OCCASION

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

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

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

17965

Distr.
RESTRICTED

IO/R.123/Add.2
28 November 1989

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

ORIGINAL: ENGLISH

TRAINING COMPONENT OF THE SUDAN SUGAR REHABILITATION PROJECT

SF/SUD/86/003

SUDAN

Technical report: Technical services for training under the Sudan Sugar Rehabilitation Project - PHASE I*

Appendix IV

Prepared for the Government of Sudan
by the United Nations Industrial Development Organization

Based on the work of John Bye, chief technical advisor

(incorporating extracts and recommendations from reports of other UNIDO experts assigned to the Project)

Backstopping officers: G. Anestis, Section of Integrated Industrial Projects and M. El Gallaf, Industrial Training Branch

---

* The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Secretariat of UNIDO. This document has not been edited.

V.89 61710

CONTENTS

Annexes

Appendices*

* Contained in IO/R.../Add.1 and IO/R.../Add.2

REPORT ON MECHANICAL ENGINEERING TRAINING

by Mr. Lennart Lygdman
Senior Training Officer

ABSTRACT

The objective of the mission was to strengthen the training capability of the Sennar Sugar Training Centre with material and techniques for modular training in organization and management of maintenance systems and techniques in mechanical engineering.
The duties where carried out January-March 1989.

Conclusions and recommendations.

The Sennar Sugar Training Centre is one of the key-resources available to assist the sugar estates to improve performance in the field of maintenance and mechanical engineering.
The present maintenance procedures used by the sugar estates can be improved by the introduction of a systematic approach to maintenance. Efforts in this direction are being attempted under the ongoing rehabilitation programme.

The training centre is recommended to provide training in order to improve human performance in mechanical engineering and maintenance as follows:

-Maintenance management.
-Maintenance systems.
-Maintenance techniques.
-Reconditioning techniques.
-In-situ repair techniques.

1.0 INTRODUCTION.

The government of Sudan represented by the Sugar Project Implementation Committee (SPIC.) in the Ministry of Industry requested assistance within the objectives of the project document in the field of planning and executing the training programmes to the Sennar Sugar Training Centre.

Subsequently the United Nations Industrial Development Organization (UNIDO) in Vienna appointed on the 1st of January the expert for the post No 11-02/ J19200 to be attached to the international team within the training centre for a period of three months.

The objective of the mission was to strengthen the training capability of the Sennar Sugar Training Centre with material and techniques for modular training in organization and management of maintenance systems and techniques in mechanical engineering.

The duties where carried out in close cooperation with the Chief Technical Advisor (C.T.A.) of the project and two appointed counterparts, centre management and other international experts and management from the sugar estates concerned.

2.0 VALUE OF CURRENCY.

The value of the Sudanese Pound during the period of mission, January-March 1989 was 11,7£ to 1US$.
UNIDO dollar cheque issued for local purchase of training material and daily subsistence allowance was 4,4£ Sudanese Pound to 1 US dollar.

3.0 EXPLANATORY TERMS.

3.1 Condition monitoring is a technique used in maintenance to find failures in equipment or machines before the failures interupt the production.

3.2 Reconditioning techniques like metal spraying, metal plating and metal stitching are valuable techniques that can prolong the lifetime of spare parts and also save valuable foreign currency. Instead of scraping worn out parts, the parts can be reconditioned and re-used again.

3.3 In-situ repair techniques are used to avoid long stops in production. In-situ repair is a techniques which reduces the repair time by repairing the machine on site with minimum dismantling by using portable machine tools.

4.0 TERMS OF REFERENCE.

Duties for the expert (Senior Training Officer).

(a)To assist in planning and executing the training programmes in organization and management of maintenance systems in mechanical engineering to be run by the Mechanical Engineering Department of the Sennar Sugar Training Centre.

(b)To coordinate with the work of the other international experts on the project and in cooperation with the team (international experts and counterparts)develop, in accordance with the needs , an approach, strategy, methods, techniques and curriculum for various programmes within his specialized field.

(c)To train the counterparts that need training within his field.

(d)To act as Deputy to the Chief Technical Advisor to the whole project.

(e)Prepare progress report and final report at the end of the assignment(s).

5.0 ACTIVITIES.

5.1 Briefing in Vienna.

During the two days briefing 5-6 January 1989 at UNIDO headquarters in Vienna, the expert was briefed by the responsible officers in order to be prepared for the assignment at the duty station in Sennar, Sudan.

The expert left Vienna for Khartoum,Sudan 7 January 1989.

5.2 Travel to Duty Station.

The expert arrived at Khartoum 8 January 1989.
After visits and introduction at the UNDP office , Sugar Project Implementation Committee (SPIC) ,and other needed administrative duties the expert left Khartoum 11 January 1989 for travel to Sennar.

5.3 Introduction at the Duty Station.

The expert arrived at the Sennar Sugar Training Centre 12 January 1989.
After introduction to the centre management and the two appointed counterparts ,Mr Osman El Tahir Ali, head of the mechanical engineering department and Mr Mohammed Abbas Mohammed , instructor in the machine shop a tour was arranged to see the centre facilities.

The Chief Technical Advisor of the project informed the expert that the third selected counterpart was on temporary leave of absence.

The impression of the centre management, as well as counterparts was positive and the expert looked forward to future cooperation in fulfilling his duties at the training centre.

5.4 Back up facility's.

The office facility and administrative staff where not up to required standards from the beginning of the assignment. However during the experts stay both the facilities and qualified staff were upgraded for the benefit of the centre.

The housing as provided by the Sennar Sugar Training Centre was brought to minimal, acceptable standards. No cooking facilities utensils or crockery were available on arrival. The Expert had been suitably briefed by the C.T.A before living Khartoum and purchased an electric hob, various pans and containers, bed sheets and blankets.
After extensive cleaning and maintenance by the Expert,his wife and support from the centre the house became tolerably for three month stay.
The house lacked the proper maintenance as well as needing household furniture and goods. It is recommended that the centre improve their awareness of maintenance in order to maintain the planned lifetime of the houses and equipment.

5.5 Study visits.

To get acquainted with the management, training officers and international experts in the sugar estates, two estates tours were organized.
The first visit was to Sennar Sugar Estate 14 January second to Assalaya Sugar Estate 24 January.
The expert was accompanied by Mr Clanton the appointed expert in training methodology.
During the organized meetings and estate tours the experts had the opportunity to discuss needed training in various critical areas of the estates.
The two study tours were interesting and useful for the experts future work.
Another interesting and informative visit was made to Wad Medani Vocational Training Centre.
After the study visits the Expert prepared a progress report for the C.T.A of the project.

