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UNIDO Contract No. 85.141

Project No. RP/RAF/85/625

(2 MALAWI: Group Training in the Management of the Maintenance of Refrigeration Equipment.

TECHNICAL ASSISTANCE NEEDS ON THE MANAGEMENT OF THE MAINTENANCE OF REFRIGERATION EQUIPMENT FOR THE ORGANISATIONS AND INDUSTRY IN MALAWI.

PRESENTED TO (UNIDO) THE UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION, VIENNA, AUSTRIA BY AnCO - THE INDUSTRIAL TRAINING AUTHORITY, DUBLIN, IRELAND.

JOHN MOORE
1986

BACKGROUND:

UNIDO in response to a request from the Governments of Ethiopia, Zambia, Tanzania and Malawi, agreed to provide assistance to these Governments in carrying out a project entitled "Group Training in the Management of the Maintenance of Refrigeration Equipment".

AnCO - The National Training Authority, Dublin, Ireland were contracted to carry out the project and the mission was undertaken by John Moore of AnCO's Training Advisory Services Division acting as a UNIDO consultant.

The Malawian leg of the mission was undertaken from 2nd - 7th March 1986.

MISSION BRIEF:

"Identify"Training Activities" requirements at both National Level and Company Level to improve Technical and Managerial competence":

- Locate Centres of Excellence:

  -Identify technical assistance needs
  -Identify potential trainers
  -Recommend trainer development
  -Recommend courses to be run
  -Identify training materials requirements
  -Identify equipment requirements

- Identify training needs of particular groups/categories including:

  -Senior Managers
  -Line Managers
  -Maintenance Personnel
  -Maintenance Managers
  -Training Function Staff

- Identify needs for preparation/adaption of training material for recommended programmes.

- To consider the wider application of maintenance.

- Recommend "Awareness Creating" strategy for Senior Government and Industry Personnel.

SUMMARY OF RECOMMENDATIONS:

- Manpower Projections and Skills/Training Survey urgently needs to be undertaken. (Preferably for the period 1987 - 1992). This exercise should be carried out under the aegis of the Department of Labour.

- Polytechnic facilities should be developed as the Centre of Excellence for both Refrigeration and Air Conditioning technical updating and development of personnel in Maintenance Management and Systems Application.

- An External Expert should be appointed to advise and assist with launch of programmes and provide periodic follow-up.

- Programme Lecturers/Tutors should be drawn jointly from the Polytechnic, Industry, and appropriate Ministries.

- Trainer Development Fellowships should be awarded to:

  Mr Webster Patric Chiromo Manda - Cold Storage Company
  Two nominated participants - Ministry of Labour
  One nominated participant - Ministry of Education and Culture.

- Programme curricula should be developed jointly between the Polytechnic Faculties of Mechanical Engineering and Commerce and qualified Industry Trainers. The External Expert should co-ordinate this phase of the programme and provide assistance.

- Advanced Refrigeration and Air Conditioning Training Hardware should be provided to the Centre of Excellence.

- Short duration intensive appreciation sessions should be developed and run for Senior and Line Managers/Supervisors, particularly on planned maintenance benefits and concepts and organisational support.

- Modules on training/instructional techniques should be developed and included on Maintenance Management Programmes to enable participating companies strengthen their training function capability.

- Promote the programmes and benefits to industry through Sector/Regional Consciousness Raising Seminars backed by an advertisement campaign using the various media.

- Programmes in the areas of Maintenance Management and Systems Application should be made widely available to other sectors of industry.

- Special Programmes in the areas of "Procurement", "Stores Management/Inventory Control" and Spare Parts Manufacture should be provided at the Centre of Excellence.

METHODOLOGY:

The methodological approach adopted included:

- Desk research of relevant material.
- Direct observations through tours of the various facilities.
- Meetings and discussions with various personnel including:

UNDP Office Lilongwe:	Matthew B Ganda - Deputy Resident Executive Mr Chintedza - Assistant
Government Department of Personnel Management and Training:	Mr S Nyirenda - Principal Training Officer Mr N Kulemeka - Assistant
Ministry of Labour:	Mr Msanjama - Principal Industrial Training Officer Mr Mahwithi - Assistant
Ministry of Education and Culture:	Mr Banda - Principal Technical Educational Officer
University of Malawi Polytechnic, Blantyre:	Mr John Myers - Head of Electrical Engineering Department Mr Bill Haney - Head of Mechanical Engineering Department
Cold Storage Company, Blantyre:	Mr E Nyirenda - General Manager Mr Manda - Maintenance Engineering Manager
Tektronic Refrigeration and Air Conditioning:	Mr E R Phiri - Contracts and Managing Director
Superfreeze Ltd.:	Mr Iqbal el Okhai - Managing Director
PVHO Training Centre Lilongwe:	Mr Colombassy - World Bank Consultant

- Debriefing sessions with UNDP Personnel.

