



TOGETHER
for a sustainable future

OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.



TOGETHER
for a sustainable future

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

15901

UNIDO Contract No. 85/141

Project No. RP/RAF/85/625

*Technical Assistance Group Training in the Management
of the Maintenance of Refrigeration Equipment*

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

PRESENTED TO (UNIDO) THE UNITED NATIONS INDUSTRIAL DEVELOPMENT
ORGANISATION, VIENNA, AUSTRIA BY ANCO - THE NATIONAL 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 was 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 Tanzanian leg of the mission was undertaken from 15th - 21st 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:

- . An update of manpower and skills projections for the industrial sector should be undertaken for the period 1987 - 1992. This exercise should be under the aegis of the Department of Manpower Planning.

- . Two potential Centres of Excellence were identified:-
 - The "University School of Engineering" and
 - "Comafric Ltd.".

An indepth feasibility study is required to decide on the most suitable establishment to meet the national requirements of Tanzania for both Refrigeration and Air Conditioning Technical Updating and development of Personnel in Maintenance Management and Systems Application.

- . An External Consultant, expert in both fields should be retained for a 3 year period to advise and assist with launch of programmes and provide periodic follow-up.

- . Programme lecturers/trainers should be drawn jointly from the academic field and industry.

- . Trainer Development Fellowships should be awarded to:-
 - Mr U S Mageni - Ministry of Industry and Trade.
 - Mr Mahara Makawe - Livestock Corporation Zanzibar.

- . Programme curricula should be collectively developed. The External Consultant should co-ordinate this phase of the exercise and provide appropriate advise and assistance.

Following final selection of the Centre of Excellence:

- . Refrigeration and Air Conditioning Training Simulators and other advanced hardware should be provided.
- . The economic and other benefits of Planned Maintenance should be promulgated to Senior and Line Managers through intensive short duration appreciation seminars.
- . Modules on analytical/instructional techniques should be included on Maintenance Management Development Programmes to augment the training capability of participating companies.
- . Promote the programmes and potential benefits to Industry nationwide, through Sector/Regional 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.
- . The basic entry route to Industry for Refrigeration and Air Conditioning Craftspersons urgently needs to be strengthened through the introduction of an improved formal State controlled Apprentice Scheme.

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:	Ms A Peterson.
Ministry of Industry & Trade:	Mr S.M.K. Sella - Industrial Economist. Mr O.S. Mageni - Head of Metals & Engineering Industries Sector.
Ministry of Education:	Dr. Ramadhani R Ntuah - Head of Education Planning. Mr Joseph M Kiluma - Sectoral Planning Section. Mr M Mwiry - Chief Officer for Technical Colleges and University.
Department of Manpower Planning:	Mr Joseph Rugumyamheto - Director.
Daikin Air Conditioning (E.A.) Ltd.:	Mr Mansoor S Samji - Director.
Afro-Cooling (Comafric Ltd):	Mr Subramanian - Director. Mr R Sathyamoorthy - Director.
National Cold Chain Operations Ltd (N.C.C.O.):	Mr Mfuru - General Manager.
Motor Mart:	Mr M I Maingu - General Manager.
Tanzanian Dairies:	Mr Laiser - Acting General Manager. Mr Kanuwa - Plant Engineer.

Vocational School
Dar as Salaan:

Principal.
Head of Refrigeration & Air
Conditioning.

University of Tanzania
School of Engineering:

Prof. J R Masuha - Dean-Engineering
Faculty.
Head of Mechanical Engineering.
Head of Refrigeration Section.

Zambian Breweries Ltd.:

Mr Hamza H Ntiruelegwa - Chief
Engineer.
Senior Refrigeration Engineer.

Ministry of Livestock
Development (Cold
Storage Plant):

Directors.

MAIN FINDINGS:

Lack of spare parts due to a severe shortage of hard currency has negated against good maintenance practice in Tanzanian Industry for many years. This was clearly evident during my visits to the various establishments, with industry generally working under capacity leading to low productivity, high cost of production and a serious problem of undercapitalisation. With few exceptions the level of maintenance activity and managerial effectiveness was also found to be low with its consequential effects on:-

- High ratio of down time to production.
- Inability to cope with high levels of technology (Industrial Electronics/Instrumentation/Automatic Control Systems etc.).
- Lack of systematic approach towards training and developing staff.
- Inadequate stores management and inventory control adding to an already worsening spares shortage.
- 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 skills requirements.
- Plant out of production for lengthy periods awaiting spares.
- Lack of, and inability to use sophisticated test equipment and specialised tools.

