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 Honiara, Solomon Islands

10 - 16 October 2003

Solomon Islands College of Higher Education
Honiara, Solomon Islands

December 2003

SPREP's Climate Change and Adaptability

Key Result Area III (KRA 3)

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

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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
RAMSI	Regional Assistance Mission to the Solomon Islands
ROAP	Regional Office for Asia and the Pacific
SICHE	Solomon Islands College of Higher Education
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

Acknowledgements

This project has been undertaken with financial assistance provided by United Nations Environment Programme Multilateral Fund Secretariat and the bilateral contribution from the Government of Australia. Our appreciation goes to the Ministry of Mines and Energy of the Government of the Solomon Islands for their in-country support and to all the participants of this workshop for their participation and providing the necessary information needed for implementing the Montreal Protocol in Pacific island countries.

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

The train-the-trainers workshop in Solomon Islands is one of the training workshops being held 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 the Solomon Islands and to assist the country to comply with the phase-out schedule for CFCs under the RS and the Montreal Protocol. The trained participants, especially the staff of the Solomon Islands College of Higher Education (SICHE) are expected to train the remaining service technicians in the refrigeration and air-conditioning sector in the Solomon Islands. 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 an unnecessary burden to the consumers. The training programme drew resources from the Solomon Islands Government's Ministry of Mines and Energy and the South Pacific Regional Environment Programme (SPREP). The New Zealand Institute of Refrigeration Heating and Air-Conditioning Engineers (IRHACE) Industry Training Charitable Trust (Inc.) provided the trainer for the course.

Mr. Barnabas Anga, the Permanent Secretary of the Ministry of Mines & Energy, opened the workshop on behalf of the Solomon Islands Government. Seventeen professionals from SICHE, the fishing industry and service workshops were trained on good practices in refrigeration during the course. The participants represented most of the major refrigeration and air-conditioning workshops and ODS users in Honiara.

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. 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 via 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 participation certificate from IRHACE and the Government of Solomon Islands and a wallet sized card to signify that they passed the New Zealand "no loss" campaign examination.

Contents

1 Introduction

The Solomon Islands is an independent state, which forms a part of Melanesia. It is situated about 1,800 km north east of Australia. It is the third largest archipelago in the South Pacific and stretches from 154^0 E to 172^0 E in longitudes and from 5^0 S to 13^0 S in latitudes. Solomon Islands is a member of the South Pacific Regional Environment Programme.

It comprises some 990 islands, of which six of them, namely Choiseul, New Georgia, Santa Isabel, Guadalcanal, Malaita and San Cristobal are large islands. The total land area of the islands is 28,400 sq km. The islands are steep rugged mountains. There are also several atolls and reef islands. The river are fast flowing and not navigable.

According to the 1999 census, the population of Solomon Islands is 409,042 with a population growth rate of 2.8 %. The growth rate has declined when compared with the 1986 census, however, the growth rate is still one of the fastest in the world. Approximately 41.5 % of the population is under the age of 15. Although the population is large by the standards of the Pacific Islands, up to eighty percent of the population according to official estimates lead a subsistence agricultural lifestyle. There are few roads and little electricity outside of provincial centres. Most development is concentrated in the capital, Honiara (population 46,000). The standard of living in the Solomon Islands is low and even in the capital, many do not have electricity in their houses. Electricity prices are also high by world standards and recently have been extremely unreliable with power available in Honiara for less than 12 hours per day.

In 1998 the Gross Domestic Product of the Solomon Islands was $US300 million with an average growth rate of 3.2 % per annum over the 1985 – 1995 period. However the economy has declined significantly since 1999 because of the ethnic unrest which lead to many major industries closing or suspended operations. The arrival of the Regional Assistance Mission to the Solomon Islands (RAMSI) in July 2003 has been extremely successful in restoring peace to the region and it is likely that the economy will be restored.

The main sectors of the economy contributing to the GDP are fishing, copra, oil palm, timber, cocoa, and gold.

All ODS, (except for a small amount of methyl bromide used for quarantine and pre-shipment (QPS) fumigation), are used in the refrigeration and air-conditioning sector. Outside of the fishing industry, which has a large amount of HCFC-22 equipment, there is little refrigeration. There are no large supermarkets and only one public ice-making facility. Most ODS are used to service domestic air-conditioning units. There is no local production of the ozone depleting substances (ODS). ODS imports are mainly from Australia, Singapore, PNG and recently India.