5.6 Essential meetings.

After the well organized study tour to the sugar estates,the expert had the opportunity to attend several meetings with the sugar estates training officers as well as other international experts.
One essential meeting was held 8 February in the Sennar Sugar Training Centre. In the meeting the expert could discuss subjects within his field of specialisation.
The expert could also follow up important issues with each training officer and international expert when needed.

Other important meetings was held in Khartoum when recruiting new instructors for the centre 4-5 February.
The Expert contributed by assisting the centre management in the interviewing of 30 candidates and the subsequent appointment of 4 counterparts.

5.7 Training programmes.

Training of trainers.

A three weeks training of trainers programme was organized 12 February for training of instructors and invited staff from the industry. The expert contributed by lecturing on the awareness of maintenance in designs and developing advanced training programmes.

Maintenance Awareness Training.

A maintenance awareness training course was organized 11-12 March for training of counterparts, instructors, and production engineers from the Sugar Estates.

The objective of the course was to increase the awareness of maintenance as well as understanding the the principle of organization of maintenance, systems, and techniques.
Prior the training course the Expert and the appointed counterparts designed a two weeks course covering the general principles of maintenance.The designed course can be used as an maintenance awareness module in connection with other courses carried out by the Centre.

6.0 ACHIEVEMENT AND PROGRESS.

The counterparts as well as instructors within the Sennar Sugar Training Centre have learnt the general principles of industrial maintenance, organization, systems and techniques.

The centre instructors have gained the knowledge to carry out training assessment and analysis related to a qualifier required during the needs assessment in the sugar estates.

The qualifier related to the mechanical engineering department is a description of all machines and equipment in use in the field of mechanical engineering and maintenance.

Training officers from the sugar estates as well as the training centre are aware of the importance of close cooperation in order to integrate the training activities carried out by the centre to the actual needs within the sugar estates.

Work plans were made for personnel,premises, materials, and equipment. One included in this report and C.T.A's final report.

7.0 CONCLUSIONS AND RECOMMENDATIONS.

The sugar estates concerned need assistance in training to improve maintenance performance in various fields.

The above findings were made after factory visits and study of the present maintenance procedures,meetings,discussions with estate management, and training officers as well as own judgement as expert in this field.

The major present maintenance procedures need a systematic approach.
The working cycle of an sugar estate provides however a very long annual maintenance window every season.To properly utilize the annual maintenance window and carry out all maintenance requirements is very difficult without a systematic condition based maintenance procedure.
The present maintenance procedure used is to operate to failure and then repair. This generates high maintenance costs due to over consumption of spare parts.

The present procedures have also other drawbacks like frequent disturbance in production or difficulties to maintain the required quality for the finished products.

7.1 The sugar Estates.

The sugar estates must recognise that maintenance is one of the key-resources to maintain and keep up planned production.

With well organized and systematic maintenance comes the following benefits:

- -Increased possibilities to achieve the planned production.
- -Decreased maintenance costs.
- -Reduced consumption of spare parts.
- -Better working environment in the estates.
- -Increased safety for the personnel'.
- -Improved quality.
- -Improved profitability.

It is a must for topmanagement in any estate to be aware and recognise the importance of maintenance. The estate policy towards maintenance must be well known by all employees working in the estate.

7.2 The Sennar Sugar Training Centre.

General.

It is recommended that the Training Centre introduce training in organization and management of maintenance as well as maintenance administration, systems and techniques.

It is also recommended that the Training Centre have the support from SPIC to enable it to introduce and convince the topmanagement from the sugar estates to recognise maintenance as one of the key resources for achieving planned production.

One method proven to be efficient is the introduction of maintenance awareness seminars for topmanagement from the sugar estates.

The main objective of the seminars is to convince topmanagenent to recognise maintenance as one of the important resources to achieve the planned production as well as maintain the planned technical life time of installed production machinery.

During the Top-management seminars, it is recommended that the Centre Director or deputy will participate and give information regarding the centres resources for training in maintenance management, systems and techniques.

When the convinced and highly motivated topmanagers return to their estates, they will look forward to sending their personnel to attend training in maintenance carried out by the centre.

7.3 Mechanical Engineering Department.

The Mechanical Engineering Department shall at all times follow the purpose and goals set up for the Sennar Sugar Training Centre.

7.3.1 Purpose of the Mechanical Engineering Department.

The Mechanical Engineering Department is responsible for providing production oriented training to improve skills and efficiency in mechanical engineering and maintenance for all personnel working in the sugar estates concerned.

7.3.2 Goals for the Mechanical Engineering Department.

The Mechanical Engineering Department shall at all times follow technical developments within the department's fields of specialisation.

Training activities carried out by the Mechanical Engineering Department shall at all times be production performance oriented.

The training assessment and analysis of training needs shall result in a cost effective ranking, of training programmes considering the best utilization of the department's resources and the impact of the training.

7.3.3 Training programmes.

The training modules, courses, seminars, workshops or programmes shall be designed and developed in accordance with the training methodology approved for the Sennar Sugar Training Centre.

The training programmes planned and carried out shall at all times follow the purpose and goals set for the Mechanical Engineering Department.

Training assessment and analysis for the various fields of mechanical engineering shall be carried out following the work plan set by the centre management and the prepared guidelines for developing modular training programmes.

It must be recognised that the training assessments and analyses have to be made in close cooperation with the line department expert and the training officer from the sugar estates concerned to ensure that the purpose and goals of the Mechanical Departments training are fulfilled.

After a study tour visiting two sugar estates and dissusions with management from the engineering and maintenance side a number of critical areas in mechanical engineering and maintenance that needed training where scheduled.

With the scheduled critical areas of training needs as a base a preliminary two years training programme can be recommended.

7.3.4 Maintenance.

It is recommended that the awareness of maintenance should be improved by introducing the general principles of maintenance in all programmes carried out by the Centre.

Further assessment and analyses of training needs in the field of maintenance shall be made following the training methodology approved by the centre as well as the UNIDO training manual for leaders of seminars on industrial maintenance in developing countries.

Training assessments and analysis have to be made in close cooperation with line department expert and the training officer from the sugar estates to ensure that the purpose and goals of the mechanical department are fulfilled.

7.3.5 Maintenance management training.

It is recommended that training in the field of maintenance will be carried out following an international recognised philosophy of maintenance.

Maintenance administration systems, manual or computer-aided shall be adapted to the recognised philosophy of maintenance.

7.3.6 Computer aided maintenance.

A systematic approach towards maintenance requires training covering the general principles of maintenance as well as maintenance administration , systems and techniques.

The Mechanical Engineering Department is recommended to have the capability to provide maintenance management training using modern administrative aids like computer aided maintenance systems.

The department is also recommended to provide training using manual maintenance systems.

The manual systems can be designed and developed within the department in accordance with the international recognised philosophy of maintenance.