The Apprenticeship System in operation is very basic and in the opinion of most industry chiefs, it significantly falls short of meeting the national requirements. Apprentices during their first year undergo basic training in college. They are then placed with interested employers for a period of three years on-the-job training. During this period, attendance at night classes is a requirement and the apprentice is expected to sit for Grade 3, Grade 2 and Grade 1 examinations each year respectively. On completion of the full apprenticeship they have the option of pursuing a career as a craftsperson or progressing to technician level through further education.

At present a total of 200 apprentices are undergoing such training in the various trade categories which results in an average of 30 - 35 graduating each year.

This throughput figure is considered too low to meet national requirements and is augmented by direct intake with its consequential lowering of standards.

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 "University of Tanzania" School of Engineering includes inputs on thermodynamics and refrigeration but is largely theoretical.

The University have recently transferred the Refrigeration and Air Conditioning Laboratory to larger premises, however shortages of both key staff and equipment are considered major problems.

CENTRE OF EXCELLENCE:

Following a preliminary assessment, two potential Centres of Excellence were identified:-

"The University School of Engineering" and
"Comafric Ltd"

Within the time constraints of the visit it was not possible to make a final selection. An indepth feasibility study is required to decide on the most suitable establishment to meet the national requirements of Tanzania for both Refrigeration and Air Conditioning Technical Updating and development of personnel in Maintenance Management and Systems Application. This study should also take cognisance of facilities at the "Institute of Development Management" MZUMBE.

(IDM) INSTITUTE OF DEVELOPMENT MANAGEMENT MZUMBE:

The Institute of development Management (IDM) was initially established at Mzumbe on 1st July 1970, as a government institution under the then Central establishments Division of the President's Office, by the amalgamation of the former institute of Public Administration (IPA) which formed part of the former University College, Dar es Salaam and the Local Government and Rural Development Training Centre, which was in existence at Mzumbe prior to 1st July 1970. On 1st July 1972 the Institute was formally established as a parastatal educational institution. From that date the governing of the institute was vested in a Governing Body. The main reasons which led to the establishment of the IDM were that:-

- (a) There had been no training institution in Tanzania which provided advanced management education not was there any institution in the country which provided residential courses leading to full professional qualifications in accountancy, secretaryship or business administration. Such training could only be obtained overseas.
- (b) Management education obtained from overseas institutions was primarily oriented towards the needs and circumstances of the country in which the institutions were situated, and was conducted within the context and against the background of that country. It was thus found imperative that such training should be provided in Tanzania where it would focus on job requirements and be responsive to the needs, aspiration, policies and background of Tanzania.
- (c) Tanzania saw it as a priority to develop a national capability.

The functions and objectives of the Institute are:

- To promote social and economic development by providing opportunities for the study of, and for training in the principles, procedures and techniques of management, accountancy and business administration, the administration of justice, public administration and rural development.
- To conduct training programmes in the specified subjects above and in such other subjects associated with development as the Governing Body may from time to time decide.
- To provide consultancy services in the specified subjects to the government, and such other bodies or organisations as may be designated by the Minister responsible for Manpower Development and Administration (the Parent Ministry of the IDM).
- To sponsor, arrange or provide facilities for conferences/seminars on the specified subjects and other related topics.
- To give advice and make recommendations on such matters of administrative reform as the Minister responsible for Manpower Development and Administration may refer to the institute for advice.
- To manage the affairs of any institute, college, training establishment or other educational institution, the interests of which are transferred to, or acquired by the institute.
- To arrange for the publication and general dissemination of material produced in connection with the work and activities of the institute including training manuals and materials, procedural handbooks and the recorded results of research projects.

The IDM training programmes are functional and job oriented and are closely related as far as possible to work situations and problems of Tanzania. Methods of instruction provide for direct active participation by students - by use of case studies, syndicate role playing as well as by direct lecturing. Visual aids are extensively used.

English is the medium of instruction for all business courses at the institute.

Term tests, end of academic year examinations and field work assignments form the basis of a student's performance and assessment.

Diplomas and Certificates are awarded to candidates who successfully complete their programmes.

Courses of relevance to Industry on offer at the Institute include:-

- Certificate in Manpower Management.
- Post graduate Diploma in General Management.
- Functional Managers Course.
- Certificate in Basic Management.
- Advanced Diploma in Business Administration.
- Top Executive Programme.