MAIN FINDINGS:

Basically an agricultural economy, Malawi is non-the-less engaged in a process of limited industrial development primarily designed to meet its own indigenous requirements. It is envisaged that industry's contribution to G.N.P. will increase from its present low level of 13% to 19% by 1992. Generally, productivity and prevailing levels of technology were found to be low and there was much evidence of undercapitalisation. These were compounded by a serious shortage of spare parts and a bureaucratic procurement policy.

The level of Maintenance Management was also found to be low with its consequental effects on:

- High ratio of down time to production.
- Inability to cope with high levels of technology (industrial, Electronic/Instrumentation/Automatic Control Systems etc.).
- Lack of systematic approach towards training and developing staff.
- Inadequate stores management and inventory control.
- Little or no planned approach to maintenance (shortage of spares has delayed the introduction of preventive maintenance in a number of plants).
- Lack of hard data on future manpower and skills requirements.
- Plant out of production for lengthy periods awaiting spares.
- Lack of, and inability to use sophisticated test equipment and specialised tools.

There is a formal Apprenticeship System in operation. The Ministry of Education is principally responsible for off-the-job aspects of the apprentices training i.e. technical instruction at its schools, while the Ministry of Labour is responsible for the overall administration of the scheme, i.e. recruitment of trainees and organising off-the-job training programmes, industrial quota allocations and the conducting of National Trade Tests.

The National Apprenticeship Scheme was established in 1965 under the provisions of the Apprenticeship Act and since 1973, the Scheme is funded largely by monies levied and payable into an Industrial Training Fund by all employers of skills craftsmen in the country. This is made possible under the provision of the Industrial Training Act which was enacted in December 1972 and became operationsl in April 1973.

The purpose of the Apprenticeship Scheme is to ensure that there are adequate skilled workers in the various trade categories. As is provided for by labour legislation, skilled workmen are so recognised by the achievement of National Trade Test qualifications grades III, II and I. The grade I qualification is the highest, and therefore the Scheme aims at having all apprentices qualifying at this level at the end of their four years training.

At present, the scheme provides for training in four main industrial trade categories of Building and Construction, Engineering, Motor Mechanics, Printing and others (Boat Building and Horticultural Nurserymanship).

Technicians generally are intended to provide the nucleus of supervisory personnel. This type of training has been developed in the four main disciplines in conjunction with the Polytechnic.

All categories undergo a period of four years training. The first year is spent in full-time training at a technical institution followed by three years in employment under contracts of Apprenticeship interspaced by block releases. For craft courses, nine months are spent in industry and three months on block release courses at technical institutions in each year, and for technician courses the three years of indentureships are divided equally into six months of industrial attachment and six months of college attendance.

The following trade categories are presently catered for:

1. ENGINEERING:

General Fitters
Electrician
Powerlinesman
Welder
Sheet Metal Worker
Mechanical Engineering Technician
Electric Technician
Laboratory Technician
Refrigeration Mechanics

2. MOTOR:

Motor Vehicle Mechanic
Auto Electrician
Diesel Fitter/Mechanic
Motor Vehicle Technician

3. BUILDING:

Bricklayers
Carpenter/Joiner
Plumber
Wood Machinist
Boat Builders
Building Technician

4. PRINTING:

Machine Operator
Booktinder/Warehouse
Compositors
Linotype
Lithographer

Standards are maintained by the "National Trade Testing Unit" which is the sole authority for establishing trade test syllabi, conducting trade tests and for issuing trade test certificates to persons who have fulfilled the necessary requirements. Maintenance of high standards of skills is seen as a priority.

Albeit, Apprenticeship is the preferable entry route to industry, many trainees for skilled occupations are recruited directly by employers and trained exclusively on-the-job. This practice has led to a dilution of standards and poor work practices in a number of areas.

There are no national training facilities for skills updating in Refrigeration and Air Conditioning. Such development is presently catered for at overseas locations mainly with equipment suppliers and is considered expensive and not very satisfactory given the highly specific (usually one machine) nature of the training provided.

The four year "Mechanical Engineering" degree course on offer at the "Polytechnic" School of Engineering includes imputs on Therodynamics and Refrigeration but is largely theoretical.

There are no programmes available in the fields of Maintenance Management Development or Systems Application.

Having assessed facilities in both Industry and the "Polytechnic" the latter was found the most suitable to meet the national requirements.

The needs which would be met both in the context of Technical Updating and Maintenance Development/Systems Application through the establishment of the Centre of Excellence were without exception viewed as strategically most important for the development of industry.

Another major problem encountered from the outset was the lack of manpower and skills needs data. With the absence of such vital information it is difficult to scientifically quantify the extent of the needs under investigation.