It is essential that the database's are obtained from the sugar estates to make the training as realistic as possible.

Establishment and implementation of maintenance systems in the estates can also be provided as in plant training in close cooperation with line department experts and the training officer.

Maintenance systems developed by international experts (MATS-Team) are recommended to be recognised by the Sennar Sugar Training Centre. One copy of all systems produced should be kept in the centre library.
Successful implementation of any system,requires training in use of the system as well as how to administer and maintain the system.
The centre is recommended to provide aining in use of developed systems.

7.3.7 Computer aided maintenance systems.

Efficient maintenance administration requires a systematic approach.
On the market of to day,we can find a number of good manual or computer aided maintenance administration systems.

To maintain and keep a manual system up to date requires awareness and discipline from the user of the system.
The sugar estates must adapt modern technology for simplifying the maintenance administration work. Modern computer aided maintenance administration systems will be an efficient tool when implementing the new approach towards maintenance.

It is important to recognise that the new technology introduced with computers, printers, as well as software also need systematic maintenance.

It is recommended that the Sennar Sugar Training Centre provide training in the use of modern computer aided maintenance administration systems. Please see recommended software and hardware for this purpose:

Recommended maintenance administration system.
Name of the software: The Idhammar System.
For micro computer type, IBM PC, or compatible.
Operative system M.S. DOS. 3.0.
Software estimated price 1989 14 000 USD.
Hardware IBM PC, + printer estimated price 1989 8000 USD.

7.3.8 Organization.

It is decided that the Mechanical Engineering Department will have 8 instructors to begin with,inclusive of the head of the department. At present the department consists of a mechanical machining section and a welding section. It is recommended that the department also has a maintenance section.

The maintenance section will carry out maintenance training in accordance with the purpose and goals set for the mechanical engineering department.

Training of instructors.

Development and training of instructors in the various field of mechanical engineering and maintenance is recommended by using short courses, workshops, or seminars in Sudan or wherever convenient to obtain needed skills as a training instructor. However,the instructors can not be experts in covering the whole field of mechanical engineering and maintenance.

It is recommended that the instructors shall have a broad knowledge of mechanical engineering and maintenance and be able to organize and carry out any training needs in the field of mechanical engineering and maintenance.

Training support.

It is recommended that the instructors can be supported by international experts from the various fields of mechanical engineering and maintenance when needed to provide the expected quality of training. The experts can be organizations or individuals which can be assigned in accordance with the scheduled training activities organized by the department.

7.3.9 Materials, Equipment and Supplies.

The Mechanical Machining Section and the Welding section are equipped to a certain extent.
During Phase 1 there are additional funds allocated for rehabilitation purpose.

Their are some urgent machine-shop requirements that have been fulfilled recently like Dividing Head and Foot Stock for the Milling Machine as well as spare parts and tools for the lathes .

Maintenance equipment and tools.

The Maintenance Section is recommended to have basic mechanical tools for maintenance purposes and also special maintenance tools associated with the introduction of condition monitoring techniques ,reconditioning and in-situ repair techniques.

Maintenance bibliography.

There is a large number of literature available in the field of maintenance management and techniques subjects.
Most of the literature, however, is theoretical. Very few references combines theoretical and practical subjects.

There is one book recommended for training purpose covering maintenance management as well as systems and techniques.
The name of the book is Maintenance and Reliability by Idhammar Forlag AB Sweden.

7.4 Summary of recommendations.

1. The Sugar Estates are recommended to improve maintenance management, systems and techniques.(7.1)

2. The Sennar Sugar Training Centre are recommended to provide maintenance management, systems and techniques training.(7.2)

3. The Mechanical Engineering Department are recommended to be strengthened in the field of maintenance management, systems and techniques. (7.3)

Purpose and Goals.(7.3.1- 7.3.2.)

Programmes. (7.3.3-7.3.5)

Computer aided maintenance.(7.3.6-7.3.7)

Organization. (7.3.8)

Material Equipment and Supplies. (7.3.9)

8.0 Work plan.

The below work plan is based on the conclusions and recommendations in chapter 7.

8.1 Maintenance equipment.

- Placement of order for equipment in priority.

1. Recommended literature.
2. Basic maintenance tools.
3. Condition monitoring equipment.
4. Reconditioning techniques equipment.
5. Computer hardware, software.

Timing, after approval from centre management.

8.2 Maintenance management.

- Preparation of curriculum UNIDO module IM 100 170,120.

Timing, one months after arrival of CTA and STE.

- Design of modules, teachers/lectures notes.

Timing,after preparation of curriculum.

- Implementation IM 100. Duration 4 days.

Timing, two annual courses.
Maintenance management expert support 2 weeks.

- Implementation IM 170. Duration 4 days.

Timing, two annual courses.
Maintenance management expert support 2 weeks.

- Implementation IM 120. Duration one week.

Timing, two annual courses.
Maintenance management expert support 2 weeks.

- Evaluation of training modules IM 100, IM 170, IM 120.

Timing, at the end of year 1.
Maintenance management expert support 2 weeks.

8.3 Preventive maintenance.

- Preparation curriculum for preventive maintenance systems.
Timing, at the beginning of year 2.

- Design of modules, teachers/lectures notes.
Timing, after preparation of curriculum.

- Implementation of PM-modules. Duration 2 weeks. 4 annual courses.
Maintenance management expert support 3 weeks.(First course).

- Evaluation of the preventive maintenance modules.
Timing, at the end of year 2.
Maintenance management expert support 2 weeks.

8.4 Reconditioning techniques.

- Preparation of curriculum, maintenance repair techniques.
Metal spraying, maintenance welding.
Timing, 6 months after arrival of CTA and STE.

- Design of training modules, teachers/lectures notes.
Timing, after preparation of curriculum.

- Implementation of modules, metal spraying, maintenance welding. Duration 3 weeks. 2 annual courses.
Reconditioning techniques expert support 6 weeks.

8.5 Maintenance repair techniques.

- Preparation curriculum, design, implementation of courses in maintenance repair techniques after further assessment and analyses of training needs.
Timing, one months after arrival of CTA and STE.

9.0 Constraints.

The following constraints exist within the duty station.

- No communication link, Telephone, Telex, Facsimile with UNDP, Khartoum or outside world.
- Houses for experts need maintenance and household facility's up to European standard.
- Project cars are too small to be practical.
- Hospitalization or medical care service can not meet acceptable standard.

Annex 1.

Training schedule.

The below outline of UNIDO maintenance management training modules is recommended to be established and carried out by the Mechanical Engineering Department. Curriculum for each module can be seen in the UNIDO training manual:

TRAINING MANUAL FOR LEADERS OF SEMINARS ON INDUSTRIAL MAINTENANCE IN DEVELOPING COUNTRIES.

