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15903

UNIDO Contract No. 85/141

Project No. RP/RAF/85/625

(2) ZAMBIA: Group Training in the Management of the Maintenance of Refrigeration Equipment

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

SUBMITTED TO (UNIDO) THE UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION, VIENNA, AUSTRIA BY ANCO - THE NATIONAL TRAINING Authority, Dublin, Ireland.

John Moore
April 1986

BACKGROUND:

UNIDO in response to a request from the Governments of Ethiopia, Zambia, Tanzania and Malawi, agreed to provide assistance to the 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 Zambian leg of the mission was undertaken from 7th - 14th March 1985.

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 needs survey for industry should be undertaken for the period 1987 -1992. This exercise should be carried out under the aegis of the Department of Manpower Planning and Training.

- Facilities at the "Zimco" Institute of Management 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/trainers should be drawn jointly from the "ZIMCO" Institute and Industry.

- Trainer Development Fellowships should be awarded to:

Mr Alexis Ngwane	-	ZAPP
Selected candidate from	-	Cold Storage Board
Mr Njobvu	-	ZAPP

- Programme curricula should be developed collectively between the Zimco Institute of Management, qualified Industry Trainers and other interested parties. The role of the External Expert would include assistance here.

- 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 including T.V.

- Programmes in the areas of Maintenance Management and Systems Application should be made widly 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.

- Urgent consideration by the relevant agencies should be given to the reintroduction of a Formal Apprentice Training Scheme.

- A feasibility study should be undertaken to assess the potential benefits through greater utilisation of the Copperbelts off-the-job training facilities.

- The Northern Technical College training facilities for Refrigeration and Air Conditioning requires up-grading of both equipment and teaching staff.

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 Lusaka	Mr G Bekelle - Senior Industrial Development Field Adviser Mr Mustala - Programme Officer Mr P Shima - Deputy Resident Representative
Zimco	Mrs Siwela - Group Training Manager
INICO	Mr Shakalima - Group Manpower Planning & Training Executive
University of Zambia School of Engineering	Prof. F.D. Yamba - Dean Dr. H.J.M. Van Megel - Head of Mechanical Engineering
Dairy Produce Board	Mr Lihonde - Production Manager Head of Engineering Maintenance Mr John Denham - Engineer
Drake Graham	Mr Frank Aung - Contracts Manager
Directorate of Manpower Planning & Training	Mr K A Chali - Director

Department of Technical Educational & Vocational Training	Mr Fisher - Principal Officer Mr D J Mbewe - Inspectorate & Curriculum Development Branch
ZAPP	General Manager Mr A J Mukane - Chief Engineer Mr Njobvu - Personnel & Training Manager Mr A Ngwane - Electrical Engineer
ZIMCO Institute of Management	Mr A.S.S. Kafuta - Director Mr N Gananadha - Deputy Director Mr L.E.C. Zulu - Personnel & Administration Officer
Zambia Breweries	Mr S.I.J. Phiri - Chief Personnel Manager
Cold Storage Board of Zambia	Mr Kalufula - General Manager Mr Mbalashu - Personnel Manager

MAIN FINDINGS:

With the life of the Copper Mining Industry now estimated at less than 20-25 years, Zambia is focusing increasing attention on its agricultural potential and related industries. However, tight economic problems manifested in an acute shortage of foreign exchange has resulted in many industries working under capacity, overmanning leading to low productivity, high cost of production, undercapitalisation, and a serious shortage of spare parts. These factors were clearly evident during my visits. With very few exceptions, 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 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 and skills requirements.

- Plant out of production for lenghty periods awaiting spares.

- Lack of, and inability to use sophisticated test equipment and specialised tools.

There is no formal "Apprenticeship" System in operation. The entry route to industry for "craft training" is direct from Technical College with graduates holding the basic craft/technician certificate. One years training exposure to industry is arranged

On securing full time employment an additional period of up to five years on-the-job training exposure is required before being deemed qualified. The Department of Technical Education and Vocational training plan to upgrade the "Refrigeration and Air Conditioning Mechanic" course run at the "Northern Technical College" from its present status of craft to technician level. An Advisory Committee, representative of the major interests including industry is collaborating with the College's Curriculum Development Division on the preparation of a revised syllabus. Focus will be largely on content, setting standards and the provision of on-the-job training, with industrial interests largely influencing the outcome.

There are no national training facilities for skills updating in Refrigeration and Air Conditioning. (The facilities at Northern Technical College can only address basics). 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 (ususlly one machine) nature of the training provided.