UNIVERSITY OF MALAWI:

HISTORICAL BACKGROUND: The University of Malawi was founded in October 1964 by the University of Malawi Provisional Council Act. The Act had two purposes, first to establish a degree college and secondly to incorporate into a single institution all the country's existing facilities for higher education.

Chancellor College admitted its first degree students in September 1965. The Ministry of Education offered the temporary use of the buildings at Chichiri Secondary School until a new college was built in Zomba. The first Chancellor College students graduated in 1969.

The second objective of the Act was achieved in January 1967 when Bunda College of Agriculture, the Institute of Public Administration, the Polytechnic and Soche Hill College were incorporated into the University as constituent Colleges of the University of Malawi. On the move to Somba in August 1973, the Institute of Public Administration and Soche Hill College ceased to exist as separate colleges. These two colleges, together with Chancellor College at Chichiri amalgamated to form the Chancellor College of Zomba.

In December 1974 the University of Malawi provisional Council Act, by which the University of Malawi was established, was repealed and replaced by the proper University of Malawi Act under which the University is currently operating.

POLYTECHNIC:

The Polytechnic offers Diploma/Degree courses in Business Studies/Accountancy and Engineering and diplomas in Technical Teaching. It is also responsible for a variety of certificate courses which are controlled by the Board of Governors.

DEPARTMENT OF PERSONNEL MANAGEMENT AND TRAINING:

The Department of Personnel Management and Training is under the Office of the President and Cabinet. It is therefore under the general control of the Secretary t the President and Cabinet who is also Head of the Civil Service.

The Department is divided into three main divisions viz the Personnel Administration Division, the Management Services Division and the Training Division. The functions of the Department include personnel administration establishment matters and the administration of training programmes and scholarships for the public service.

TRAINING:

The Training Division, which is one of the three Divisions of the Department is mainly charged with the responsibility for seeking scholarships and training places in overseas universities, colleges and other educational institutions for training Malawians in those fields which are appropriate to the country's general needs for trained manpower.

PROCESSING INDUSTRY AND COLD STORAGE PLANTS:

Facilities visited were in urgent need of equipment refurbishment. The "Cold Storage Companies" plant at Blantyre plan to get such a programme underway. The quality of utilities installations was generally low particularly in the older plants and also requires upgrading. Lack of spare parts and the lead time required in reordering was the bigest single problem maintenance departments had to contend with. This was largely attributed to foreign exchange controls and licencing arrangements.

On the technical side both the industrial electronic and instrumentation components will pose major repair and maintenance problems and are above the capability of the existing level of maintenance expertise. Modernisation of plants will pose similar training problems. Training in advanced refrigeration is required in all the plants visited. Very few Maintenance Managers received formal training in the management function. The few attempts at planned maintenance in evidence were very elementary. There was a reluctance to undertake normal preventative maintenance due to spares shortages.

The costs of tooling a local facility to produce even a limited range of sophisticated spares - such as those used in most refrigeration equipment, would be prohibitive. However, industry generally improvised with some degree of success in replacing/substituting basic spare parts.

ASSEMBLY AND SERVICE REPAIR INDUSTRY:

"PVHO" are the only company to operate a limited assembly operation of vehicle air conditioning units at their Blantyre Plant. The service depots operate on the "meccano" principle - repair by replacement. Training is largely provided at their "Lilongue" Training Centre including development programmes for newly promoted supervisors.

Facilities in the other premier listed companies including Fabrication, Welding, Spray Paint finishing and work methods were decidedly out of date. There was little use of jigs in evidence and virtually no test equipment. Operations consisted mainly of canabalisation used equipment and rebuilding. For economic reasons, the largest company visited combined Refrigeration & Air Conditioning with the repair/metal fabrication of electric cookers, filing and other metal storage cabinets, security strong boxes and metal desks. One or two such companies had submitted project proposals to government vis:-

- Large scale assembly of domestic equipment in collaboration with overseas manufacture.

- Assembly of domestic DC units for use in rural areas.

The latter has been extensively progressed and is awaiting Government clearance.

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE STRATEGY

CONCLUSIONS:

The major maintenance problems facing Malawian Industry can be summarised as follows:

- Shortage of technical skills, particularly in the fields of Refrigeration and Air Conditioning, Industrial Electronics and Instrumentation.

- Shortage of Maintenance Management Skills, principally in the areas of Planned Maintenance and Systems Application.

- Inadequate local Technical and Maintenance Management Development facilities.

- Shortage of spare parts - exasperated by currency exchange controls and licencing constraints.

- Lack of specialised tools and equipment.

- Inability to handle the introduction of high levels of technology.

- Lack of local specialised manufacturing facilities for spare parts.

- Widespread use of out-of-date plant and equipment - for which major spares are virtually non obtainable.

All of the problems are finance related and significant investment is urgently required in the need areas identified.

It should also be noted that a definite co-relationship exists between planned (preventive) maintenance, and availability of spare parts and that lack of readily available spares has prevented the introduction of much needed effective planned maintenance, thus compounding problems.