Outline of training modules.

Module IM 100:	Awareness-creating seminar on industrial maintenance in developing countries.
Module IM 110:	Seminar on industrial maintenance in developing countries.
Module IM 120:	Seminar on the organization of maintenance at factory level.
Module IM 130:	Workshop-seminar on technical documentation.
Module IM 140:	Workshop-seminar on spare parts.
Module IM 150:	Workshop-seminar on local manufacture of spare parts.
Module IM 160:	Seminar on maintenance workshops.
Module IM 170:	Seminar on the training of maintenance personnel.
Module IM 180:	Seminar on arrangements to be made concerning maintenance when purchasing equipment.
Module IM 190:	Seminar on maintenance costs and budgets.
Module IM 200:	Workshop-seminar on maintenance diagnosis in a factory.

ABSTRACT

REPORT ON TRAINING METHODOLOGIES AND CURRICULUM DEVELOPMENT

by Richard L. Clanton

Training methodologies and curriculum development

Objective

To strengthen the training capability of the Sugar Training Centre in training methodology and curriculum development through the introduction of a modern training system that is modular based, performanced-oriented and criterion-referenced and which upgrades the technical and supervisory skills of training officers, trainers and instructors.

Duration

Two and a half months.

Main Conclusions and Recommendations

Methodology and Curriculum Development-Upon arrival of UNIDO personnel, no scientific systematic approach to the design and development of training programmes existed that would standardized and integrate all training for the Sugar Estates.

Recommendation: Adopt the Instructional Systems Development (ISD) approach as outlined in United Nations and International Labour Organization documents and presented in staff development

[illegible] the [illegible] in the [illegible] design and [illegible] of the training centre and [illegible]

[illegible] the [illegible] were [illegible] the training Programme [illegible] the last [illegible] weeks [illegible]

[illegible] and train [illegible] estates.

[illegible] inadequate for [illegible]

[illegible] reference [illegible] the Program [illegible]

[illegible] limited training and [illegible] equipment.

[illegible] request documents [illegible] of equipment and [illegible] additional copies of [illegible] maintenance manuals for the training centre.

[illegible] made use [illegible] equipment by purchasing TV with attached [illegible] and a computer with related [illegible] for [illegible] development.

I. BACKGROUND

A. OBJECTIVES

The developmental objective of the Technical Services Agreement for Training between the Government of the Republic of Sudan represented by the Sugar Project Implementation Committee (SPIC) in the Ministry of Industry and the United Nations Industrial Development Organization (UNIDO) is to increase production while reducing production costs by providing the skilled manpower through training, which is an essential element of the Sugar Rehabilitation Project.

The immediate objectives are to:

- o Rehabilitate and stregthen the Sennar Sugar Training Centre (SSTC) complex with the appropriate training and accomodation facilities.
- o Establish an integrated training capacity and mechanism at SSTC and the four public sugar estates by providing the training infrastructure and training and support staff needed to make training a viable activity for effective job performance oriented modular training to be conducted at SSTC and the facilities of the sugar industry.

- Provide induction and up-grade training supplementary to the national education system of Sudan in order to develop the appropriate skills and knowledge to meet the needs of (a) training officers, trainers and instructors; (b) engineering personnel; (c) technicians and operatives; (d)administrative and financial personnel; and (e) field staff.

The agreement was signed in June 1987 and would begin when certain pre-conditions were met ie. satisfactory accomodations and office space for assigned experts. A revision was signed in November 1988 but did not significantly affect the original agreement.

Although the Chief Technical Advisor(CTA) and Senior Training Expert(STE) were assigned to the project in June 1988, the activities of this report on training methodology and curriculum development took place during a two and half month period beginning 3 January 1989. Considerable ground work had been done by the CTA and STE in training methodolodgy and curriculum development prior to the arrival of subject expert. Therefore, all objectives were attained even though there were many constraints to accomplishing the work.

B. State of the Sugar Industry

The first sugar mill was established in Sudan at El Guneid in 1962. Since then sugar estates were open in New Halfa in 1965, Sennar in 1977, Assalaya in 1979 and Kenana in 1980. All but Kenana are owned and operated by the government of Sudan. Production at Kenana, the private sector company, was approximately 295,000 tons in 1985/86 and estimates for the fiscal year 1986/87 indicated an output of about 310,00 tons. The four public sector mills together produced 192,000 tons in 1984/85 and 158,000 tons in 1985/86. Production capacities of the mills are as follows:

SUGAR ESTATE	CAPACITY
El Guneid	60,000
New Halfa	90,000
Sennar	110,000
Assalaya	110,000
Kenana	330,000

C. The State of Sugar Industry Training

The four sugar estates in the public sector covered by the rehabilitation project employs over 7,400 professional, technical and administrative staff and over 15,000 unskilled personnel on a seasonal basis. Thus, the sugar industry is one of the leading economic sectors in Sudan.

The positions in the sugar industry cover a wide range of technical and professional skill requirements. Due, however, to the increasing unattractiveness of the salary and incentives package, the turnover has been high and financial constraints have impeded manpower development. This situation has been recently addressed by the government and a better payment structure is being proposed at this time.

The estates currently depend on the education system of the country for their supply of personnel at the different levels. The Vocational Training Centres provide basic training for artisans, the Polotechnics for technicion level and the Agricultural and Engineering Colleges for senior engineers and management personnel. The output, however, does not appear adequate to cover the full needs of the industry.

The Sennar Training Centre was established tc ›vide training within the industry for the required number of artisan level employees. The Centre, however, has been practically dormant the past few years. The main deficiencies, as noted in annex A to the agreement, are inadequate infrastructure and training facilities, lack of finance, skilled trainers, equipment, materials as well as accomodations for students and staff.

II. EXPLANATORY NOTES

A. Value of Local Currency

The value of the local currency during the period of this report was 11.7 to 12.0 Sudanese Pounds = $1.00 Us Dollar. UNDP paid local currency at 4.4 per $1.00 US Dollar making local purchases and subsistance very expensive.