The average level of CFC imports from 1995 – 1997; the “base level” for reductions under the Montreal Protocol is 2.4 ODP tonnes. Thus, Solomon Islands is a developing country and qualifies as operating under Article 5.1 of the Montreal Protocol. In 2002 the reported level of consumption was 600 kg, which is well below the base level for the Montreal Protocol.

Solomon Islands acceded to the Vienna Convention (1985) and the Montreal Protocol (1987) on 17 June 1993. It acceded to the London Amendment (1990), Copenhagen Amendment (1992) and the Montreal Amendment (1997) on 17 August 1999.

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 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).

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 Solomon Islands was one of a series of workshop being carried out in the region under the Regional Strategy. The trainer, 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 equipment required for the training was supplied from New Zealand suppliers, 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 replacements are part of the overall phase-out strategy. The training and skills will assist Solomon Islands 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.

Workers in the refrigeration and air-conditioning sector who took part in the training came from a wide range of technical backgrounds. Formal qualifications included trade certificates in refrigeration from Australian training centres and formal apprenticeships in the Solomons under foreign-trained supervisors. Others had learned on-the-job although most had some formal training. The Solomon Islands College of Higher Education (SICHE) does not conduct any formal courses in refrigeration. Refrigeration is however, taught as part of a marine engineering course. In comparison with many other Pacific Islands, SICHE has a relatively well-equipped training workshop for teaching refrigeration servicing. However, a shortage of funds meant that some equipment was no longer operating or had not been able to be properly maintained in recent years.

In addition to teaching commercial refrigeration, SICHE's automotive section has a good quality CFC and HFC recovery and recycling machine. It was used only for training and, due to the unrest associated with the tensions, no courses had been held recently to demonstrate it. This training course did not have time (and equally importantly, the supply of electricity) to use this equipment. We were unable to determine if it was operating properly.

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 Solomon Islands 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. 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

Although the National Compliance Centre (NCC) of the Ministry of Mines and Energy selected twenty participants for the course, only seventeen attended the full course. Those attending included representatives from most of the larger refrigeration and air-conditioning service organisations along with three tutors from SICHE. The level of skills ranged from a few years experience in the industry, to more than twenty years practical experience.

The list of participants and an indication of their experience and background is attached as Annex 11.2.

The trainer for the workshop was Mr Murray Butler of the IRHACE Industry Training Charitable Trust (Inc) and he was assisted by the SPREP Regional Consultant Mr Iain McGlinchy. The National Ozone Officer, Mr Douglas Alex of the Ministry of Mines and Energy 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 Solomon Islands work place.

Only one refrigeration-repair workshop in Solomon Islands had any form of CFC-recovery or recycling equipment which was broken and had not been used for several years. The SICHE automotive unit does have a working CFC/HFC recovery and recycling machine, but this is not available for public use and is not often used.

High levels of corrosion, frequent power outages, voltage fluctuations and in the case of motor vehicles, very poor condition of roads especially outside of Honiara, 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 Solomon Islands. These must be ordered from off-island and may take many months to arrive.

Opening Statement
Mr. Barnabas Anga, the Permanent Secretary of the Ministry of Mines & Energy welcomed the participants and thanked SPREP and the IRHACE Training Trust for organising the workshop. The workshop is important to ensure Solomon Islands 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 encouraged them to go out and train novice technicians around Solomon Islands once they had completed this course.

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, 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". It is expected that workers will pass on their knowledge to their workmates. SICHE is also investigating holding further versions of the course using their own tutors and the teaching material provided by IRHACE.

The workshop consisted of both theoretical presentations and practical "hands-on" demonstrations. UNEP's "Training Manual on Good Practices in Refrigeration" was used as resource document.

There will be several years during which CFC and non-CFC based equipment will be operated side by side in Solomon Islands. The training will ensure that the technicians understand the difference and servicing will be done appropriately.

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 Solomon Islands 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.

7 Contents

During the five-day workshop, the participants learned about the importance of protecting the ozone layer and the harmful effect 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 and explained the role of UNEP and SPREP in the implementation of such treaties. The lectures also reviewed the basic principles of refrigeration and responded to the question on how to service refrigeration and air-conditioning equipment in order to avoid refrigerant emissions. Alternative refrigerants were also discussed.

In addition, the proper procedures for refrigerant recovery were demonstrated to the participants during the practical portion of the workshop. The process of refrigerant recovery was demonstrated in a hands-on session on training equipment in the SICHE workshop. However, retrofitting practices and recovery and recycling using dedicated equipment were only covered in theory. The course also covered preventive maintenance programmes, record-keeping and safety issues. During the hands-on sessions, the participants practised basic refrigeration techniques, such as brazing, recovery of refrigerants from refrigerators and leak testing using modern leak testing equipment.