In addition special courses of study both internal and external may be pursued using the services of the Institute Library. The Library houses a collection of 30,000 volumes which covers all the courses conducted at the Institute, and includes a Circulation Section, which lends books for reading outside the Library, reference and Periodical Section, which provides reference services, back issues of newspapers and periodicals as well as photocopying services and Acquisitions and a Processing Section, which procures and prepares books ready for disposal to library users.

All these sections are headed by qualified librarians to ensure efficient services.

Study careers are available for student's use in carrying out research. There is a seating capacity for 210 students at any one time.

The Library publishes a "contents and recent acquisitions" listings each year.

MINISTRY OF LABOUR AND MANPOWER DEVELOPMENT:

This ministry has responsibility for areas including:

- . Wages and Employment.
- . Manpower Development at places of employment.
- . Development of formal education.
- . Training Institutions.
- . Regionalisation.
- . Manpower Studies.

A national priority is the provision of universal Primary Education to all 7-13 year olds. There is a higher educational bias towards self-employment in both technical and agricultural fields which makes heavy demands on the limited educational equipment resources and qualified teachers.

Only a tiny percentage of people in employment receive formal company based training and development. The promotion of the company based training function concept is therefore actively encouraged.

Although a number of Manpower Studies have been undertaken they have been very limited in scope. This is mainly due to limited data gathering in highly controlled sections of the economy. They do not provide a proper base for forecasting long term strategic manpower and skill demand. Such an exercise, however would prove expensive and present major logistical problems.

The Director of Manpower Planning intimated that many aid programmes were so loaded with caveats as to make them practically useless. He also saw a large vacuum in the present range of national facilities for middle/line management development.

On the major issue of maintenance problems facing the country, he advocated an approach based on the "Zimbabwe" model where they became practically self sufficient in spares manufacture during UDI. Plans are currently underway from this Department to introduce a "Maintenance Economics" programme in the University of Dar es Salam.

MINISTRY OF EDUCATION:

This ministry has responsibility for the University and Technical Colleges. Their role is strictly confined to providing education and training in line with needs identified by the Ministry of Labour and Manpower Development. Only two of the state's Technical Colleges (one located in Dar es Salam) run courses in Mechanical Engineering which includes inputs on Refrigeration. This is the only form of such basic training provided for students and apprentices.

A new college currently under construction in Mbeya will offer a special programme in Maintenance Engineering and is scheduled to open in July 1986 for first intake.

A key priority for this ministry is the production of an "Educational Plan" to meet national requirements up to the end of the century.

PROCESS INDUSTRY AND COLD STORAGE PLANTS:

The contribution of the Manufacturing and Processing sector to Gross Domestic Product is in the region of 5% only and has been declining in recent years. In fact production in many industries - including the key food processing sector has dropped sharply over the past three years.

Among the contributing factors to this downward trend of production were lack of spare parts and raw materials, also intermittent water and electricity supplies. All these problems are underpinned by a serious shortage of foreign currency. As a consequence of this situation, many industries have had to close down temporarily which further disrupts production and results in the under utilisation of key staff.

Only one large company visited (Tanzanian Breweries) displayed first hand evidence of planned plant maintenance actually underway. The overall level of maintenance provided by their combined maintenance staff of 230 - including 4 Refrigeration Mechanics was severely restricted by lack of spares. There were no Instrument Mechanics or Electronics Technicians employed and the introduction of process control and automatic systems has given rise to skills problems, which has to be topped up quickly through overseas training.

"Tanzanian Daries" saw shortages of key skills - specifically refrigeration and Air Conditioning Mechanics and lack of spares as the key problems. One of the milk processing lines in their largest plant has been out of production for the past three years due to the latter. The second more modern line cannot therefore be taken out of production for long overdue planned maintenance which in turn will shorten its projected working life from 20 to 5-7 years.

The National Cold Chain Operations Ltd., were experiencing similar problems which resulted in significant quantities of primary food produce being improperly stored and hence wasted.

ASSEMBLY, SERVICE REPAIR AND SPARE PARTS INDUSTRY:

Tanzania was unique among the four project countries visited in that it had a modern, well equipped production facility for domestic refrigerators and related products.

"Daikin Air Conditioning (L.A.) Ltd." was privately established in 1967 as a service and repair company and was expanded in 1980 to include the production plant with a throughput capacity of 10,000 units per year. To-date a total of 450 units only have been produced due entirely to lack of raw materials. Shortage of foreign exchange has prevented the import of vital components. A proposed bartering arrangement designed to overcome this problem has recently fallen through. They are still the premier Tanzanian company engaged in: - Systems Design, Repair, Installations and Service of Industrial and Domestic Refrigeration and Air Conditioning Equipment.