B. Definitions

The following definitions are presented to avoid possible future misunderstanding regarding the integrated systematic training approach recommended for adoption throughout the public sector of the sugar industry. References are cited in the Bibliography..

o Competency-based: A training programme based on the actual tasks successful workers perform on the job rather than on textbooks and other sourses removed from the job itself. (Similiar in meaning to criterion-referenced instruction and performance oriented training)

o Criterion: A description of the degree of acceptable or desirable performance.

o Duty: A convenient label given to a broad category of similiar job tasks (sometimes called blocks or major units of the work)

o Instructional Systems Development(ISD): ISD is the deliberate and orderly process for planning, developing and managing training programmes. It insures that personnel are taught the skills, knowledge and attitudes essential for successful job performance.

o Job Analysis: The analytical process used in descibing human work in terms of tasks.

o Job Description: A brief description of the major activities performed by a worker.

o Job Specifications: The identification and analysis of global, national and specific profiles for a particular occupation.

o Module: A module is a logical and acceptable division of work within a job or occupation. Similiar to and used interchangeably with task.

o Occupation: An occupational area is defined by normal acceptable usage, but does not vary from international standards.

o Occupational Analysis: The process of analyzing or breaking down an occupation into worthy performances or tasks performed by workers on the job.

o Task: A self-contained unit of work which produces a useful result.

o Task listing: A document listing duties and tasks performed by successful workers on the job.

o Training Need: A training need exists when a work performance problem can be traced directly to a skill deficiencey. A training need can thus be described as a specific skill which an individual must acquire in order to perform a task effeciently and effectively.

o Training Programme: One or more modular units of instruction that helps to ensure that participants will obtain the skills necessary to become competent workers.

Please note that the term Sennar Sugar Training Centre(SSTC) is used throughout this report in order to be consistent with the terms of reference in the original agreement. The sign in front of the Centre has been changed twice since arrival, from National Training Centre to National Sugar Training Centre.

III. PROJECT ACTIVITIES

A. Terms of Reference

The primary objective for the expert in training methodology and curriculum development was to strenghthen the training capability of the Sugar Training Centre in training methodology and curriculum development through the introduction of a modern training system that is modular based, performanced-oriented and criterion-referenced and which upgrades the technical and supervisory skills of training officers, trainers and instructors (see Annex A,"Job Description" SF/SUD/86/003/11-03/Rev.4).

Duties

The Training Methodology and Curriculum Development expert is to work in close co-operation with other UNIDO experts and the national staff to:

- Focus on increasing the effectiveness of the training activity by strengthening the industrial training capacity of the SSTC.

Provide training to national counterparts on training and implementation of a modular system of performance-oriented criterion referenced training.

Plan, organize and conduct appropriate training courses for national counterparts and instructional personnel which meet expressed needs and focus on:

Methods and procedures for designing performance oriented training programmes which result in increasing trainee performance.

Training methods, techniques and curriculum development applicable to industrial trainers and instructors.

Assessment and analysis of training needs.

Assist in the design of overseas training programmes for training officers, trainers and instructors.

Prepare a technical report at the end of the assignment.

Additionally, the training methodology expert will laise closely with the CTA, STE and national counterparts to establish an overall strategy for the future development of the training facilities at the SSTC from:

Statistical data prepared by the CTA

Background information from briefings by the CTA and STE

Visits to at least two Sugar Mills and one Vocational Training Centre for orientation

Consultations with other UNIDO experts and national counterpart staff

Advise the national director, CTA and design architect during their consultations to convert the developmental strategies into prioritised developmental schedules for the physical facilities.

Prepare progress reports and a final technical report at the end of the assignment.

B. Activities and Accomplishments

The formal briefing by UNIDO personnel and the written information provided during the briefings helped considerably in preparing the expert to gather the necessary information immediately upon arrival in Sudan.

Despite many constraints, much was accomplished during the brief eight and half weeks in Sudan. Tours and meetings with management personnel at the Sennar and Assalaya Sugar Estates were made; a three week course was planned organized and conducted for the training staff of SSTC and training officers of the sugar estates; visits were made to the Vocational Training Centre and Gizera Agriculture Training Centre in Wad Medini; a formal meeting of training officer's and key SSTC staff was attended; meetings were held with individual Management and Training Systems (MATS) group members and SSTC staff; and most importantly liaised closely with the CTA, STE, the SSTC Director and other UNIDO experts in producing the findings, conclusions and recommendations of this report.

In addition, a counterpart for training methodology and curriculum developmented was recruited, interviewed, hired and although highly qualified, was trained in a comprehensive systems approach to training. Also participated in interviewing candidates for other SSTC professional staff positions. The major activities are described in more detail in the following sections.

Counterpart and Instructor Training

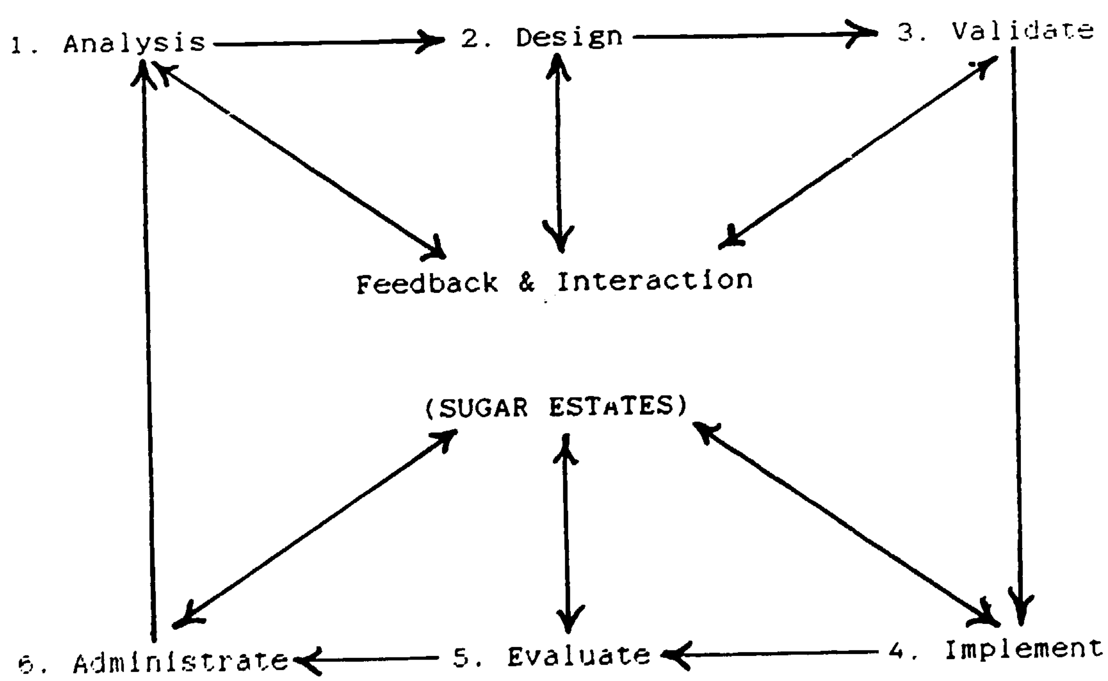
Prior to the arrival of the methodology and curriculum development expert, a "Staff Development Training Programme" (see Annex B, "Programme Plan") was conducted for the SSTC professional staff and training officials from the sugar estates. The course was designed to provide a uniform understanding of one specific model for designing modular training systems. The model presented was the ILO "Modules of Employable Skill" (MES) as described in Staff Development learning elements produced by the Vocational Training Branch of the ILO.

