficiency Performance (MEPs) already in place in Australia and New Zealand;
- Size units correctly for minimum run time thus reducing carbondioxide emissions;
- Equipment only installed by approved personnel for instance those with “No-Loss” card holders; and
- Maintenance records including dates and personnel carrying out inspection.

8.2 Part 2 (Practical)

After the second part of the training workshop, the trainer is of the opinion that the majority of the participants will use the equipment, providing it is available to them, considering it is being held by the Public Works Department and eight out of the eleven were from private companies.

As in other Pacific Island countries, there is good business in Tuvalu in recycling old equipment and this where recovery of CFC and HFC for re-use is important. Where the refrigerant has already escaped, the use of "drop-in" alternatives or changing to new-generation refrigerants can be implemented.

There are almost no large commercial plants (ie equipment) on Tuvalu where the loss of refrigerant could be of concern.

In the area of home appliances, ie refrigerators, display coolers and deep freezers, where in the past these have used the CFC refrigerant, servicing of these can be the same method as for the recycled equipment. New products coming into the country from USA, Australia, Europe or New Zealand should have the new generation refrigerant HFC 134a. However, other second hand products may not use HFC-134a and some method of control should be looked at.

# 9 Follow up Action Plan

This training programme is part of the process of implementing the NCAP for Tuvalu. As such it will be accompanied by other training and policy related activities as defined in the NCAP. These activities will be co-ordinated by the National Compliance Centre located in the Department of Environment, ensuring the continued and successful phase-out of CFCs in the refrigeration sector. The Department of Environment will establish a control and monitoring mechanism to ensure that the objectives of the programme are met and will produce follow-up reports on the status of implementation and the achievements of the train-the-technicians programme.

The course participants all indicated an eagerness for further technical training in specific areas of refrigeration practice that are appropriate to Tuvalu. Unfortunately, the focus of the SPREP project is on the environmental issues, and the project does not have a mandate (or funds) to carry out such training. Approaches need to be made to aid programmes to carry out additional and longer (possibly several weeks or even a month long) technical training in Tuvalu, and possibly other Pacific Islands if appropriate.

One issue that was unresolved at the end of the course concerned the purchase of equipment to assist with the phase-out of ODS. The Government of Tuvalu, under the Regional Strategy, has been allocated US$8,000 (approx. AUS$12,000) for the training programme and purchase of "recovery and recycling equipment". The issue of how best to use these funds was discussed at the workshop. It was the opinion of the participants, Tuvalu's ODS Officer, IRHACE and SPREP that because of the patterns of ODS usage and type of equipment failure, there was little need for recovery and recycling equipment in Tuvalu. The very small volume of CFC still in circulation did not justify the relatively high cost of dedicated equipment. The participants discussed this matter and recommended that instead new equipment be purchased that would help them more effectively maintain and minimise leakage from existing equipment. The participants, with the assistance of the trainer, developed the following indicative list of equipment they thought would be useful:

Table 1: List of additional equipment for Tuvalu

| *No.* | *Equipment* | *Priority (1-10)* |
|---|---|---|
| 1 | Recovery Unit & Cylinders | 1 |
| 2 | Leak Detector – Big blue | 10 |
| 3 | Vacuum pump, 10L oil | 2 |
| 4 | Gauges | 5 |
| 5 | Digital thermometer – with 2 probes | 3 |
| 6 | Nitrogen gas & Regulator | 4 |
| 7 | Flaring tools | 7 |
| 8 | Large recovery cylinder ~65kg | 1 |
| 9 | Pipe benders | 9 |
| 10 | Bending Springs | 8 |
| 11 | Cutting tools & spare cutting wheels | 6 |
| 12 | Map Gas Welder | 2-4 |

In addition, the participants also developed a list of spare parts as follows:

- Compressors for domestic refrigerators/freezers
- Soft drawn copper tube
- Coil protectant
- Compressor Relays Domestics
- Line tap works

- Domestic evaporator fans
- Thermostats for domestic fridges
- Capacitors
- Driers for domestic and commercial
- Tube insulation
- Capilliary tube
- Flare nuts
- Oil – 4L POE oil

The participants did not decide of any equipment should be provided at no cost, or at a subsidised price. This matter was to be discussed at a meeting of affected parties that the Department of Environment intended to hold following the training workshop.