RECOMMENDATIONS:
MANPOWER PLANNING:

Given the total absence of such vital information, there is an immediate need to undertake a long term "Manpower and Skills Needs Survey" to obtain an "accurate fix" on future requirements.

This exercise should be carried out under the aegis of the Ministry of Labour and should ideally form a strategic part of the proposed UNDP 5 year plan for Malawi which will address areas including "Industry", "Human Resources" and "Development Planning".

It should include the development of an economic model for forecasting future demand levels by market area and a manpower model for forecasting labour demand by skill.

It should:

- Determine the present employment levels in the relevant sectors.
- Determine the employment effects of expected productivity changes in each market area.
- Determine the employment and skill effect of technology changes.
- Determine the level of employment and skills growth for each market area in the period in question.

The study should be undertaken in the context of a definite period of time (1987 -1992) and it should establish a basis for the continued review of requirements.

Key skills for the sector under review in this report would include:

- Plant Managers/Supervisors.
- Maintenance Managers/Supervisors.
- Refrigeration and Air Conditioning Mechanics/Technicians.
- Electricians.
- Mechanical Fitters.
- Electronics/Instrumentation Mechanics/Technicians.
- Plant Operatives.
- Apprentices.

CENTRE OF EXCELLENCE:

There is sufficient evidence of immediate needs to economically justify the establishment of a Centre of Excellence.

From discussions and observations, the "Polytechnic" is the most suitable venue and offers the best long term prospects of success. Programme imputs should be through a co-operative joint University/Industry effort, with lecturers/tutors drawn freely from both streams. The programme objectives in all cases should be "Industry Specific" with no prescribed entry qualifications for practicing personnel. Two levels of programmes should be offered:-

(a) Management/Systems Development.
(b) Technical Updating.

The formal programmes requiring classroom facilities only, could be provided at very short notice. To meet the national requirements, programmes in the following areas should be developed and on offer by the end of 1987.

- Awareness - Creating or Appreciation Seminar on Industrial Maintenance for Senior Personnel.
- Appreciation of Industrial Maintenance Programme for Line Managers/Supervisors.
- Maintenance Management Development Programme.
- Maintenance Stores Management Programme.
- Instructional Techniques/SKills Development for Maintenance Staff.
- Technical Development in Refrigeration and Air Conditioning.
- Spare Parts Manufacturing.
- Procurement.

EQUIPMENT:

The classroom facilities at the "Polytechnic" equiped with modern presentation aids are adequate, even in the short term to meet the programme requirements.

To develop the Polytechnic's capability as the Centre of Excellence for Refrigeration and Air Conditioning Technical Development, the following equipment should be provided:

(See Appendix 1)

(N.B. A detailed inventory of existing equipment should be undertaken to asertain suitability and possible areas of substitution.)

EXTERNAL EXPERT:

An expert in the field should be contracted from an agency of international standing to advise and assist and provide impetus with the initial launch.

The experts' role would include course evaluation and design and provide field follow-up with selected maintenance management participants to reinforce the formal course learning. The expert should be retained on an open ended contract for approximately 3 years.

TRAINERS AND TRAINER DEVELOPMENT:

Programme lecturers and trainers should be selected jointly from the Polytechnics Facilities of Engineering and Commerce, Industry and Government Departments and used to provide imputs on the various programmes as appropriate. The industry perspective on such programmes is of crucial importance and their contribution should be through the "part-time" involvement of selected key personnel who would act as trainers. The yearly net time contribution for selected personnel would amount to approximately 2 months.

The following personnel were identified as potential trainers:

Mr Webster Patric Chiromo Manda - Cold Storage Co. Ltd.

In addition the "MInistry of Labour" expressed a wish to select a suitable canditate for development and subsequent involvement.

The selected personnel should undergo a comprehensive trainer development programme in the management of Industrial and Vocational training.

The aims of such a programme should provide the participants with:

- A sound understanding of training and its role in the development of an economy.
- A detailed knowledge of training at management, supervisory, craft and operative level.
- Analytical consultancy and presentation skills.
- A practical grasp of the use of appropriate training methods and equipment.

On completion of the programme participants should be able to:-

- Carry out an Assessment of Training Needs (ATN) on an organisational or regional basis.
- Evaluate the effectiveness of a wide range of training approaches and methods.
- Provide a report outlining the role of training in the development of their own country's economy.
- Deploy newly acquired skills in training at operative; supervisory and management level.

The programme content should include:

Training:
. The learning process.
. Training skills.
. Assessment of training needs.
. Training methodology.

The Trainers Job:
. Presentation skills.
. Interviewing and influencing skills.
. Operator training.
. Role of the instructor
. Supervisory training.
. Management training.

Management of Training:
. General management theory and practice.
. Managing and administering training facilities.
. Control and accounting procedures.
. Personnel admininstration.
. Safety and hygiene.