After the successful completion of the workshop, all participants passed a written examination based on the "No Loss" programme operating in New Zealand. The participants will receive photo ID cards indicating that they passed the course. They will all also receive certificates from the IRHACE Industry Training Trust.

The workshop agenda is attached as Annex 11.1.

Figure 1: Murray Butler, the trainer, on the first morning of the course.

Figure 2: Consulting the work book during practical session.

Subjects Covered

✍
✍✍ Ozone Depletion ✍
✍✍ Global Warming – Green House Gases ✍
✍✍ Basic Refrigeration Cycle ✍
✍✍ Refrigerant Flow Controls ✍

- Good Practices in Refrigeration including leak detection, fault finding and retrofitting
- Refrigerants – Zeotrope, Hydrocarbons, Ammonia, Carbon Dioxide
- Recovery machine – techniques, domestic refrigeration, commercial equipment, Industrial equipment and mobile air-conditioners
- Cylinder filling, testing, discharging
- Safe Work Practices – At all stages throughout the training, safe work practices were encouraged and reinforced.

8 Results, Conclusions, Recommendations and Lessons learned

The objectives of the workshop outlined in section 2 above have been met and the main results were:

- Training of seventeen service technicians on "Good practices in refrigeration" including recovery and recycling of refrigerants;
- 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 excellent;
- The classroom was well suited to the task. The SICHE workshop was used for the practical sessions and was appropriate for the practical hands-on sessions; and
- The lack of reliable electrical power was an impediment to practical training. This was largely overcome by the use of a petrol generator and also by rescheduling some activities for times when power was available.

Environmental issues concerning the disposal of contaminated refrigerants, oil and other used material was also raised in discussions. The trainer and SPREP advised that the best technique to deal with recovered CFC-12 is to re-use it to service vehicle air-conditioning as this type of equipment is more tolerant of impurities that might be present in recovered materials.

The use of CFC refrigerants is declining rapidly in the Solomon Islands. The participants reported that they no longer used CFCs for servicing, except for domestic refrigerators. There are relatively large stocks (several hundred kg) of CFCs, including CFC-11 and CFC-502 in the refrigerant wholesale companies in Honiara which sales staff expected to last for some more years at the rate of current consumption.

Until regulations are in place it will remain legal to import CFCs and, with the recent growth in the economy since the arrival of RAMSI this remains a risk. However, it is likely that any future imports will be very limited, as there is little demand for these. Demand for HCFCs is rising steadily and it will be important to monitor these imports for reporting to the Ozone Secretariat.

It was made clear to SPREP and the trainer that there was little opportunity for recovery of significant quantities of CFCs or other gases during most servicing since little, if any, preventative maintenance is carried out. Corrosion of pipes from exposure to sea air is the major reason for failure and accordingly the workshop participants reported there is usually little or no CFC (or other ODS) left in equipment at the time they are called in to carry out servicing.

For similar reasons, the salt air and very poor state of the roads meant that servicing car air-conditioning was rare. The small amount of working vehicle air-conditioning equipment that is serviced is reported to primarily be using HFC-134a. The participants were very keen to learn about retrofitting, as there have been an influx of second hand vehicles from Japan, which still had CFC-12 in their air-conditioning systems. However, they reported that in practice most of the vehicle owners could not afford to maintain the cars after purchase. It was unlikely that many would seek to repair their air-conditioning once it failed.

The trainer felt that the need for all technicians in the Pacific to use dry-nitrogen for cleaning systems and also while brazing copper pipes must be emphasised. A reliable and cost-effective supply will be important and should be discussed with BOC Gases (SI) Limited as they are the current importers.

In discussions at the end of the workshop participants requested that it be a legal requirement that all workers in their industry undertake a training course such as this one. SPREP agreed that this would be desirable, but it would be important that the industry realised that further courses would need to be paid for from within the Solomon Islands. They would have to agree, as an industry, to pay for further courses to be held. The participants agreed to discuss this matter further with the NCC.

9 Follow up Action Plan

This training programme is part of the process of implementing the NCAP for Solomon Islands. 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 (NCC) located in the Ministry of Mines and Energy, ensuring the continued and successful phase-out of CFCs in the refrigeration sector. The NCC 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 they would appreciate the opportunity for further technical training in other areas of refrigeration practice. 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 any trade-training. Approaches may be made to regional aid agencies to see if any funding would be available to carry out additional and longer (possibly several weeks or even month long) technical training in Solomon Islands and other Pacific Islands if appropriate.