The question of the types of equipment purchased should be considered by SPREP (to ensure it would be consistent with ExCom guidelines and decisions) as well as by the Government of Tuvalu. Final approval should be sought from the Government of Australia, which is funding this training programme in the eight core countries. Particular attention would need to be given to the fairness of any distribution of equipment among companies in Tuvalu.

## 10 Evaluation by participants

The evaluation Questionnaires obtained from the first and second parts of the workshop, along with detailed analyses and results, are available in Annex 11.3.

10.1 Part 1 (Theory)
In the first part of the workshop, the evaluation of the programme was carried out on the afternoon of the last day. The twelve participants who attended the week's training returned all evaluation forms.

In order to summarise the responses, a weighted average has been used. A response of "Excellent" was given four points, a response of "very good" three, "good" two, "acceptable" one, and "unacceptable" and "blank" responses were given zero points. For the twelve responses, this gives a maximum of 48 points for the relevant questions. Dividing the sum of resulting score by 48 gives a percentage figure. For example, if all twelve responses gave a score of "excellent" the percentage average would give a result of 100%.

It is clear from this evaluation that the theory session was successful as indicated by the consistently positive rating. The need for "hands-on" practical sessions was highlighted and the consistently low rating for the relevant questions indicated this. Most participants rated the overall course highly and regarded IRHACE as "excellent" or "very good" training organisation. Overall, the majority of participants indicated that the course was very valuable to their work.

There were requests in the comments section for further training on an annual basis, which may be considered by SPREP and IRHACE using other sources of funding. One response specifically requested training overseas in a modern" workshop.

10.2 Part 2 (Practical)
The questionnaires used for the second part of the workshop were a simplified version of that used in the first part so as to minimise confusion of terms used. Here, responses were divided into four categories: good, adequate, poor, and blank. Similarly for part 1 above, a weighted average has been used but based on only four responses. A response of "good" was given two, "adequate" one, and

"poor" and "blank" responses were given zero points. For the eleven responses this gives a maximum of 22 points for the relevant questions. Dividing the sum of resulting score by 22 gives a percentage figure. For example, if all eleven responses gave a score of "good" the percentage average would give a result of 100%.

Feedback from the participants indicated ten of the eleven attendees felt the right amount of material was covered on the course, nine of the eleven regarded the course as very valuable for their work and the same number rated the training as good. Majority of participants gave top ratings for the equipment provided as well as "hands-on" practical sessions.

# 11 Annexes

## 11.4 Agenda

**DAY 1**

| Session | Subject | Presentation (PowerPoint or Video) | Duration |
|---|---|---|---|
| 8.15 – 8.30 | | Training Trust Presentation (PP) | self running |
| 8.30 – 10.00 | Introduction | | |
| 10.15 – 12.00 | Basic Refrig Theory | Basic Refrigeration (PP) | 14 slides |
| 12.30 – 3.00 | Refrigerants & Safety | Refriger (PP) | 26 slides |
| 3.15 – 4.30 | Basic Refrig Practical | Copper Tube Work Cut & Bend (Vid) | 10 min |
| | Lab # 17A (from notes) | | |

**DAY 2**

| Session | Subject | Presentation (PowerPoint or Video) | Duration |
|---|---|---|---|
| 8.15 – 8.30 | | Training Trust Presentation (PP) | self running |
| 8.30 – 10.00 | Ozone Depletion | Science Presentation (PP) | 50 slides |
| | | Protecting Ozone the Search… (Vid) | 10 min |
| 10.15 – 12.00 | Montreal Protocol | Montreal Protocol & Where ODS..(PP) | 34 slides |
| | | Protecting Your Future (Vid) | 20 min |
| 12.30 – 3.00 | Global Warming | (end of) Science Presentation (PP) | 13 slides |
| | Basic Refrig Practical | cont. Lab # 17A (from notes) | |
| 3.15 – 4.30 | Basic Refrig Practical | cont. Lab # 17A (from notes) | |

**DAY 3**

| Session | Subject | Presentation (PowerPoint or Video) | Duration |
|---|---|---|---|
| 8.15 – 8.30 | | Training Trust Presentation (PP) | self running |
| 8.30 – 10.00 | Oils & Lubricants | Oils & Lubricants (PP) | 35 slides |
| 10.15 – 12.00 | Recovery | Recovery (PP) | 16 slides |
| | Recovery Practical | | |
| 12.30 – 3.00 | Leak Detection | Leaks (PP) | 50 slides |
| 3.15 – 4.30 | Press Test Evac & Charg | Pressure (PP) | 24 slides |