The ten field service teams employed, have to contend with lengthy delays in meeting customer requirements, because of a hopelessly inadequate and unservicable transport fleet. This again, is due to lack of spare parts. Vital customer equipment spares are imported using a very limited (1 million Tanzanian Shillings) foreign exchange licence which was obtained four years ago.

All technical staff employed were recruited directly and exclusively trained in-company.

Part of the new production facility was converted into a training/lecture room for this purpose, and also to meet industrial users requirements. (A recent example of this was a 21 day intensive training programme run for Fisheries Officers in related aspects of Refrigeration and Air Conditioning.) All lecture materials and notes were drawn from "International Carrier Training Manuals" of which this company hold a complete set. Inputs were knowledge related, as no hardware/simulators were acquired for the Training Centre which would facilitate practical demonstrations.

There would appear to be a reluctance on the part of Government Agencies to use this facility given the largely private status of the company.

Among the smaller companies operating in the same field, only one with a present employment level of 40 had plans for expansion. The majority of apprentices are trained under the formal system already described.

Lack of national standards in this field has given rise to many problems including poor work practices. The majority of both suppliers and users spoken to, would welcome the introduction of such standards. This would also help raise the level of technical skills which is widely perceived as a priority problem. Local fabrication of counter cabinets and other equipment was of a very low order.

One establishment (Comfric) which was viewed as a potential centre of Excellence operate two plants in Dar es Salam:- One trading under the name "Afro Cooling" which manufacturers a range of high quality Automobile and Locomotive Radiators, and the other larger plant engaged in Auto Re-Conditioning and rebuilding.

The technology employed is largely "Indian" based and the well tooled facilities were established under aid programmes. The range of activities in the latter plant extends beyond auto parts refurbishment to include heavy industrial equipment including Air Conditioning and Refrigeration Compressors, Electric Motor Casings etc. Their technical capability includes metal welding repairs, metal spray rebuilding, tensiling and annealing, precision turning and machining, extremely fine tolerance vertical and horizontal boring, crankshaft grinding,, precisig balancing and caliberation, overhauls and refitting.

This organisation have a well established training function and have developed a systematic training capability for the following categories:-

- Operations and Assembly Personnel.
- Quality Control and Test Inspectors.
- Machine Operators.
- Engineering Craftspeople.
- Toolmakers.
- Test Technicians.
- Supervisors.
- Line Managers.
- Trainer Development.

The important category of toolmaker for example is recruited from successful graduates of the two year course in "Dar es Salaam" Technical College. Following an additional 5 year intensive in-company apprenticeship which is supplemented with related theory inputs they undergo a further 2 years 'improvership' in India, before being deemed fully qualified.

Trainers are drawn from company based ex-patriats and outside experts.

Trainee throughput normally amounts to 15% of total employment.

Training methodologies include:-

- Basic training in specially zoned production areas.
- On-the-job training under the guidance of experts.
- Special demonstrations.
- Job routing / Special assignments.
- Lectures in purposely built lecture rooms located on the premises and equipped with modern presentation/visual aids.

This company expressed interest in the mission and a ready willingness to expand their training capability (with grant aid assistance) to develop a 'Centre of Excellence' for both Refrigeration and Air Conditioning technical updating and development of personnel in Maintenance Management and Systems Application.

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE STRATEGY

Conclusions:

From the foregoing the major maintenance problems facing Tanzanian 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 level technology in manufacturing and process industry.
- . 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.
- . Inadequate Refrigeration and Air Conditioning Mechanic Apprentice Training System.
- . Inadequate planned maintenance in many industries.

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.

RECOMENDATIONS:**MANPOWER PLANNING:**

Albeit limited manpower forecast data exists there is nonetheless a 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 Manpower Development and should ideally form part of the proposed National Industrial Development Strategic Plan. 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.

- 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
- Precision Machinists and Toolmakers.
- Electronic/Instrument 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 in Tanzania.

From discussions and observations two potential establishments were identified:-

'The University School of Engineering' and
'Comafric Ltd.'

An in-depth feasibility study should be undertaken to determine which of these establishments offers the best long term prospect of success. Selection criteria should include:

- . Track record of training in comparable fields.
- . Lecture and workshop facilities.
- . Equipment availability.
- . Curriculum development capability.
- . Trainer Competence.
- . Willingness to use Industry Trainees on a part-time basis.
- . General commitment to specific industry related development etc.