The participants put forward the following suggestions for areas of future training:

- Practical sessions on the use of recovery and recycling equipment as this was only covered in theory on the course;
- The use of new refrigerants, especially R410A, the likely replacement for HCFC-22 in new air-conditioning equipment;
- Basic electric controls for refrigeration and air-conditioning equipment;
- Capacity and sizing of equipment, especially air-conditioning equipment; and
- Brazing skills.

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 Solomon Islands, under the Regional Strategy, has been allocated US$24,000 for the 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 and of the trainer and SPREP that because of the patterns of ODS usage and type of equipment failure, there was

only a limited need for recovery and recycling equipment in Solomon Islands. The very small volume of CFC still in circulation did not justify the relatively high cost of dedicated equipment for all workshops. The participants discussed this matter at length and suggested that one or two recovery and recycling units be purchased and held at SICHE where they could be used for training, but also loaned by workshops when necessary. In addition, they also recommended that the funds be used to purchase new equipment 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:

- Reclaim machine
- Kotza Refrigeration training CD ROM (A free sample version of this computer program was demonstrated by the tutor and was very popular with the participants. The full version is approximately US$1,500).
- Recovery cylinders
- Portable recovery unit
- Vacuum pumps of various sizes
- Pipe benders of various sizes
- Leak detectors – electronic, Ultrasound and UV light.
- Flaring kits
- Pipe cutters
- Reamers
- Electronic vacuum gauge
- HFC-134a gauge manifolds
- R410A gauge manifolds
- R404A gauge manifolds
- Electronic Refrigeration Scale
- Flare nut spanners
- Parts catalogues
- Nitrogen (N_2) Regulator and flow gauge for brazing
- Mapp Gas
- Multitest meter
- Electronic thermometer
- Personal safety equipment
- Refrigerant analyser
- Vacuum thermistor gauge

After generating this list, the participants ranked their top requirements in order. These were:

1. Reclaim unit and cylinders
2. Portable recovery unit/vacuum pump
3. Electronic scales
4. Vacuum thermistor gauge
5. Leak detectors
6. Gauge manifolds
7. Kotza Refrigerant training programme

The participants did not decide if the 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 NCC in the Ministry of Mines and Energy intended to hold following the training workshop.

The question of 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 Solomon Islands.

Approval to purchase these would be sought by the Government of Australia. Particular attention would need to be given to the fairness of any distribution of equipment among companies in Solomon Islands.

10 Evaluation by the participants

The evaluation of the programme was carried out on the morning of the last day. The evaluation Questionnaire and a detailed analysis of the results are available in Annex 11.4. All seventeen participants attended the week's training and seventeen evaluation forms were returned. Most answered all questions, although there were some blanks and one question (17 (f)) was missed by most due to a formatting problem on the printed form.

The results of the written evaluation were very positive. All participants rated the course as "very valuable", or "Definitely useful for my work". Scores on the individual questions (shown below) were also very positive. Written and verbal comments were also very positive.

The only area of consistent concern in the responses was the training material provided to the participants. This did not have page numbers and the participants found it difficult to find the sections the trainer was covering.

Many also requested that the course, or a similar one be held more often (annually) to continue with the awareness raising and also to raise the skills of the sector.