A staff development training programme in "Instructional Systems Development" was designed, developed and implemented from 11 FEB 89 through 3 MAR 89 to continue and expand on the efforts began by the CTA and other UNIDO experts in the previous counterpart training programme. The primary objective of the course was to provide an integrated standardized approach to the design and development of all training programmes conducted for the National Sugar Estates.

Although considerable information was presented (see Annex C, "Syllabus") and participants were required to produce performance documents in all major subject areas, each person, including the Centre Director who was also a participant, saw the need for such an integrated systematic approach for training at the centre and the sugar estates.

The Instructional Systems Development process described in the program and presented as a recommendation in this report is as outlined in United Nations and International Labour documents (see Bibliography). The process is summarized in the following diagram:

INSTRUCTIONAL SYSTEMS DEVELOPMENT



Organizational training needs assessment, job analysis evaluation and administration were taught by the training methodology expert. Course design was presented by Mr. Jack Bye, CTA and writing objectives and class presentations by Mr. Ibrahim AbdelMagid Ibnaouf, methodology and curriculum development counterpart. In addition, Mr. Lennart Lygdman, STE, presented several sessions on production-oriented and preventive and conditioning maintenance training. The course evaluation instruments, designed by the participants, indicated the course was highly successful in both content and participant performance.

Although the methodology and curriculum development counterpart was a recent appointee, late January 1989, he was highly qualified and assisted with each session. In addition, discussions were held daily and sometimes into the late evening on training, methodology and curriculum development.

Two additional counterparts were identified and offers tendered after the interview sessions at SPIC headquarters in Khartom in early Feb 1989. However, both declined the offers because of Sennar's remoteness and unattractive salary and benefits package.

Discussions were also held with the CTA and STE regarding overseas training programmes for training officers, trainers and instructors. Several programmes were identified that might meet the developmental needs of several staff members. The Maeger Institute and programs offered by the American and International Society for Training and Development were mentioned as possibilities for the SSTC Director, Mr. Fadlabi and the Training Programme Development Head, Mr. Ibnaouf.

To assist in determining future training needs, general profiles of the training and instructional staff for the public sugar estates were made from classroom observations and discussions with the individuals (see Annex J through M). No resumes or CV's were available in English and no formal assessments were made on the individuals. Therefore, the profiles are general in nature and were developed only through observations and classroom assignments.

Annex J (Group 1) shows the profile of two individuals that were part of the new recruits during Phase I. Both individuals were above average in aptitude and personal characteristics. Although economically deprived because of the current economic situation in Sudan and thus limited in social and cultural contacts with people from other countries, their English ability and communication skills make them excellent candidates for overseas training in an English speaking country.

Annex K (Group 2) profiles the remainder of the recent recruits for Phase I. Although two individuals received training in Germany, their German and English speaking ability appeared to be poor. Thus training for this group might best be done in an Arabic speaking country.

Annex L (Group 3) gives a general profile of the training and instructional staff on board upon arrival in January 1989. The aptitudes and characteristics of this group are mostly above average. Although four of the individuals may need further English training prior to recieving training in English, their comprehension is generally good and all should benefit from an overseas fellowship.

Annex M profiles three of the training coordinators from the sugar estates. Their knowledge, abilities, and aptitude appeared to be higher than the group average and should be condsidered for further overseas training similiar in scope to the Sennar Centre staff.

Annex N, "Job Description for Department Head, Training Program Development Department" was developed to describe job requirements and provide guidance for meeting the development needs of the methodology counterpart.

Training Officers' Meeting

The meeting with Training Officers and their counterparts on 7 Feb 89 was very productive in gaining information regarding the problems implementing training at the sugar estates (see Annex D,"Minutes of Training Officers' Meeting"). All participants indicated that such meetings were invaluable in introducing and coordinating an integrated systems approach to training and future meetings will be a necessity. Another meeting was scheduled for 12 March 1989. The Board of Directors and SPIC indicated that the Sugar Estates Director General should attend the next meeting.

Tours of Sugar Estates

Tours of the sugar factories in Sennar and Assalaya were arranged by the CTA. The tours showed that the facilities and equipment had deteriated considerably since commissioning twelve years ago. Meetings with plant officials showed a lack of understanding or interest in maintenance and/or maintenance training. No facilities or equipment have been allocated for in-plant training, making it very difficult for training officers to carry out their functions. This was reinforced during the training officers' meeting mentioned above.

Wad Medini Vocational Training Centre

Mr. Ibrahim Ibnaouf, methodology counterpart, previously worked in train-the-trainer sessions for the Vocational Training Centres and thus arranged a very thorough and informative tour of the facilities. Although the ILO has donated considerable equipment and materials for instruction, the maintenance and and care of the workshops and facilities was somewhat lacking.

Gizera Agriculture Training Centre

A tour of the Gizera Agriculture Training Centre was arranged by the Italian Aide Training Consultant. The facility has been vitually dormat for several years so considerable efforts were made to upgrade and remodel the facilities. The proposed training programme in agriculture equipment technology would take a minimum of three years to complete.

Sennar Sugar Training Centre (SSTC)

The Sennar Sugar Training Centre, which is located within the Sennar Sugar Estate, present facilities consist of four workshops with some equipment, six classrooms, a spare parts store room, and limited office space (see Annex E, "Sketch of Existing Facilities"). In addition, there are accomodations for 160 trainees, seven pre-fabricated houses for international personnel when on-site and 15 houses allocated for local staff.

In addition to the director and administrative personnel, there was supposed to be 24 professional staff, trainers and instructors, on board during Phase 1 for training by the international experts. However, because of the remoteness, limited accomodations for staff and families, and the unattractiveness of the salary and benefits package, the centre was only able to hire a total of 15 instructional staff during the period of this report.

The materials and equipment for instructional purposes are extremely limited (see Annex F,"List of Audio-Visual Equipment" and Annex G,"Reference Materials List"). The audio-visual equipment was scattered troughout the facilities when the first experts arrived. Since then, the equipment has been stored in the temporary office of the methodology expert. Although the equipment is somewhat antiquated, attempts were made to clean and repair them. The STE ordered the spare parts and upon arrival repairs were made on salvageable equipment.

The reference materials were extremely limited and were kept locked in a cabinet. The instructors' did not know what reference materials were available nor where they were kept.