Course Design:
. Training objectives.
. Curriculum and programme development.
. Testing-phase and terminal.
. Evaluating/Validation.
. Training Materials - Manuals
Graphics
Audio visual/computer
learner based.

The Trainee:
. Selecting trainees.
. Aptitude testing.
. Counselling and guidance.
. Skill inventories.

Building and Equipment:

. Training Centre location and design.
. Equipment selection and specification.
. Subcontracting training requirements.

Manpower:

. The labour force.
. Skill categories.
. Manpower planning and forecasting.
. Sectoral Studies.

The programe methodology should be highly participative and each participant, with the guidance of an expert tutor should work on an individually prepared practical training assignment. This should involve the secondment of participants to Training Centres or selected specialist organisations. The programme should combine this individual approach with theoretical imput. Learning should be reinforced with case studies, group discussions and practical exercises.

At the end of the programme each participant should have:

. A through working knowledge of all aspects of modern training practice and theory.

. Gained valuable practical experience which can be adapted to their own organisations.

. Have a comprehensive grasp of industrial and vocational training practice and administration.

CURRICULUM DESIGN:

An Advisory Committee representative of the Ministry of Labour and Industry should be established to advise on the content and format of programmes to meet national requirements. A key objective should be to aim for the highest international standards on such programmes. Much of the core content will consist of available on-the-shelf material - sources to include:

- International Carrier Technical Training Manuals.
- Maintenance Management Training Manual - UNIDO.
- Polytechnic Course Modules.

All relevant material should be extracted, synthesed and re-formatted as appropriate. The External Expert should be used in a consultative capacity for this purpose.

P.R. PROMOTION:

The importance and potential benefits of planned maintenance to Malawian Industry should be promulgated through Regional/Industry Sector Seminars backed by an advertisement campaign using the various media.

The economic rationale should be the major thrust of this campaign.

In so far as possible local "success stories" should be communicated in case study format. Endorsements by "high profile" senior industry and business executives should also feature.

A locally published Maintenance "Newsletter" or "Journal" designed to share and exchange information, and co-ordinate Industrial Maintenance activities at the National level would significantally advance good maintenance practice. A central maintenance library, subscribing to the major international publications, and widely disseminated would do much to also "push the state of the art" of good maintenance practice.

Appendix I

CENTRE OF EXCELLENCE WORKSHOP

Equipment and Tools

(Based on a Class of 12)

ITEM	DESCRIPTION	QUANTITY
1.	Pillar Drilling Machine (floor mounted) 3 Phase 380V 50 Hz. Speeds 200 - 3,500 R.P.M. T Slotted Drilling Table Drilling capacity to 30 mm Spindle Nose with No. 3 Morse Taper, gear driven, power fed Chuck adaptor and chuck Chuck key etc.	1
2.	Heavy Duty Machine Vice for above m/c. with milled slots for precision mounting Replaceable steel bed plate and graduated swivel base. Jaw width 150 mm Opening 130 mm	1
3.	Lathe	1
4.	Pedestal Grinder, double ended 3 phase 380V 50Hz. 3,000 R.P.M. 200 mm Grinding Wheel Adjustable Tool Rests	1
5.	Portable Electric Drill (heavy duty) 110V 1 phase Variable speed 200 - 3,000 R.P.M. Chuck, key and second handle	1

ITEM	DESCRIPTION	QUANTITY
6.	Impact Electric Drill, portable heavy duty Dual speed 500 and 16,000 R.P.M. Chuck key and second handle 110V 1PH 50Hz.	1
7.	Vacuum Pump : 230V 50 Hz. Self contained and portable Capacity 2 litres/sec. at atm. pressure Final Vacuum 0.6 pa or 50 microns gas ballast valve and non-return valve	2
8.	Graduated Charging Cylinder Scales in c.c. and grammes Compensation for volume fluctuation 5 kg. capacity Suitable for R12, R22, R502 Equipped with pressure relief valve and pressure gauge	2
9.	Portable Charging Station with self contained vacuum pump Graduated charging cylinder in c.c. and grammes Charging cylinder option of 5 kg. capacity Manifold gauge set and thermistor Vacuum Gauge Pressure relief valves etc.	1
10.	System Flushing Apparatus _ 230V 50 Hz. Self contained with acid resistant pump, R11 container, filters and valves. (Used with Hermetic systems only)	1