**DAY 4**

| Session | Subject | Presentation (PowerPoint or Video) | Duration |
|---|---|---|---|
| 8.15 – 8.30 | | Training Trust Presentation (PP) | self running |
| 8.30 – 10.00 | Retrofitting | Retrofit (PP) | 46 slides |
| | | Refrigerants Change Over Series (Vid) | 30 mins |
| 10.15 – 12.00 | Review of Course to Date | | |
| | Prep for “No-Loss” Exam | | |
| 12.30 – 3.00 | “No-Loss” Exam | | |
| 3.15 – 4.30 | TXV & Superheats | Superhea (PP) | 46 slides |

**DAY 5**

| Session | Subject | Presentation (PowerPoint or Video) | Duration |
|---|---|---|---|
| 8.15 – 8.30 | Training Trust Presentation | | self running |
| 8.30 – 10.00 | Mobile Air Conditioning | | |
| | Setting LP/HP & OP Switches | | |
| 10.15 – 12.00 | Resit “No-Loss” Exam if Required | | |
| 12.30 – 3.00 | Question Time | | |
| 3.15 – 4.30 | Discussion | | |

### 11.4 List of participants

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## 11.3 List of Resource personnel

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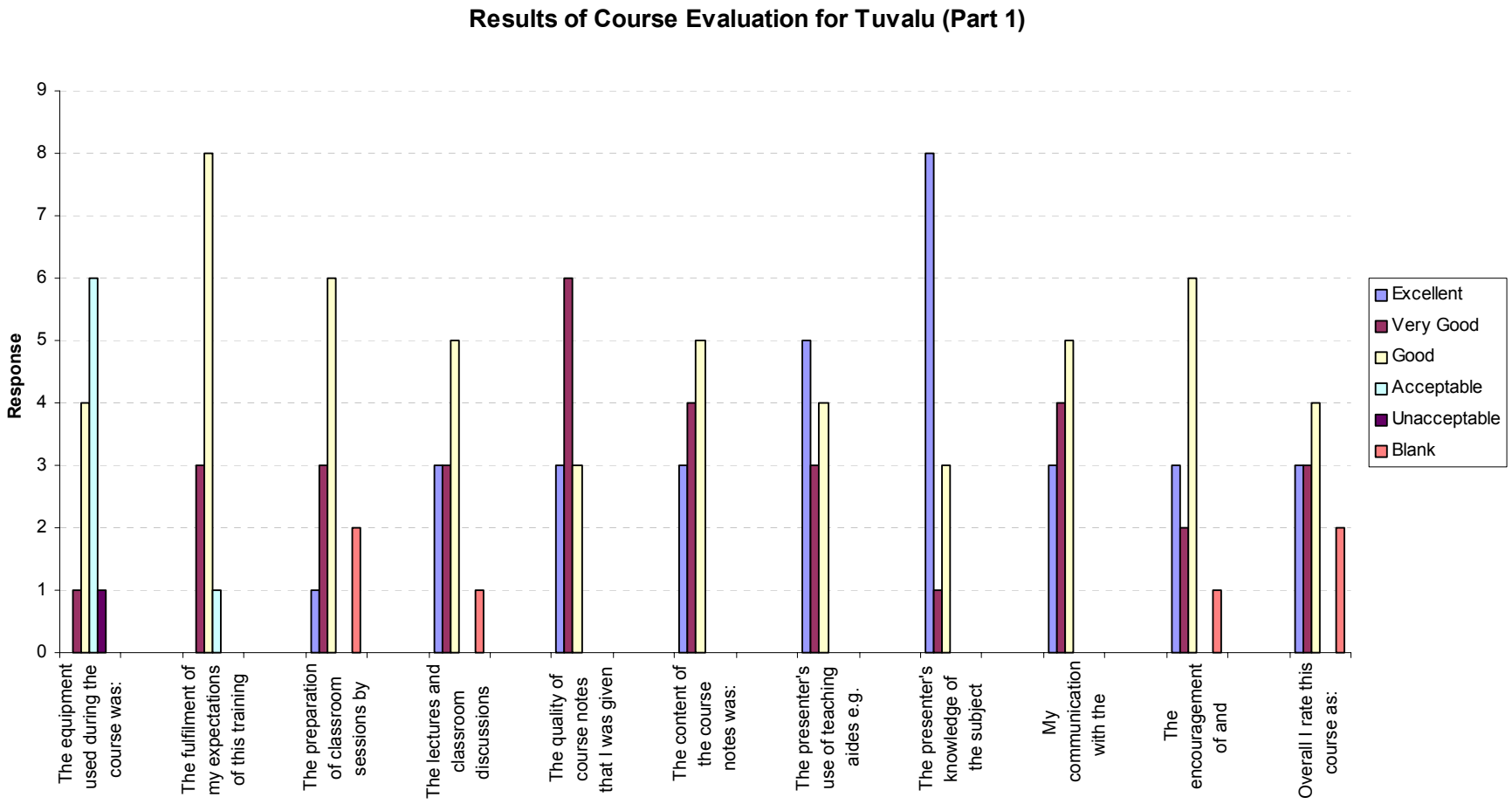
### 11.4 Evaluation Questionnaire