The four year "Mechanical Engineering" degree course on offer at the "University of Zambia" School of Engineering includes inputs on therodynamics and Refrigeration but is largely theoretical. In the case of one employer visited, two recently recruited graduates were undergoing 18 months of field exposure to provide them with the technical competence before being considered for executive positions.

Managment Training is provided by the "ZIMCO Institute of Management" and "INDECO Management Development and Training Centre". The former institute has on offer a wide range of management and supervisory development programmes in addition to practical workshop training in Mechanical and Electrical Engineering. Having assessed the potential at both the University's School of Engineering and Zimco Institute of Management for setting up a Centre of Excellence, the Zimco Institute 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.

There is a serious lack of co-ordination in the provision of training services by the multiplicity of state agencies involved. One senior official in the Department of "Manpower Planning and Training" admitted that this uncoordinated approach has led to duplication, overlapping, confusion and a waste of scarce resource. He sees as a major objective the untangling of the present system. Also the many excellent training facilities located at the copperbelt have not been used to any appreciable extent for the benefit of the country at large. The utilisation of spare training capacity for an extra quota of industry sponsored trainees on a programme such as Industrial Instrumentation and Control could prove very beneficial and cost effective.

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.

ZIMCO - (Zambia Industry and Mining Corporation)

Zimco is the state unbrella or holding company for enterprises amounting to 80% of the country's turnover. Included among its 11 sectors are - Mining, Agriculture, Industry & Distribution. They provide a group training advisory service which includes a training needs assessment for the various sectors, have a decision making role on training budget allocation and run the Zimco Institute of Management. Outside expertise is also used on a regular basis.

INDECO - (Industrial Development Corporation)

The Indeco group comprises the 37 companies of the Zimco Industrial Sector. With two or three exceptions, the state is either the major shareholder or outright owner. Indeco provide a group training service to each of the 37 companies through the individual company based training function where possible. Albeit not very systematic, an attempt is non the less made to carry out a regular assessment of training needs. Many of the identified needs are met at Indeco's Management Development and Training Centre which is part of the "Directorate of Personnel and Public Relations".

The Centre which houses the Group Training Specialists and Manpower Planning Services provides training facilities in specialised and essential skills intended to respond to the particular training need of Indeco Group of Companies. The major part of the group training programmes are organised and conducted at the Centre. In addition to training programmes, the Centre staff provides the following services to the other interested agencies in the parastatal and the private sector.

1. Identification of training needs.

2. Designing and conducting in-company training programmes based on unique individual company needs.

3. Job Evaluation

4. Manpower Planning

5. Training, Evaluation and Validation

6. Career Counselling

The training policy provides that where an operating company's particular needs cannot be adequately met by the MDTC, then it can arrange with appropriate external agencies the provision of required services.

Zimco Institute of Management:

Zimco Institute of Managment (ZIM), the Multi-Occupational training Centre of Zambia, offers courses in a wide variety of fields and disciplines. In recent years, ZIM has been concentrating of designing and running Management Training Programmes including Executive Development Workshops for Senior Management Personnel from Government Parastatals and Private Sector Organisations. Facilities include well equiped lecture rooms and Electrical and Mechanical Engineering Workshops.

The Managment Training Department consists of both the Secretarial Studies Section and the Management Studies section. Management Studies cover the fields of Supervisory Development, Human Resource Management and Transport and Physical Distribution Management. Both sections run in-service modular training programmes as well as courses of longer duration leading to professional qualifications.

The methodical approach adopted emphasises the practical aspect of management and towards thie end many courses are conducted in the form of a workshop. Case studies, closed circuit television, films, simulation exercises, management games, practical assignments, tests and other audio visual aids are extensively used to ensure consolidation of learning.

The Accountancy and Financial Management Training Department is divided into two sections: Accountancy and Financial Management and Computer Studio and Information technology. These two sections also run short modular courses designed to bridge the performance gap and courses of longer duration leading to professional qualifications of local and international recognition.

The Operations and Engineering Department consists of the following three sections: Mechanical Engineering, Electrical Engineering and Commercial Repair and Driving. The Engineering Sections run career development courses leading to formal qualifications.

Department of Manpower Planning & Training

With a total staff of 79 including Manpower Officers regionally located in the Ministeries, Local Authorities, Parastatals etc., this department sees its role as " the initiator and formulator of Zambian Manpower Development in the entire human resource area". 80% of its services are directed towards Government with 20% only towards private industry. They devise matters of policy on the Zambianisation Programme. A major cause for concern here is the state's level of dependance on "outsiders" and "outside funds" and the lack of ability to sustain progress when such intervention ends.