The Institute of Development Management located at MZUMBE should also be visited and facilities there assessed as a possible third option.

PROGRAMMES:

Programme inputs should be provided through a joint Centre of Excellence/ 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 by any of the shortlisted establishments. 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:

Following final selection of the Centre of Excellence, classroom facilities should be developed to a high standard - equipped with modern presentation aids, to meet programme requirements. This should be a short term objective.

To develop the Centre of Excellence capacity for Refrigeration and Air Conditioning Technical Development, appropriate equipment as detailed in Appendix 1 should be provided.

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 design and evaluation 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 from the Centre of Excellence, the Ministries, and Industry and used to provide inputs 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 industry personnel were identified as potential trainers:-

Mr D.S. Mageni	-	Ministry of Industry & Trade.
Mr Mahara Makawe	-	Livestock Corporation, Zanzibar.

In addition the Brewery expresses a wish to select a suitable candidate 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 Administration.
- . Safety and hygiene.

Course Design:

- . Training objectives.
- . Curriculum and programme development.
- . Test-phase and terminal.
- . Evaluation/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 programme 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 input. Learning should be reinforced with case studies, group discussions and practical exercises.

At the end of the programme each participant should have:

- . A thorough 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 Manpower Development, The Ministry of Education, The Centre of Excellence 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.
- . Centre of Excellence Courses.

All relevant material should be extracted, synthesised 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 Tanzanian Industry should be promulgated through Regional/Industry Sector Seminars backed by an advertisement campaign using the various media.

The economic rationale should form 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 significantly 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.

APPRENTICE TRAINING:

Special consideration should be given to upgrading the Apprentice Training System particularly in refrigeration and Air Conditioning, incorporating a co-ordinated Industry/Department of Education and Ministry for Labour and Manpower Development involvement. A feasibility study should be undertaken to decide on the most suitable system to meet the national requirements.

A suggested four year model for "Refrigeration and Air Conditioning Mechanics" including a job training profile is outlined hereunder. A prerequisite to its introduction however would be the upgrading of facilities at Dar es Salam and Rural Technical Colleges which should also constitute part of the feasibility study.

OUTLINE OF 4 YEAR APPRENTICESHIP TRAINING MODEL

YEAR	PROGRAMME	TEST/CERTIFICATES
1.	Off-the-job training and related theory education (6months) On-the-job Exposure (6 months)	Terminal Test Junior Stage Examination
2.	Off-the-job related theory/training (3 months) On-the-job Exposure (9 months)	*Junior State Examination (repeat option)
3.	Off-the-job related theory/training (3 months) On-the-job Exposure (9 months)	Senior Stage Examination
4.	On-the-job Exposure (12 months)	*Senior Stage Examination (repeat option) Completion Certificate

(A special facility should be provided for apprentices to "build-up" a tool kit over the four year period) - See Appendix 2

A recommended Job Training Profile for Refrigeration and Air Conditioning Mechanics is listed overleaf.

Job Training Profile - Refrigeration & Air Conditioning Mechanic

Workshop Practice:

1. Bench Fitting, marking out, cutting, filing, drilling, tapping and fixing to specified tolerances.
2. Pipework 3"
Select and install annealed copper tubing up to 4 using Flare Fittings.
3. 3"
Select and install un-annealed copper tubing over 4 using wrought copper fittings.
4. Form bends and off-sets in annealed tubing using bending springs.
5. Form bends and off-sets in copper tubing using hand and machine benders.
6. Select and install steel tubing using Oxy-Acetelyn and Arc welding equipment.
7. Fabricate bends, off-sets and tees in steel tubing.
8. Repair and maintain Copper and Steel Tubing installations on Commercial and Industrial equipment.
9. Fabricate and install Surge Traps and Oil Traps in Discharge and Suction Lines.
10. Select and install Discharge Line wafflers and Vibration eliminators.
11. Select, install, commission, maintain and repair Suction Pressure Regulators.

12. Handle, store and transfer refrigerants safely between storage vessels.
13. Select refrigerant and charge capillary systems using graduated charging equipment.
14. Select refrigerants charge and leak test systems using R11.
15. Select refrigerant, charge and leak test systems using R12, R22, R500 or R502.
16. Select refrigerant, charge and leak test Ammonia Systems.