11. ANNEXES

11.1 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		
	Course Evaluation		

11.2 List of Participants

	Name	Company	Address	Contact	Background/ experience
1	Densley Kesi	Soltai Fishing Processing Ltd	PO Box 83 Munda	Telephone: (677) 61202	Registered Electrician
2	Timothy Maezama	Soltai Fishing Processing Ltd	PO Box 665 Honiara	Telephone: (677) 61012 E-mail: Aspri@soltai.com.sb	Marine Engineer
3	Albert Rura	Jamcor Electrical and Refrigeration Services	PO Box 1752, Honiara	Telephone: (677) 39734	Electrician
4	Abraham Rongo	Solomon Motors	PO Box 20, Honiara	Telephone: (677) 22219	Motor Mechanic
5	Robert Kalita	Arakei Refrigeration	C/- Simon Wame, SICHE, PO Box R113, Honiara	Telephone: (677) 27411	7 years refrigeration, now Mobile refrigeration
6	Amena Dakei	Tongs Corporation	PO Box 128 Honiara	Telephone: (677) 38182	Automotive
7	Barnabas Ogai	Northfreeze Refrigeration & Engineering Ltd	PO Box R151 Honiara	Telephone: (677) 39650 Fax: (677) 39561	Refrigeration
8	John Siau	Northfreeze Refrigeration & Engineering Ltd	PO Box R151 Honiara	Telephone: (677) 39560 Fax: (677) 39561	Qualified Refrigeration from FIT in Fiji
9	Eddie Brown	Auto Refrigeration and Air Conditioning	PO Box 1846 Honiara	Telephone: (677) 28340	Electrical, Correspondence
10	Simeon Rukasi	BOC Gases	PO Box R60 Honiara		BOC Gas distribution
11	Glenn Riasage Loe	Honiara Refrigeration and Air-conditioning Ltd	PO Box 700, Honiara	Telephone: (677) 30015/39189 E-mail: Riasage@hotmail.com	3 yrs experience in refrigeration 2 year apprenticeship in Australia.
12	Augustine Toto	Guadalcanal Electrics, Quality Foods Ltd.	PO Box 521 Honiara	Telephone: (677) 72824/30157/ 25151	Electrician
13	Fredrick Hamatagi Pado	Ela Motors Ltd	PO Box 140, Honiara	Telephone: (677) 30314	Basic Refriegration and mobile AC, Sydney

14	Simon Wame	SICHE	PO Box R113, Honiara	Telephone: (677) 30112, 30113, 30111	Marine Engineer 3rd, SICHE Attended IRHACE course in 2000 at MIT
15	Michael Daiwo	SICHE	PO Box R113, Honiara		Mechanical certificate
16	Tony Nori	Eastwind Enterprises	PO Box 658, Honiara	Telephone: (677) 39646	Diploma Engineering from Melbourne MIT
17	Leslie Lazarus	SICHE	PO Box R113, Honiara	Telephone: (677) 3011 Fax: (677) 30390 Imaresol@solomon.com.sb	Marine Engineer Attended IRHACE course in 2000 at MIT

11.3 List of Resource personnel

1. Mr Murray Butler

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3. Mr Douglas Alex

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11.4 Evaluation Questionnaire

Responses to the evaluation questionnaires are summarised in Table 1 and graphically illustrated below.