Responses to the evaluation questionnaires are summarised in Tables 2a and 2b and graphically illustrated below.



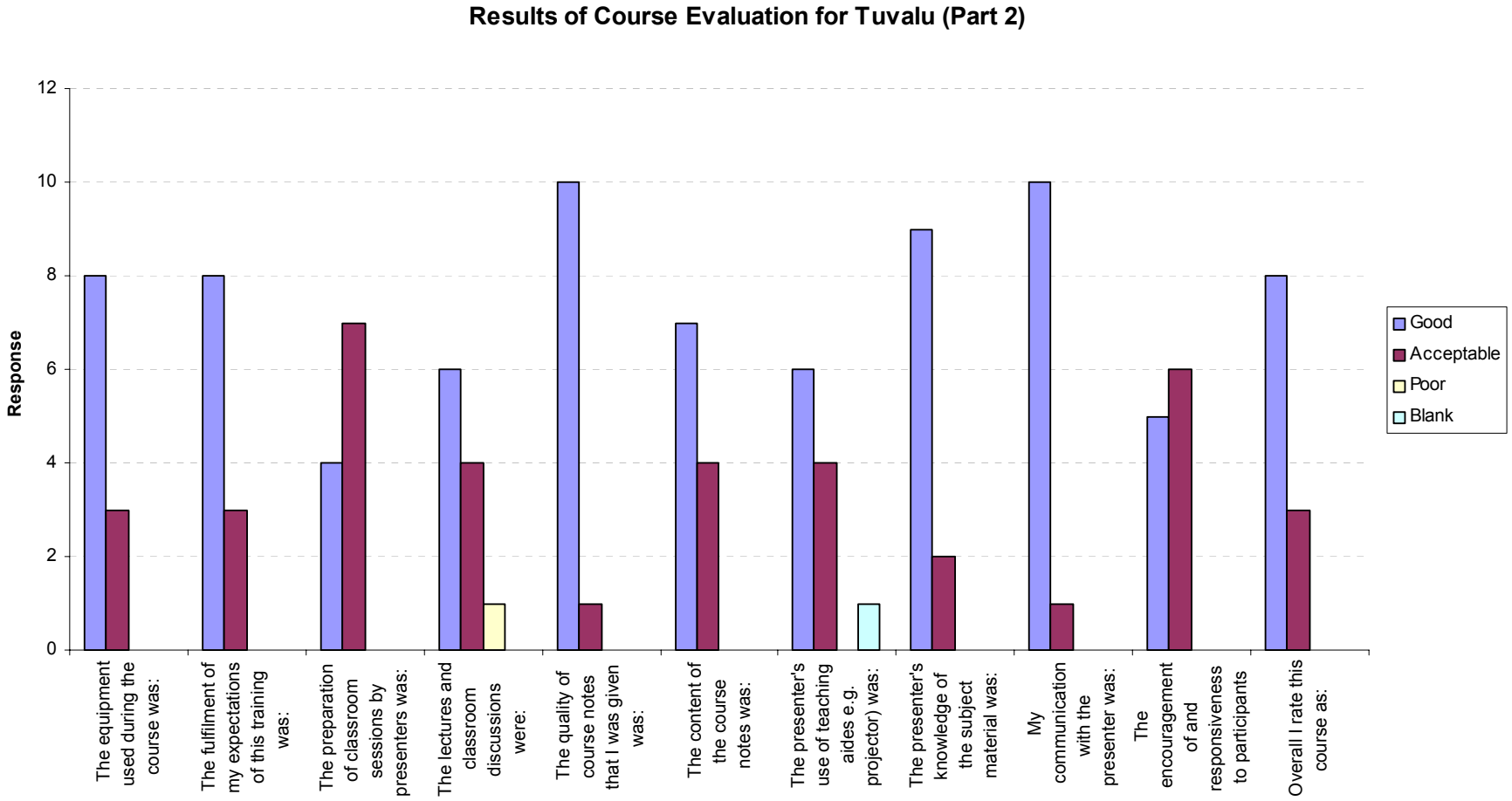

Results of Course Evaluation for Tuvalu (Part 2)
Response
0
2
4
6
8
10
12
Good
Acceptable
Poor
Blank
The equipment used during the course was:
The fulfilment of my expectations of this training was:
The preparation of classroom sessions by presenters was:
The lectures and classroom discussions were:
The quality of course notes that I was given was:
The content of the course notes was:
The presenter's use of teaching aides e.g. projector) was:
The presenter's knowledge of the subject material was:
My communication with the presenter was:
The encouragement of and responsiveness to participants
Overall I rate this course as:

Table 2a: Analysis of Evaluation Questionnaires (Part 1)

| QUESTIONS/RESPONSES | | Weighted average | Excellent | Very Good | Good | Acceptable | Unacceptable | Blank |
|---|---|---|---|---|---|---|---|---|
| Question 1. | The equipment used during the course was: | 35% | | 1 | 4 | 6 | 1 | |
| Question 2. | The fulfilment of my expectations of this training was: | 54% | | 3 | 8 | 1 | | |
| Question 3. | The preparation of classroom sessions by presenters was: | 52% | 1 | 3 | 6 | | | 2 |
| Question 4. | The lectures and classroom discussions were: | 65% | 3 | 3 | 5 | | | 1 |
| Question 5. | The quality of course notes that I was given was: | 75% | 3 | 6 | 3 | | | |
| Question 6. | The content of the course notes was: | 71% | 3 | 4 | 5 | | | |
| Question 7. | The presenter's use of teaching aides e.g. projector) was: | 77% | 5 | 3 | 4 | | | |
| Question 8. | The presenter's knowledge of the subject material was: | 85% | 8 | 1 | 3 | | | |
| Question 9. | My communication with the presenter was: | 71% | 3 | 4 | 5 | | | |
| Question 10. | The encouragement of and responsiveness to participants questions was generally: | 63% | 3 | 2 | 6 | | | 1 |
| Question 11. | Overall I rate this course as: | 60% | 3 | 3 | 4 | | | 2 |
| | | | | | | | | |