Compressors:

17. Select, install, commission, maintain and repair up to 5HP Hermetic Compressors, Single and 3 phase.
18. Select, install, commission, maintain and repair up to 20 HP Semi-hermetic Compressors Single and three phase.
19. Select, install, commission, maintain and repair Open-type Compressors up to 50 H.P.
20. Commission, maintain and repair Reciprocating Compressors Single and 2 stage.
21. Commission, maintain and repair Centrifugal Compressors Single and Multi-stage.
22. Commission, maintain and repair Helical Rotary Compressors.
23. Align Vee Belt and Directo Drive Compressors.
24. Maintain and Repair Cylinder Off-loading systems and mag-valves.
25. Commission, maintain and test pressure relief valves.

Compressor Lubrication:

26. Select Lubricants for low, medium and high-temperature applications.
27. Test and top-up oil in splash and force lubricated compressors.
28. Maintain, fault-find and repair oil circulation systems.
29. Select, install, commission and repair oil safety switches and controls.
30. Select, install, commission and repair oil Separators.

Condensers - Receivers:

31. Select, install, commission and maintain Air Cooled Condensers (Close coupled and remote).
32. Select, install, commission and maintain Shell and Tube condensers (Close coupled and remote).
33. Install, commission and maintain Evaporative Condensers.
34. Commission and maintain Water Cooling Towers.
35. Install, commission, maintain and repair condenser water pumps.
36. Install, commission and maintain pneumatic and motorised water valves.
37. Select, install, commission, maintain and repair Head Pressure Control devices.

Evaporators:

38. Select, install, commission, maintain and repair Forced Draft evaporators up to 25 kw.
39. Install, commission, maintain and repair D.X. and flooded chillers.
40. Commission, test and maintain secondary coolant systems.
41. Install, commission, maintain and repair refrigerant re-circulating systems and pumps.
42. Install, commission, maintain and repair Evaporator Defrost Systems.
43. Select, install, commission maintain and repair Evaporator Pressure regulators.

Liquid Flow Metering Devices:

44. Select, install, commission, maintain and repair Thermostatic Expansion Valves.
45. Install, commission, maintain and repair high-Side Float Valves.
46. Install, commission, maintain and repair Low Side Float Valves.
47. Install, commission, maintain and repair electronic Modulating Valves and sensors.
48. Install, commission, maintain and repair pneumatic modulating valves and controls.

Electrical:

49. Design, select, install, commission, maintain and repair Control Panels Single Phase.
50. Design, select, install, commission, maintain and repair Control Panels Three Phase.
51. Select, install, commission and repair Relays, Contactors, Thermal and Magnetic Over-loads.
52. Select, install, commission, test and Repair Single and 3 phase Motors up to 50 k.w.
53. Select, install, commission and test over-current and short circuit protective devices.
54. Select, install, commission, maintain and repair Pressure Control Safety Switches.
55. Select, install, commission, maintain and repair Temperature Control and Safety Switches.
56. Select and install conduits, trunking and Cable Trays for cable and tubing protection.
57. Select, install and terminate Multi-core Cables.

Evacuation and De-hydration:

58. Select, install and maintain Suction and Liquid Line de-hydrators and Filters.
59. Install and test Vacuum Pumps and Vacuum Gauges.
60. Select and install suitable purging and evacuating systems.

61. Select, install, commission, maintain and repair Ice Making Machines.

62. Select and install water supplies and drains.
63. Install, commission, maintain and repair domestic and plug-in type Refrigerators and Freezers.
64. Install, commission, maintain and repair plug-in type Commercial Display Units.
65. Select, install, commission, maintain and repair Cold Room equipment and controls to 0 C.
66. Select, install, commission, maintain and repair Low Temp. Holding Room equipment and controls to - 30 C
67. Select, install, commission, maintain and repair Blast Freezer equipment and controls.
68. Select, install, commission, maintain and repair Milk Storage Bulk Tank equipmwent and Controls.
69. Install, commission, maintain and repair High and Low Temperature package units and controls.
70. Install, commission, maintain and repair Package type Liquid Chillers and controls.
71. Install, commission, maintain and repair Air Volume dampers and conrols.
72. Install, commission, maintain and repair Heat Pump and Room Air Conditioners.
73. Install, commission, maintain and repair Heat Reclaim Systems and controls.
74. Commission, maintain and Repair Air Conditioning Systems and Controls.