Their Zambianisation policy includes providing more In-Country Training through developing a total National Training Capability. A pre-requisite for the achievement of this goal is the immediate undertaking of strategic manpower studies particularly for key industry skills to provide training investment justification. No such studies have been previously undertaken.

(Mr K A Chali - Director, was most enthusiastic and supportive of the mission and undertook to bring it to the attention of the highest levels of government, also my advice and recommendations on the re-introduction of a formal Apprentice Training System and The National Strategic use of the training facilities located at the Copperbelt).

Department of Technical Education and Vocational Training:

This department is responsible for running the states two Technical Colleges which offer a wide range of craft and technician programmes including the two and a half years duration Refrigeration and Air Conditioning Mechanic's course at the Northern Technical College.

Programme Content: Refrigeration Workshop Operations; Principles of Refrigeration Equipment; Gas and Electric-Arc Welding and Cutting; Preventative Maintenance; Receiving Instructions and Initiating On-Site Action; Trouble-Shooting; Repairing of Refrigeration and Electrical Equipment.

Communication Skills and Political Education are taught throughout the course.

After completing the course, the successful graduate is issued with an Interim Certificate and is expected to work under supervision for a minimum period of one year before being awarded a Craft Certificate upon the employer's recommendation.

Employment opportunities exist in big firms such as Zambia Horticultural Products Ltd., Zambia Pork Products, Cold Storage Board of Zambia and many other institutions which deal in the preservation of food products; or the hospitals, Zambia Breweries or refrigeration and air-conditioning maintenance and repair firms. After gaining experience, the Refrigeration and Air-Conditioning Mechanic can set up his own shop.

As previously mentioned plans are in hand to upgrade the course to technician level. The present output of 16 graduates every two and a half years is considered inadequate to meet industry's requirements. This situation has led to direct recruitment of unqualified personnel by industry with the consequent lowering of standards. Lack of both trained teachers and equipment has prevented expansion. 25% of students are directly sponsored. On the issue of formal apprenticeship, there is a perceived lack of training function expertise at employer level to handle such a system.

Processing Industry and Cold Storage Plants:

Most of the facilities visited are in need of equipment refurbishment. A number have already launched on such a programme including the Brewery's, Dairy Processing & Cold Storage Plants. The quality of installation work was generally found to be of a high standard. Lack of spare parts and the lead time required in re-ordering was the biggest single problem maintenance departments had to contend with. One department instanced the recent replacement of a simple sealing washer whereby a key maintenance technician had to spend an entire day searching the various stores in lusaka. Even conventional tools are in very short supply. The Dairy Product Board have a significant capital investment programme underway which will include the installation of a number of complex high tech. lines. The Chief Maintenance Engineer commented that 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 the Breweries 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 function. The few attempts at planned maintenance in evidence were very elementary. One Engineer spoken to was reluctant to undertake normal preventative maintenance, his rational being " Why dismantle equipment if no spares are available to replace worn parts". A local high precision engineering shop has undertaken limited spares manufacturing of engineering compontents but the costs were found to be prohibitive even by local industry standards.

UNIVERSITY OF ZAMBIA:

The School of Engineering offers a four year degree course in Mechanical Engineering which includes imputs on Thermodynamics and Refrigeration. This coverage is highly theoretical with limited laboratory and virtually no workshop practicals. Lack of finance is seriously delaying the upgrading of faclities.

SERVICE & REPAIR INDUSTRY:

One major privately owned company together with a number of smaller competitors are engaged in systems design, service, and repair work. Limited fabrication work is also undertaken - mainly display cabinets and air conditioning ducting systems. Technical staff are recruited from the Nortern Technical College and a further five years on-the-job training is provided. Spares provisioning is a major and expensive problem, - almost to the point of being prohibitive. Spare parts procurement is generally undertaken on a contractual basis using the limited currency import facility licenced by the client. One design expert spoken to, with 20 years of local experience, intimated that 15 - 20% of spares requirements only, could be met by developing a local spare parts manufacturing capability, given the sophisticated specialised nature of key components. (Unkile auto parts refurbishment - where a properly tooled facility can cover 30% of parts).

Recent price escalations also caused the cancellation of a significant number of service contracts including some key installations. However, because of local inability to substitute maintenance coverage, the consequential increased incidence of breakdowns have persuaded many clients to renegotiate contracts. A typical service checklist is included overleaf.