Proably the most critical finding was the lack of an integrated and systematic approach to the development of training programmes for the sugar estates. The center has been prcticaliy dormat the past few years and as a result, training both external and in-house, has ceased to keep pace with the evolving needs. Enrollment figures kept by the centre (see Annex H,"SSTC Enrollment Figures") reflect attendance in some programs, but don't give any indication of how many programmes were offered, the type of training that took place nor the number of instructional hours in the programmes. A complete overview of management and administration of training programmes was thus addressed during the staff development training programmes. The participants in the programmes actually designed the forms and formats to be followed by the centre and the sugar estates.

IV. CONCLUSIONS AND RECOMMENDATIONS

Upon analysis of the activities and progress reports submitted to the CTA, the following conclusions and recommendations are suggested.

A. Methodology and Curriculum Development

Upon arrival of UNIDO personnel, no scientific systematic approach to the design and development of training programmes existed that would standardized and integrate all training for the Sugar Estates.

Recommendation: Adopt the Instructional Systems Development (ISD) approach as outlined in United Nations and International Labour documents and presented in staff development programmes as the process to be followed in the design and development of all training programmes at the training centre and sugar estates.

Recommendation: Prior to or within the first 3 months in Phase II a "Guide to the Design and Development of Training Programmes" for the sugar estates should be written by the CTA, STE, methodology and curriculum development expert or other such specialist and approved by SPIC for implementation.

B. Training Staff

Only 15 of the 24 counterparts at the center were on board during the training offered in phase I and the Training Programme Development Department, which is responsible for training methodology and curriculum development, only hired an employee the last six weeks of the project.

Recommendation: Increase efforts to recruit, hire and train qualified training staff at the center and sugar estates.

Recommendation: The Training Programme Development Department should be reorganized and the following staff hired and trained:

Training Programme Development Dept. Head (hired)
2-Analysts/writers
Media Specialist
Graphic Artist
Librarian
Evaluation Specialist
Clerk/Typist

The primary functions of the department would be to provide instructional support to trainers and instructors at the centre and the sugar estates and conduct the train-the-trainer sessions.

Although the Training Officers at each estate would be primarily responsible for training needs analysis, in-plant training and the evaluation of programmes involving personnel at his estate, the writer/analysts would assist the sugar estates training officials conduct organizational training needs analysis and occupational/job analysis. In addition, they would be a resourse to instructors in reviewing curriculum and insuring it meets acceptable standards. They must be fluent in English as well as Arabic.

The media specialist would be in charge of all audio-visual equipment and also serve as the centre's photographer and camera man for video programmes. The graphic artist would assist in curriculum development by helping instructors with the design of wall charts, engineering drawings and any other drawings or graphs required. The evaluation specialist would assist by coordinating evaluation efforts of students, instructors, trainers and programmes. The librarian would of course be in charge or all reference materials and the files for all training programmes designed and developed by the centre and the sugar estates. The British council, through the efforts of the CTA, has agreed to provide training for the librarian in an information retrivial system.

C. Facilities

The centres facilities were poorly maintained and inadequate for introduction of a modern system of training. In addition, only one sugar estate had facilities dedicated for training. The CTA is addressing the facilities in his report and is working with local architects in designing additional facilities and refurbishing existing buildings.

Recommendation: Include in all construction plans a reference library, audio-visual storage space and offices for the Program Development Department staff.

Recommendation: Each sugar estate provide a workshop, classroom and office space for training coordinators and instructors.

D. Materials and Equipment

The training centre had limited training and reference materials and antiquated audio-visual equipment lacking spare parts.

Recomendation: Insert a "training clause" in all bid request documents of over $25,000 US Dollars for suppliers of equipment and services to provide training manuals and additional copies of operations and maintenance manuals for the training centre.

Recommendation: Prior to Phase II modernize audio-visual and curriculum development equipment by purchasing TVs with attached VCRs, portable overhead projectors and a computer with related software and hardware for curriculum development (see Annex I,"Equipment Purchase List").

E. Summary of Recommendations

The above recommendations are summarized in order of priority as follows.

1. Recommendation: Adopt the Instructional Systems Development (ISD) approach as outlined in United Nations and International Labour documents and presented in staff

development programmes as the process to be followed in the design and development of all training programmes at the training centre and sugar estates.

2. Recommendation: Increase efforts to recruit, hire and train qualified training staff at the center and sugar estates.

3. Recommendation: The Training Programme Development Department should be reorganized and the following staff hired and trained:

Training Programme Development Dept. Head (hired)
2-Analysts/writers
Media Specialist
Graphic Artist
Librarian
Evaluation Specialist
Clerk/Typist

4. Recommendation: Include in all construction plans a reference library, audio-visual storage space and offices for the Program Development Department staff.

5. Recommendation: Each sugar estate provide a workshop classroom and office space for training coordinators and instructors.

6. Recomendation: Insert a "training clause" in all bid request documents of over $25,000 US Dollars for suppliers of equipment and services to provide training manuals and additional copies of operations and maintenance manuals for the training centre.

7. Recommendation: Prior to Phase II modernize audio-visual and curriculum development equipment by purchasing TVs with attached VCRs, portable overhead projectors and a computer with related software and hardware for curriculum development (see Annex I,"Equipment Purchase List").

8. Recommendation: Prior to or within the first 3 months in Phase II a "Guide to the Design and Development of Training Programmes" for the sugar estates should be written by the CTA, STE, methodology and curriculum development expert or other such specialist and approved by SPIC for implementation.

The above conclusions and recommendations evolved during a brief two and half month assignment and thus cannot be all inclusive. However, similiar to designing training programmes based on a continuing needs analysis, the recommendations are intended to form the basis for methodology and curriculum development during Phase II, but still allow for the flexibilty to meet evolving needs.

LIST OF FORMS

NATIONAL SUGAR TRAINING CENTRE

SENNAR, SUDAN

17 MARCH 1989

The following forms were either given to the instructional staff of the Sennar Sugar Training Center as a handout or were designed by the participants in the I.S.D. staff development course. The handouts and participant designed forms have been requested from the Sennar Sugar Training Centre.

HANDOUTS

- Course Syllabus
- Checklist for Determining Training Needs
- Training Needs Analysis Worksheet
- Task Listing Form
- Task Verification Form
- Task Analysis Form
- Job Description Form
- Job Specifications Form
- All forms included in the MES Staff Development Program.

PARTICIPANT DESIGNED FORMS

- Syllabus
- Learning Element
- Learning Package
- Written Text Example Format
- Performance Test Example Format
- Student Evaluation Form
- OJT Progress Report Form
- OJT Evaluation Report Form
- Student Roster and Grade Report
- Student Control Card
- Certificate of Completion
- Letter of Attendance
- Letter of Completion

The participant designed forms were done in Arabic and given to Ibrahim Ibanouf for final design.

BIBLIOGRAPHY

"Application of Modules of Employable Skill to Vocational Training," Vocational Training Branch, International Labour Office, Geneva, 1986.