75. Commission, maintain and repair Humidifying Systems and Controls.

76. Select, install , commission, maintain and repair Air Circulation Fans and Controls.
77. Install, commission, maintain and repair Industrial Ammonia Systems and Controls.
78. Select, install, commission, maintain and repair Beer Chiller equipment, controls and pumps.
79. Install, commission, maintain and repair 2 stage Freib abd Ammonia Systems and Controls.
80. Install, commission, maintain and repair Cascade Systems and Controls.
81. Install, commission, maintain and repair Low and Medium temperature, Transport Refrigeration Systems.

Safety:

82. Review safety procedures.

CENTRE OF EXCELLENCE WORKSHOP

Equipment and Tools

(Based on a Class of 12)

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
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

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
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

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
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

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
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

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
25.	Socket Sets 3/8" Square drive A.F./mm/Whit A.F. <u>3</u> " - 1/2" 16 mm 4 - 13 mm B.A. 10 - 0	2
26.	Allen Key Sets Metric x 2 1.5 - 22 mm Imperial x 2 <u>1</u> " - 3/4" in leather cases 16 Files with plastic handles Flat medium double cut 200 mm Half-round medium double cut 200 mm Round medium double cut 200 mm Flat, fine double cut 120 mm Half-round, fine double cut 120 mm Round, fine double cut 120 mm Centre punches: 100 mm	4
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

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
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 " - 3/4" Copper 16	2

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
45.	Flaring Tool Set Double type set $\frac{3}{16}$ " - 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 Capillary 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

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
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 Soldering Stations	2 Off 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

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
62.	Charging Manifold Including hoses (red, blue and yellow) valves and pressure gauges in KPa	2 Sets
63.	Vacuum Gauges, Panel Mounting, Glycerine Filled 120 mm diameter 0-100 PA Scale with re-calibration set screw	2
64.	Compound Gauges, Panel Mounting, Glycerine 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

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
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 ⁰ C to 120 ⁰ C 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 ⁰ C + 60 ⁰ C (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

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
73.	Whirling Hygrometer Scale Range 0 - 30 ^o 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

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
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

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
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

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
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

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
	<u>(STOCK ITEMS)</u>	
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

APPENDIX 2

REFRIGERATION MECHANIC TOOLKIT

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
1.	TOOL BOX Steel construction 5 compartment Size 500 X 200 X 200 mm.	1
2.	Brass lock of good quality	1
3.	Ball Pein Hammer: 650 g Hickory Handle	1
4.	Pliers: Insulated 200 mm long nose off-set	1
5.	Pliers: Insulated 200 mm good quality.	1
6.	*Pliers Circlip: for external use 8 - 25 mm Straight Nose	1
7.	Crimping Tool and Wire Stripper: Insulated Handle 200 mm long.	1
8.	*Scissors: Multi purpose for gasket making etc.	1

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
9.	Screw Drivers with plastic handles: (a)3 mm tip X 100 mm long insulated. 1 off. (b)6 mm tip X 150 mm long insulated. 1 off. (c)8 mm tip X 200 mm long 1 off.	3
10.	Phase Tester: Insulated, of good quality, for 500 volts. 300 mm tip X 150 mm long	1
11.	Screwdrivers Crosshead: (a)3 mm tip X 100 mm long (b)6 mm tip X 150 mm long	2
12.	Hacksaw Tubular Steel: Adjustable up to 300 mm Good quality grip for hand protection.	1
13.	Junior Hacksaw of good quality.	1
14.	File: Half-round, medium double-cut, plastic handle. 200 mm long.	1
15.	File: Flat, fine double-cut, plastic handle. 150 mm long.	1

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
16.	Scribber: 200 mm long	1
17.	Dividers: 200 mm long with exchangeable needle tips.	1
18.	Centre Punch: 100 mm long	1
19.	Chisel: 150 mm flat.	1
20.	Universal (Stanley) Knife: With retractable blade and 1 set of spare blades.	1
21.	Spanners: Metric O/E 6 - 25 mm.	10
22.	Spanners: A.F. O/E <u>1" 9"</u> 2 X 16	1
23.	Adjustable Spanner: of good quality 20 mm gap.	1
24.	Adjustable Spanner: of good quality 30 mm gap.	1
25.	Ratchet Spanner: <u>1"</u> 4 square drive, of good quality	1