| Question 12. | The amount of material covered during the course was: | Too Much | About Right | Too Little | | | | |
| | | 1 | 5 | 6 | | | | |
| Question 13. | I regard this course as: | Very valuable for my work | Definitely useful for my work | Somewhat useful for my work | | Of little use for my work | | |
| | | 10 | 1 | 1 | | | | |
| Question 14. | Overall, how would you rate IRHACE Training Trust as a training organisation: | Excellent | Very Good | Average | Poor | | | |
| | | 5 | 7 | | | | | |
| | | | | | | | | |
| | | Weighted average | Excellent | Very Good | Good | Acceptable | Unacceptable | Blank |
| Question 15. | Did the course provide the information you expected | 67% | 2 | 4 | 6 | | | |
| Question 16. | Was the communication between participants possible and useful | 77% | 2 | 9 | 1 | | | |
| Question 17. | As far as the contents of the presentation are | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | concerned did you find them adequate in explaining: | | | | | | | |
| | a) Environmental issues | 67% | 3 | 2 | 7 | | | |
| | b) Basic principals of refrigeration | 73% | 2 | 7 | 3 | | | |
| | c) CFC/HCFC/HFC/HC refrigerants and technologies | 73% | 2 | 7 | 3 | | | |
| | d) General trade safety | 67% | 2 | 5 | 4 | 1 | | |
| | e) Operation and use of trade specialty tools | 44% | 1 | 2 | 5 | 1 | 1 | 2 |
| | f) Operation and use of passive and active recovery devices | 35% | 1 | 2 | 3 | 1 | 2 | 3 |
| | g) Good refrigeration practices | 60% | 1 | 5 | 5 | | | 1 |
| | h) Retrofitting to alternative refrigerants | 44% | 1 | 1 | 5 | 4 | 1 | |
| | i) Creating preventive maintenance programs and record-keeping | 50% | 1 | 2 | 6 | 2 | | 1 |
| Question 18. | Has the recovery issue been adequately dealt with in the practical hands-on sessions | 33% | 1 | 1 | 2 | 5 | 2 | 1 |
| Question 19. | Did the training course provide you with the relevant information regarding the train-the-technicians phase to be carried out by yourself in your country (please indicate whether additional material could be useful) | | 2 | 5 | 3 | 1 | | 1 |