ITEM	DESCRIPTION	QUANTITY
11.	Oxy/Acetylene Welding and Cutting Set Reducing Valves and Gauges Non-return valves and 5 m each of Red and black hose Gauge readings in KPa Bottle Keys Welding and burner nets for universal use with range of nozzles, taps - cleaners and gas lighter 2 trolleys	2 Sets
12.	Sheet metal cutting/folding and bending machine. Bench type - hand operated Suitable for material 750 mm wide and up to 8 gauge sheet	1
13.	A.C. arc welding set : 380V 50 Hz A.C. Selector switch for 50, 60, 70, 80 amps 2 and 5 m cables Electrode holder and clamp	1 set
14.	Propane/Butane brazing set Complete brazing set with gas cylinder, reduction valve, pressure gauge in KPa Rush-gas stop safety valve, 1.5 m hose Handle, burners and gas lighter	1 set
15.	Portable Service Cylinders Suitable for R12, R22, R502 with pressure relief valve 5 kg liquid capacity	12 off
16.	Platform Scale Heavy duty type 0 - 15 kg. scale	1

ITEM	DESCRIPTION	QUANTITY
17.	Spring Scale 0-10 kg. scale	4
18.	Bench Vices with folding pipe lining 120 mm width	4
19.	Hoisting Pulley Block Manual operation - gear and chain type Capacity 2 tons. Hoisting height up to 6 mm with load holding capacity	
20.	Open end and ring spanners sets 6 mm - 30 mm in 1 mm steps	4 combination
21.	Combination Spanner Sets 1/4" - 1 5/8" A.F.	2
22.	Adjustable Wrenches 2 with 20 mm opening 2 with 30 mm opening 2 with 40 mm opening 2 with 60 mm opening	8
23.	Flexible Box Spanner Set 15 pcs. 6 - 20 mm	1
24.	Socket sets 12 point 1/2" square drive A.F. metric and Whitworth A.F. 1/4" - 1 1/4" Metric 10 - 32 mm Whit 1/8" - 3/4" in metal box with accessories	2

ITEM	DESCRIPTION	QUANTITY
25.	Socket Sets 3/8" Square drive A.F./mm/Whit A.F. 3/16" - 1/2" mm 4 - 13 mm B.A. 10 - 0	2
26.	Allen Key Sets Metric x 2 1.5 - 22 mm Imperial x 2 1/16" - 3/4" in leather cases	4
	Files with plastic handles	
	Flat medium double cut 200 mm	2
	Half-round medium double cut 200 mm	2
	Round medium double cut 200 mm	2
	Flat, fine double cut 120 mm	2
	Half-round, fine double cut 120 mm	2
	Round, fine double cut 120 mm	2
	Centre punches:	
	100 mm	2
27.	Refrigeration special socket sets See Britool catalogue for details	2
28.	Torque Wrenches (1) 5 to 30 Nm. (2) 30 to 150 Nm.	2
29.	Sheet metal shears	2
30.	Pop Rivette - pliers type Nozzle sizes : 2.4; 3.2; and 4 mm	1
31.	Rubber and plastic hammers 500 g and 300 g respectively	2

ITEM	DESCRIPTION	QUANTITY
32.	Pinch-off Pliers for copper pipe 6 - 16 mm	1
33.	Combination Pinch-off and re-rounding tool for copper pipe 6 - 16 mm	1
34.	Scribers	4
35.	Dividers 200 mm span with interchangeable needle tips	2
36.	Chisels flat 150 mm	2
37.	Hole-punch sets 4, 6, 8, 10, 12 and 14 mm diameter	2
38.	Pulley Puller Set	1
39.	Stud Extractor Set 3 to 20 mm sizes	1
40.	Stock and Die Sets 2 - 16 mm in case	1
41.	Stock and Die Sets 1/8" H.N.F. to 5/8" in case	1
42.	Stock and Die Sets 1/8" N.P.T.F. to 5/8" in case	1
43.	Drill and Stand Set	1
44.	Flaring and Swaging Tool Sets 3/16" - 3/4" Copper	2

ITEM	DESCRIPTION	QUANTITY
45.	Flaring Tool Set Double type set 3/16" - 3/4" Copper	1
46.	Re-surfacing tool for 1/4" - 3/4" Flare	1
47.	Lever Type Swaging Tool for 1/2", 5/8", 3/4",7/8", 1", 1 1/8" and 1 1/4" Copper	1
48.	Tee Extractor Kit (Lever type) from 1/2", 5/8", 3/4", 7/8", 1" and 1 1/8"	1
49.	Electric Tee Extractor Kit for above sizes 110V 50 Hz. A.C. supply Oil Charging Pump Manual and suitable for 5 litre cans Capilliary Tube Cleaner Hydraulic and manual operation G. Clamps 2 + 100 mm 2 + 150 mm	1
50.	Pipe Bending Tool Set (Lever type) With degree indicator on the forming wheels For O.D. copper 6, 8, 10, 12, 16, 18 and 22 mm diameter	6 Sets
51.	Pipe Bending Tool Floor mounting with pipe vice Formers and guides for copper pipe 12 to 35 mm O.D.)) diameter 12 to 35 mm I.D.)	1 Set