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
26.	*Valve Stem Socket Spanner: <u>3"</u> <u>1"</u> 16 X 4	1
27.	External Bending Springs: <u>3"</u> <u>1"</u> <u>5"</u> <u>3"</u> 8 , 2 , 8 , and 4	4
28.	Charging Manifold: Robust type with charging lines and flare blanks. Compound Gauge 0KPa - 700 KPa pressure Gauge 100 KPa - 3,000 KPa	1
29.	Flaring and Swaging Set: of good quality. <u>3"</u> <u>3"</u> 16 - 4 O.D. Copper. (4.7 mm)	1
30.	Tube Cutter: with reamer and spare cutting wheel. 3 mm - 30 mm tubing.	1
31.	Pocket Thermometer in Steel Case: Scale - 40 ⁰ C to 50 ⁰ C approx.	1
32.	Steel Tape: of good quality. 3 M (min. length) with scale in mm.	1
33.	Square (Steel): 200 mm long with scale in mm.	1

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
34.	Level: of robust quality 600 mm long.	1
35.	Plumb Line: 200 g wt. and 10 M of line.	1
36.	Allen Key Set: Metric in plastic case.	1
37.	Small Dust Brush: 50 mm wide X 150 mm.	1
38.	Safety Goggles: with exchangeable lenses.	1
39.	Stillson: of good quality. 400 mm.	1
40.	Vice Grip Pliers: of good quality. 250 mm.	1
41.	B.A. Box Spanners: 2B.A., 3B.A., 4B.A. and 5B.A.	1

TANZANIA

TANZANIA

METHODOLOGY

Organisation visited and persons spoken to:

UNDP	Ms A Peterson
Ministry of Industry & Trade	Mr S.M.K. Silla - Industrial Economist Mr O.S. Mageni - Head of Metals & Engineering Industries Sector.
*Ministry of Education	Dr. Ramadhani R. Ntuah - Head of Education Planning Mr Joseph M Kiluma - Sectoral Planning Section
Department of Manpower Planning	Mr Joseph Rugumyamheto - Director
Daikin Air Conditioning (E.A.) Ltd	Mr Mansoor S Samji - Director
Afro-Cooling (Conafric Ltd)	Mr Subramanian - Director Mr R Sathyamoorthy - Director
National Cold Chain Operations Ltd (N.C.C.O.)	Mr Mfuru - General Manager
Motor Mart	Mr M I Maingu - General Manager
Tanzanian Dairies	Mr Laiser - Acting General Manager Mr Kanuwa - Plant Engineer
Vocational School Dar as Salaan	Principal Head of Refrigeration & Air Conditioning.
*Ministry of Education	Mr M Mwiry - Chief Officer for Technical Colleges and University.
University of Tanzania School of Engineering	Prof. J R. Majuha - Dean - Engineering Faculty Head of Mechanical Engineering Head of Refrigeration Section.
Zambian Breweries Ltd	Mr Hamza H Ntirngilegwa - Chief Engineer Senior Refrigeration Engineer

SUMMARY OF RECOMMENDATIONS :

- . An update of Manpower and Skills Projections for the Industrial Sector should be undertaken for the period 1987 - 1992. This exercise should be under the aegis of the Department of Manpower Planning.
- . Two potential Centres of Excellence were identified:-
 - The "University School of Engineering" and
 - "Comafric Ltd".

An indepth feasibility study is required to decide on the most suitable establishment to meet the national requirements of Tanzania for both Refrigeration and Air Conditioning Technical Updating and development of Personnel in Maintenance Management and Systems Application.

- . An External Consultant expert in both fields should be retained for a 3 year period to advise and assist with launch of programmes and provide periodic follow-up.
- . Programme lecturers/trainers be drawn jointly from the academic field and industry.
- . Trainer development Fellowships be awarded to :
 - Mr O S Mageni - Ministry of Industry and Trade
 - Mr Mahara Makawe - Livestock Corporation Zanzibar.
- . Course software be jointly developed. The External Consultant should provide direct assistance. Sources of material would include: Carrier International Training Manuals and UNIDO Maintenance Management Manual.

Following final selection of the Centre of Excellence

- . Refrigeration and Air Conditioning Training Simulations and other advanced hardware should be provided.
- . The economic and other benefits of Planned Maintenance should be promulgated to Senior and Line Managers through intensive short duration appreciation courses.
- . Modules on analytical/instructional techniques should be included on Maintenance Management Development programmes to augment the training capability of participating companies.
- . Promote the programmes and potential benefits to Industry nationwide, through Sector/Regional seminars backed by an advertisement campaign using the various media.
- . Programmes in 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.
- . The basic entry route to Industry for Refrigeration and Air Conditioning Craftspersons urgently needs to be strengthened through the introduction of a formal State controlled Apprentice Scheme.