Table 2b: Analysis of Evaluation Questionnaires (Part 2)

| **QUESTIONS/RESPONSES** | | Weighted average | Good | Acceptable | Poor | Blank |
|---|---|---|---|---|---|---|
| Question 1. | The equipment used during the course was: | 86% | 8 | 3 | | |
| Question 2. | The fulfilment of my expectations of this training was: | 86% | 8 | 3 | | |
| Question 3. | The preparation of classroom sessions by presenters was: | 68% | 4 | 7 | | |
| Question 4. | The lectures and classroom discussions were: | 73% | 6 | 4 | 1 | |
| Question 5. | The quality of course notes that I was given was: | 95% | 10 | 1 | | |
| Question 6. | The content of the course notes was: | 82% | 7 | 4 | | |
| Question 7. | The presenter's use of teaching aides e.g. projector) was: | 73% | 6 | 4 | | 1 |
| Question 8. | The presenter's knowledge of the subject material was: | 91% | 9 | 2 | | |
| Question 9. | My communication with the presenter was: | 95% | 10 | 1 | | |
| Question 10. | The encouragement of and responsiveness to participants questions was generally: | 73% | 5 | 6 | | |
| Question 11. | Overall I rate this course as: | 86% | 8 | 3 | | |
| | | | | | | |
| Question 12. | The amount of material covered during the course was: | Too Much | About Right | Too Little | | |
| | | | 10 | | | 1 |
| Question 13. | I regard this course as: | Very valuable for my work | Definitely useful for my work | Somewhat useful for my work | | Of little use for my work |
| | | 9 | 1 | | | 1 |
| Question 14. | Overall, how would you rate IRHACE Training Trust as a training organisation: | Excellent | Very Good | Average | Poor | |
| | | 8 | 2 | | 1 | |
| | | | | | | |
| | | Weighted average | Good | Acceptable | Poor | Blank |
| Question 15. | Did the course provide the information you expected | 86% | 8 | 3 | | |
| Question 16. | Was the communication between participants possible and useful | 86% | 8 | 3 | | |
| Question 17. | As far as the contents of the presentation are concerned did you find them adequate in explaining: | | | | | |
| | a) Environmental issues | 73% | 6 | 4 | | 1 |
| | b) Basic principals of refrigeration | 86% | 9 | 1 | | 1 |
| | c) CFC/HCFC/HFC/HC refrigerants and technologies | 73% | 7 | 2 | | 2 |
| | d) General trade safety | 86% | 9 | 1 | 1 | |
| | e) Operation and use of trade specialty tools | 77% | 8 | 1 | 1 | 1 |
| | f) Operation and use of passive | 86% | 9 | 1 | 1 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | and active recovery devices | | | | | |
| | g) Good refrigeration practices | 86% | 9 | 1 | 1 | |
| | h) Retrofitting to alternative refrigerants | 73% | 6 | 4 | | 1 |
| | i) Creating preventive maintenance programs and record-keeping | 55% | 3 | 6 | 1 | 1 |
| Question 18. | Has the recovery issue been adequately dealt with in the practical hands-on sessions | 86% | 9 | 1 | 1 | |
| Question 19. | Did the training course provide you with the relevant information regarding the train-the-technicians phase to be carried out by yourself in your country (please indicate whether additional material could be useful) | 73% | 6 | 4 | 1 | |