ITEM	DESCRIPTION	QUANTITY
52.	Pipe Bending Tool Floor mounting with pipe vice and formers for 20 and 25 mm Galv. Conduit	1 Set
53.	Stocks and Dies Suitable for 20 and 25 mm Galv. Conduit	6 Sets
54.	Vernier Caliper 120 mm long and graduated in mm	2 Off
55.	Micrometer For outside measuring 0 - 25 mm range	2 Off
56.	Inside Caliper 150 mm long, locking joint	2 Off
57.	Outside Caliper 150 mm long with locking joint	2 Off
	Soldering Stations	4 Off
58.	Feeler Gauges 0.05 to 1 mm	1 Set
59.	Engineers Square 200 mm long with scale in mm	3 Sets
60.	Spirit Level 600 mm long	1 Off
61.	Spirit Level 150 mm long	1 Off

ITEM	DESCRIPTION	QUANTITY
62.	Charging Manifold Including hoses (red, blue and yellow) valves and pressure gauges in KPa	2 Sets
63.	Vacuum Gauges, Panel Mounting, Clycerine Filled 120 mm diameter 0-100 PA Scale with re-calibration set screw	2
64.	Compound Gauges, Panel Mounting, Clycerine Filled 120 mm diameter 0-700 KPa Scale with re-calibration set screw	1
65.	Pressure Gauges, Glycerine Filled for panel mounting 120 mm diameter 0-3,500 KPa Scale with re-calibration set screw	1
66.	Dead Weight Tester Suitable for re-calibrating to above gauges	1
67.	U Tube Manometer Suitable for vacuum measurement down to 1 mm Hg.	1
68.	Electronic Vacuum Gauge Thermistor controlled. Scale Range in Microns or Pa. Battery operated in carrying case.	1

ITEM	DESCRIPTION	QUANTITY
69.	Recording Pressure Meter Range 0 - 3,000 KPa Electronic with facility for measurement of 3 pressures and change-over switch 3 sensors and recording charts 230V 50 Hz. A.C.	1
70.	Temperature Recording Meter Range 60^0C to 120^0C Electronic with facility for simultaneous measurement of 6 temps. High and low temperature scales with change-over switch. 6 Sensors with assortment of clamps 220V 50 Hz. A.C.	1
71.	Thermometers Electronic : Dual Scale Range Scale - 60^0C + 60^0C (High and Low) facility for 4 probes Assortment of probes for product, super-heat, room and air temperature measurement. Self contained battery and carrying case.	1 off
72.	Differential Pressure Gauge Measurement of static pressure differential across coils, filters, ducts, fans etc. Scale in Pa.	1 off

ITEM	DESCRIPTION	QUANTITY
73.	Whirling Hygrometer Scale Range 0 - 30°C Robust type in carrying case	2 off
74.	Recording Hygrometer (Dual Scale) Range 20% to 100% Including Sensors and facility for more than 1 sensor. Recording charts - 220V 50 Hz. A.C.	1
75.	Volt/Watt Meter Reading of actual power being consumed. Range 110 - 220V 0 - 300 watts 0 - 1,500 watts 0 - 3,000 watts including test cords and connectors	1
76.	Clip-on Volt/Amp/Ohm Meter Heavy duty type Range (V) 0 - 150 - 300 - 600 volts (I) 0 - 6 - 15 - 30 - 60 - 300 A (R) 0 - 100 including test leads and carrying case.	6 off
77.	A.V.O. Meter for accurate testing of A.C. and D.C. volts Milliamps and Ohms.	1

ITEM	DESCRIPTION	QUANTITY
78.	(Annie) Hermetic Unit Analyser and Tester with facility for measurement of volts, Amps and Ohms Capacitor and potential relay testing Starting and running of Hermetic Units to include test leads, spare fuses, etc.	2 off
79.	Capacitor Tester Dual Scale 0 - 50 mfd. 0 - 200 mfd. Complete with test lead, carrying case and spare fuses.	1 off
80.	Air Velocity Meter to read velocity in M/S Scales range 0 - 0.5 M/S 0 - 2.0 M/S 0 - 5.0 M/S 0 - 10.0 M/S	1 off
81.	Electronic Gas-leak Detector with audio-visual indication of Halogen Gas leaks. Variable sensitivity and 0.5 m flexible sensor lead. Carrying case and spare battery etc.	2 off
82.	Gas Flame Lead Detectors Propane or Butane Gas operated Supplied with spare copper reactors and L.P.G. hose connection.	4

ITEM	DESCRIPTION	QUANTITY
83.	Rev. Counter Electronic Dual Range 0 - 10 R.P.S. 0 - 50 R.P.S. in carrying case with spare battery and sensing lead.	1
84.	Bell Jar Size 200 x 150 x 150 Complete with base plate and vacuum hose connection	1
85.	Storage Cabinets 2,000 mm High 1,000 mm High Adjustable shelves Steel construction and lockable Pull-out shallow drawers suitable for spanners, socket-sets, dies, small tools etc. Pull-out plastic containers on shelves	4 off 4 off
86.	Trainee Personal Bench/Storage Cabinet/Locker Suitable to store personal tools, notes and clothes. Suitable to store small items of consumable/ durable equipment. Suitable as work bench when dismantling and re-building motors and compressors and assembling control panels.	12 off
87.	Cold Rooms Suitable for low/medium and high temperature installations.	1 off