PERIODIC PREVENTIVE MAINTENANCE SERVICE REPORT

CLIENT: _____

PREMISES: _____

DATE OF VISIT: _____ JOB NO: _____

TYPE OF EQUIPMENT: _____

Schedule of equipment to be ticked as applicable. Faulty or defective equipment to be noted in the remarks column below.

AIR FILTER CLEANED		CONTROLS VALVES CHECKED		
CONDENSER COIL CLEANED		REFRIG. COMPRESSOR CHECKED		
EVAP. COILS CLEANED		REFRIG. CONTROL CHECKED		
HUMIDIFIERS CLEANED		REFRIGERANT CHARGE CHECKED		
FANS CLEANED AND CHECKED		HALIDE LEAK TESTED		
MOTORS CLEANED		SOLENOID VALVE CHECKED		
BEARINGS LUBRICATED		REFRIGERANT PIPING CHECKED		
DRIVES CHECKED AND ADJUSTED		WATER PIPING CHECKED		
PUMP GLANDS CHECKED AND ADJUSTED		ELEC. PIPING CHECKED		
HOLDING BOLTS CHECKED		SPACE TEMPERATURE		
COOLING TOWERS CLEANED		OIL FILTERS CHECKED		
WATER SPRAYS CHECKED		OIL LEVEL CHECKED		
CHEMICAL TREATMENT CHECKED		CONDENSER TEMP	OUT	
ELEC. CONTROLS CLEANED AND CHECKED		CHILL PRESSURE	IN	
AIR HEATERS CHECKED		CHILL PRESSURE	OUT	
INDICATORS CHECKED		CHILL TEMPERATURE	IN	
CONTROL STATS CHECKED AND CALIBRATED		CHILL TEMPERATURE	OUT	
ALL SAFETY CONTROLS CHECKED		SUCTION PRESSURE		
TIME CLOCK CHECKED		DISCHARGE PRESSURE		
INSULATION CHECKED		OIL PRESSURE		
AIR DUCTING AND GRILLES CHECKED		LOG BOOK FILLED	IN	
ALL PRESSURE GAUGES CHECKED				
PNEUMATIC CONTROLS CHECKED				

REMARKS:

MATERIAL:

LABOUR:

Engineer's Signature _____ Clients Signature _____

Date: Date:

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE STRATEGY

Conclusions:

From the foregoing the major maintenance problems facing Zambian Industry can be summarised as follows:

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

- 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.

- Lack of formal apprentice training system.

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 Department of Manpower Planning and should ideally form part of the proposed National 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 labout demand by skill. It should:

- Determine the present employment levels in the relevant sectors.

- Determine the employment effect 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 economicly justify the establishment of a Centre of Excellence.

From discussions and observations, the "Zimco Institute of Management" is the most suitable venue and offers the best long term prospect 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 Zimco Institute of Management, equiped with modern presentation aids are adequate, even in the short term to meet the programme requirements.

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

(See Appendix 1)

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 Zimco Institute of Management and Industry 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 industry personnel were identified as potential trainers.:

Mr Alexis Ngwane	-	ZAPP
Mr Njobse	-	ZAPP

In addition the "Cold Storage Board" expressed a wish to select a suitable canditate for development and subsequent involvement.

The three selected industry 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.
- Testing-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 Traiing 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 comprenensive grasp of industrial and vocational training practice and admininstration.

Curriculum Design:

An Advisory Committee representative of the Directorate of Manpower Planning and Training, ZIMCO Institute of Management, Indico, Department of Technical Education and Vocational Training, and Industry representatives should be established to advise on the content and format of programmes to meet national requirements. A key objective shold 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.

. Zimco Institute of Management Courses, including:

- Management Development Course.
- Business Management Course.
- Purchasing and Supply Course.
- Workshop Management Course.
- Stores Management Course.

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 Zambian Industry should be promulgated through Regional/Industry Sector Seminars backed by an advertisement campaign using the various media including T.V..

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

In so far as possible local "success stories" shjould 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 coordinate Industrial Maintenance activities at the Natinal 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.

Apprentice Training:

Special consideration should be given to the re-introduction of a formal Apprentice Training System, incorporating a coordinated Industry/Department of Education and Vocational Training involvement. A feasibility study should be underatken 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 profle is outlined hereunder. A prerequisite to its introduction however would be the upgrading of facilities at the Northern Technical College which should also constitute part of the feasibility study.