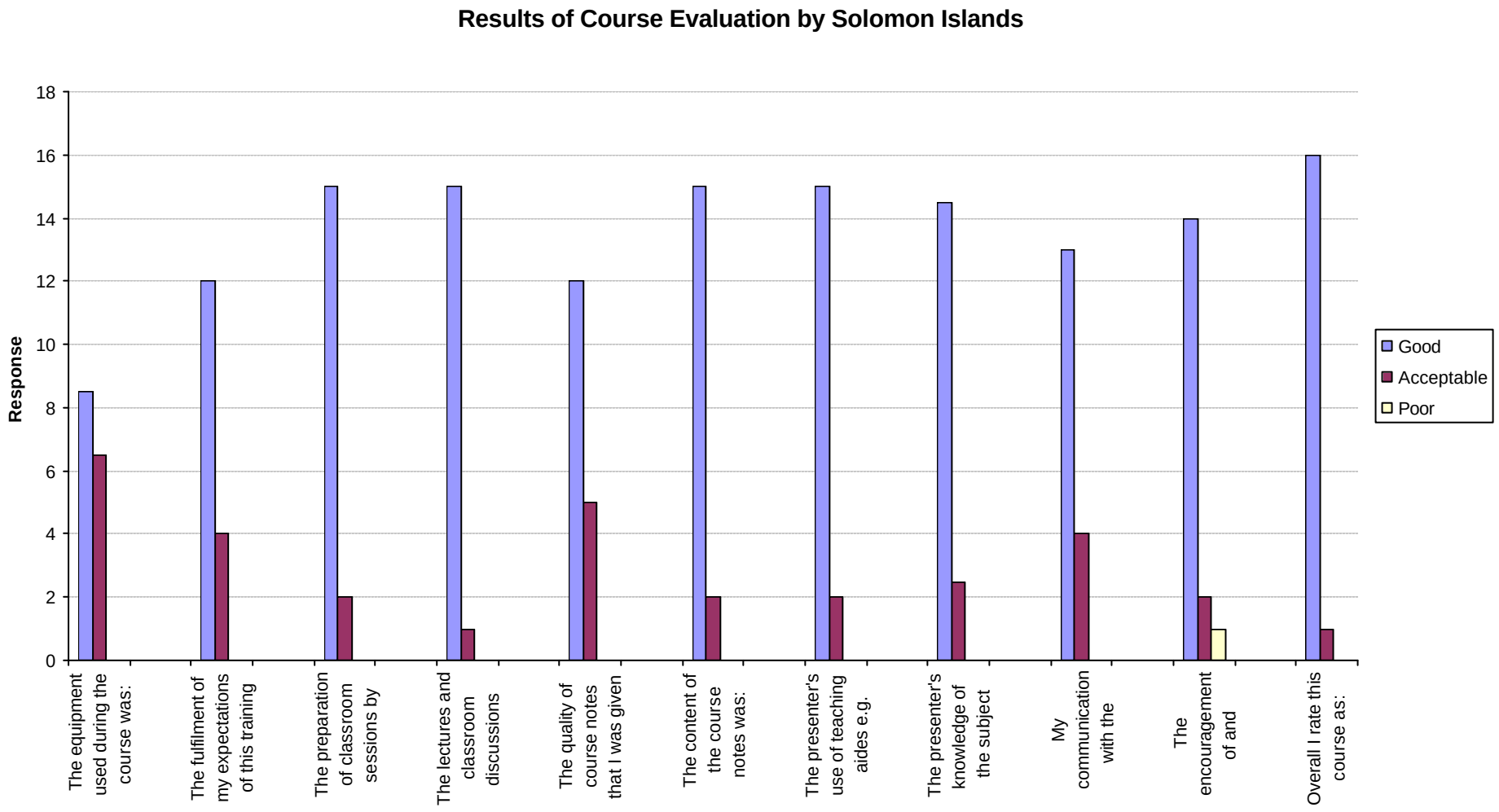

Table 1: Analysis of Evaluation Questionnaires

QUESTIONS/RESPONSES		Weighted average	Good	Acceptable	Poor	Blank
Question 1.	The equipment used during the course was:	75%	8.5	6.5	0	2
Question 2.	The fulfilment of my expectations of this training was:	86%	12	4	0	1
Question 3.	The preparation of classroom sessions by presenters was:	96%	15	2	0	0
Question 4.	The lectures and classroom discussions were:	92%	15	1	0	1
Question 5.	The quality of course notes that I was given was:	90%	12	5	0	0
Question 6.	The content of the course notes was:	96%	15	2	0	0
Question 7.	The presenter's use of teaching aides e.g. projector) was:	96%	15	2	0	0
Question 8.	The presenter's knowledge of the subject material was:	95%	14.5	2.5	0	0
Question 9.	My communication with the presenter was:	92%	13	4	0	0
Question 10.	The encouragement of and responsiveness to participants questions was generally:	92%	14	2	1	0
Question 11.	Overall I rate this course as:	98%	16	1	0	0
Question 12.	The amount of material covered during the course was:	Too Much	About Right	Too Little		
		3	14	0		
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	7	0		0
Question 14.	Overall, how would you rate IRHACE Training Trust as a training organisation:	Weighted Average	Good	Satisfactory	Poor	
		98%	16	1	0	
		Weighted average	Good	Acceptable	Poor	Blank
Question 15.	Did the course provide the	90%	14	2	0	1

	information you expected					
Question 16.	Was the communication between participants possible and useful	94%	14	3	0	
Question 17.	As far as the contents of the presentation are concerned did you find them adequate in explaining:					
	a) Environmental issues	92%	13	4	0	0
	b) Basic principals of refrigeration	86%	12	4	0	1
	c) CFC/HCFC/HFC/HC refrigerants and technologies	94%	14	3	0	0
	d) General trade safety	84%	11	5	0	1
	e) Operation and use of trade specialty tools	80%	9	7	0	1
	f) Operation and use of passive and active recovery devices	67%	8	5	0	4
	g) Good refrigeration practices	78%	12	2	0	3
	h) Retrofitting to alternative refrigerants	86%	11	5	1	0
	i) Creating preventive maintenance programs and record-keeping	80%	8	8	1	0
Question 18.	Has the recovery issue been adequately dealt with in the practical hands-on sessions	92%	13	4	0	0
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)	74%	9.5	4.5	0	3

In order to summarise the responses, a weighted average has been used. A response of "Good" was given three points, "Acceptable" two and "Poor" one. Blank responses were given zero points. This gives a maximum of 72 points for the relevant questions. Dividing the resulting score by 72 gives a percentage figure. For example, if all seventeen responses gave a score of "excellent" this would give a result of 100%.