ITEM	DESCRIPTION	QUANTITY
88.	Refrigeration Equipment for Low Temperature Installation (For Cold Room) 3 - 4 KW Capacity Direct drive compressor and motor Electric defrost evaporator Shell and tube condenser Valves/Controls/Tubing etc.	1 set
89.	Refrigeration Equipment of Medium and High Temperature Installation (For Cold Room) 0.75 to 1 KW capacity Semi-lekmetic condensing unit Electric or hot gas defrost evaporator Valves/Controls/Tubing etc.	1
90.	Air Handling Unit with steam heating coil, secondary refrigerant coil, humidifying system, variable air volume motorised valves etc.	1 off
91.	Packaged Liquid Chiller Liquid chilling unit with remote condenser and with shell and tube evaporator for use with above.	1 off
92.	Window Air Conditioning Units Small capacity of 2 KW/hr Electric heating elements and humidity and temperature controls 230 or 380 Hz. A.C.	2 off

ITEM	DESCRIPTION	QUANTITY
	(STOCK ITEMS)	
93.	Refrigerant R12 in 50 kg. cylinders	12 off
	Refrigerant R22 in 50 kg cylinders	2 off
	R 502 in 50 kg cylinders	3 off
	R 11 in 50 kg drums	2 off
	R 13 in 50 kg. cylinders	1 off
	Dry Nitrogen in 50 kg. cylinders	12 off
	Propane or Butane in 25 kg. cylinders.	6 off

M A L A W I

METHODOLOGY

The methodological approach adopted, included:

. Desk research of relevant material

- Malawi Yearbocks 1979 - 82
- Report on Manpower - SADCC conference held at "Hararr" Republic of Zimbabwe 30th - 31st January 1986.
- Visits to the following Ministries/Establishments and meetings/discussions with named personnel:

UNDP Office Lilongwe	Matthew B Ganda - Deputy Resident Executive Mr Chintedza - Assistant
Government Department of Personnel Management and Training	Mr S Nyirend - Principal Training Officer Mr N Kulemeka - Assistant
Ministry of Labour	Mr Msamjama - Principal Industrial Training Officer Mr Mahwithi - Assistant
Ministry of Education and Culture	Mr Banda - Principal Technical Educational Officer.
University of Malawi Polytechnic	Mr John Myers - Head of Electrical Engineering Department Mr Bill Haney - Head of Mechanical Engineering Department.
Cold Storage	Mr E Nyirenda - General Manager Mr Manda - Maintenance Engineering Manager.
Tektronic Refrigeration and Air Conditioning	Mr E R Phiri - Contracts and Managing Director.
Superfreeze Ltd	Mr Igbal el Okhai - Managing Director
PVHO Training Centre Lilongwe	Mr Columbaffy - World Bank Consultant

. Debriefing sessions with UNDP Personnel.

SUMMARY OF RECOMMENDATIONS :

- Polytechnic facilities should be developed as the Centre of Excellence for both Refrigeration and Air Conditioning technical updating and development of Personnel in Maintenance Management and Systems Application.

- An External Expert should be appointed to help launch programmes and provide periodic follow-up.

- Programme Lecturers/Tutors should be drawn jointly from the Polytechnic, Industry, and appropriate Ministries.

- Trainer Development Fellowships should be awarded to:

  Mr Manda - Cold Storage Company
  Two nominated participants - Ministry of Labour
  One nominated participant - Ministry of Education and Culture.

- Programme Software should be developed jointly between Polytechnic Facilities of Mechanical Engineering and Commerce and qualified Industry Trainers. The role of the External Expert should include co-ordinating responsibility.

- Advanced Training Hardware in Refrigeration and Air Conditioning should be provided to the Centre of Excellence.

- Short duration appreciation sessions should be developed and run for Senior and Line Managers, particularly in Planned Maintenance and Organisational Support.

- Modules on Training/Instructional Techniques should be developed and included on programmes to enable participating Companies to develop a maintenance training function capability.

- Promote the programmes and benefits to Industry through Regional/Sector seminars backed by an advertisement campaign.

- Programmes in the areas of Maintenance Management and Systems Application should be made widely available to other sectors of Industry.

- Special programmes should be provided in the areas of

  "Spares Procurement"
  "Inventroy Control"
  "Stores Management"
  "Spare Parts Manufacure".

- Manpower Projections and Skills/Training survey urgently needs to be undertaken. (Preferably for the period 1987 - 1992)