OUTLINE OF 4 YEAR APPRENTICESHIP TRAINNG MODEL

YEAR	PROGRAMME	TESTS/CERTIFICATES
1	Off-the-job Training and related Theory Education (6 months) 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)

Job Training Profile - Refrigeration Mechanic

Workshop Practice:

1. Bench fitting, marking out, cutting, filing, drilling, tapping and fixing to specified tolerances.

Pipework

Select and install annealed copper tubing up to ¾" using Flare Fittings

3. Select and install un-annealed copper tubing over ¾" 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 capilliary 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 Direct 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 Seperators.

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

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 [illegible] 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 $0^{o}C$.

66. Select, install, commission, maintain and repair Low Temp. Holding Room equipment and controls to $-30^{o}C$.

67. Select, install, commission, maintain and repair Blast Freezer equipment and controls.

68. Select, install, commission, maintain and repair Milk Storage Bulk Tank equipment 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 controls.

72. Install, commission, maintain and repair Heat Pump and Room Air Conditioners.

73. Install, commission, maintain and repair Heat Reclaim Systems and Controls.

74. Install, 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 Freon and 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.

REFRIGERATION MECHANIC TOOLKIT

ITEM	DESCRIPTION	QUANTITY
1. (A)	Tool Box: Steel construction 5 compartment Size 500 x 200 x 200 mm.	1
2. (A)	Brass lock of good quality	1
3. (A)	Ball Pein Hammer: 650 g Hickory Handle	1
4. (A)	Pliers: Insulated 200 mm long nose off-set.	1
5. (A)	Pliers: Insulated 200 mm good quality.	1
6. (A)	*Pliers Circlip: for external use 8 - 25 mm Straight Nose	1
7. (E)	Crimping Tool and Wire Stripper: Insulated handle 200 mm long.	1

ITEM	DESCRIPTION	QUANTITY
8. (A)	*Scissors: Multi purpose for gasket making etc.	1
9. (A)	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. (E)	Phase Tester: Insulated, of good quality, for 500 volts. 300 mm tip x 150 mm long.	1
11. (A)	Screwdrivers Crosshead: (a) 3 mm tip x 100 mm long. (b) 6 mm tip x 150 mm long.	2
12. (A)	Hacksaw Tubalar Steel: Adjustable up to 300 mm Good quality grip for hand protection.	1
13. (A)	Junior Hacksaw of good quality.	1
14. (A)	File: Half-round, medium double-cut, plastic handle. 200 mm long.	1
15. (A)	File: Flat, fine double-cut, plastic handle. 150 mm long.	1

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

ITEM	DESCRIPTION	QUANTITY
26. (B)	*Valve Stem Socket Spanner: $\frac{3}{16}$" x $\frac{1}{4}$"	1
27. (B)	External Bending Springs: $\frac{3}{8}$", $\frac{1}{2}$", $\frac{5}{8}$", and $\frac{3}{4}$".	4
28. (B)	Charging Manifold: Robust type with charging lines and flare blanks. Compound Gauge 0KPa - 700 KPa Pressure Gauge 100 KPa - 3,000 KPa	1
29. (B)	Flaring and Swaging Set: of good quality. $\frac{3}{16}$" - $\frac{3}{4}$" O.D. Copper. (4.7 mm)	1
30. (B)	Tube Cutter: with reamer and spare cutting wheel. 3 mm - 30 mm tubing.	1
31. (B)	Pocket Thermometer in Steel Case: Scale - 40°C to 50°C approx.	1
32. (A)	Steel Tape: of good quality. 3 M (min. length) with scale in mm.	1
33. (A)	Square (Steel): 200 mm long with scale in mm.	1
34. (A)	Level: of robust quality 600 mm long.	1

ITEM	DESCRIPTION	QUANTITY
35. (A)	Plumb Line: 200 g wt. and 10 M of line.	1
36. (A)	Allen Key Set: Metric in Plastic case.	1
37. (A)	Small Dust Brush: 50 mm wide x 150 mm.	1
38. (A)	Safety Goggles: with exchangeable lenses.	1
39. (A)	Stillson: of good quality. 400 mm.	1
40. (A)	Vice Grip Pliers: of good quality. 250 mm.	1
41. (A)	B.A. Box Spanners: 2B.A., 3B.A., 4B.A. and 5B.A.	1

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	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 - ear 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 wet 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 O - 3,OO 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^{O} to $120^{O}C$ 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 - $60^{O}C$ + $60^{O}C$ (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

ITEM	DESCRIPTION	QUANTITY
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

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