Blank, W.E., "Handbook for Developing Competency-based Training Programs", Prentice-Hall, New Jersey, 1982.

Dictionary of Occupational Titles, U.S. Department of Labor, Washington D.C., 1977.

"International Standard Classification of Occupations," International Labour Office, Geneva, 1962.

Lockwood, D., "Effective Vocational Training Design," International Labour Office, Geneva, 1986.

"Manual of Training Methods," Japan Industrial Training Association, Inc., International Labour Office, 1964.

"Modular Training Series," Turin Centre, International Labour Office, Turin, 1986.

Stanley, L., "Guide to Evaluation of Training," International Center for Public Enterprises in Developing Countries, 1984.

Stanley, L., "Guide to Training Needs Assessment," International Center for Public Enterprises in Developing Countries, 1984.

ANNEX A

JOB DESCRIPTION

SF/SUD/86/003/11-03/Rev. 4

Post title	Industrial Training Expert in Industrial Training for Training Methodologies Techniques and Curriculum Development
Duration	Two and a half months
Date required	January 1989
Duty Station	Sennar, Sudan, Sugar Training Center (STC), with travel to other sugar estates
Responsible to:	UNIDO Chief Technical Advisor
Purpose of project	To strengthen the training capability of the Sugar Training Centre for audio-visual methodologies, materials and techniques for a modular training system for performance oriented criterion referenced training for upgrading the technical know-how and supervisory skills of training officers, trainers and instructors.
Duties	The training expert will work in close co-operation with other UNIDO experts and the national staff and he will: (a) Focus on increasing the effectiveness of the training activity by strengthening the industrial training capability of the STC.

Applications and communications regarding this Job Description should be sent to:

Project Personnel Recruitment Section, Industrial Operations Division

UNIDO, VIENNA INTERNATIONAL CENTRE, P. O. Box 300, Vienna Austria

He will provide training to national counterparts on training, and implementation of a modular system of performance-oriented criterion referenced training.

(b) Plan, organize and conduct appropriate training courses for national counterparts and instructional personnel which meet expressed needs and focus on:

- Methods and procedures for designing performance oriented training programmes which result in increasing trainee performance.

- Training methods, techniques and curriculum development applicable to industrial trainers and instructors.

- Assessment and analysis of training needs.

- Will assist in designing overseas training programmes for training officers, trainers and instructors.

- Prepare a technical report at the end of the assignment(s).

(c) Additionally, for the preparatory phase, the training expert will liaise closely with the CTA, STE and national counterpart to establish an overall strategy for the future development of all the training facilities at the STC from:

- statistical data prepared by the CTA

- background information from briefing by CTA and STE

- visits to at least two Sugar Mills and one vocational training centre for orientation.

- consultation with other UNIDO experts and national counterpart staff.

(d) Advise the national director, CTA and design architect during their consultations to convert the development strategies into prioritised development schedules for the physical facilities.

(e) Prepare progress reports and a final technical report at the end of the assignment(s).

Qualifications

(a) Academic qualifications:

Appropriate university studies, preferably a degree in education/pedagogy as well as extensive experience in developing and implementing training of trainers programmes with special emphasis on performance oriented criterion referenced training activities.

(b) Professional qualifications:

- Ability and experience to develop and conduct training programmes for trainers and instructor training courses which increase the effectiveness of industrial trainers including skills of curriculum development, training methods and techniques.

- Possess knowledge of theory as it relates to presentation methods and techniques for industrial instructors, modular training systems and training equipment utilization.

- At least one year of related training of trainers experience in developing countries and in strengthening industrial training functions is an asset.

Language English, a working knowledge of Arabic will be an advantage

Background Information:

The former Public Sector of the Sugar Industry in Sudan consists of factories and sugar cane estates with a joint rated output of 374,000 tons per annum.

The industry is currently being developed under a World Bank Rehabilitation Scheme.

UNIDO has responsibility for assisting with the development of needed training facilities on behalf of the Sudan Government to support the Rehabilitation Programme.

The Sugar Training Center (STC) has recently been incorporated to be responsible for the development of a comprehensive training service for the Sudan Sugar Industry.

It is a strategy formulating body responsible to the Sugar Project Implementation Committee (SPIC) representing the Government of Sudan and the Sugar Industry. Management of the Centre is the responsibility of the Sudanese National Director who reports to SPIC.

A detailed assessment and analysis of training needs has been made by UNIDO. International funding for the project has been agreed to as part of the overall Sudan Sugar Rehabilitation Programme.

Funding is under the control of the World Bank and includes substantial contributions from other sources such as the Arab Fund.

As the climatic and natural conditions are favorable for expanding its Sugar Industry, the Sudan is aiming at becoming self-sufficient for internal consumption of sugar.

Later it intends to become an exporter of sugar, particularly to the oil-producing Arab countries. Therefore, in its development, priority has been given to the development of this sector. The essential characteristics of the STC programme will be:

(a) A training of trainers programme for:

- training officers
- technical trainers/instructors (full-time)
- instructors (part-time)

(b) A programme for engineers, senior technicians and supervisory personnel.

(c) Practical training programme for vocational personnel and operators.

ANNEX .B.

National Sugar Training Centre,
Sennar.

Staff Development Training Programme.

PROGRAMME PLAN.

Title: The Introduction to a Modular System of Training to be Developed at the National Sugar Training Centre, Sennar.

Date: NOVEMBER, 1988

J.Bye.UNIDO. C.T.

UNIDO

Subject Structure.

No.	%.	Subject Fields.	Subjects.
6.	5	Follow-up and Feedback:-	a. Evaluating Efficiency and Effectiveness of Training. b. Designing and Carrying out follow-up procedures after Training.

METHODOLOGY

In order to achieve the objective of the programme the following procedures will be adopted:-

25% of time engaged in Seminar-Lecture activities.

75% of time occupied by supervised project work.

i.e. Individual and Group Projects will be assigned and whilst the time allocation may vary through the duration of the programme, as necessary, the ultimate aim is to spent 30% of total time available on Group Activities and 45% on Individual Project Activities.

The pattern of time allocation will be:-

07.00 to 07.30 -	Seminar, discussion etc. to consolidate the previous days assignment activities.
07.30 to 09.00 -	Prese tation of subject material.
10.00 to 14.00 and 17.00 to 19.00 -	Group and Individual Projects.

PROJECT ASSIGNMENTS

The Individual and Group Assignments will be selected and supervised as follws:-

The assignments will be concerned with the detailed development of Modular Units and Modular Unit Learning Packages.

The final sessions of the programme will be devoted to the presentation of the materials developed as a basis for assessment and evaluation.

INSTRUCTIONAL PRACTICE

The application of the training materials and presentation techniques developed during the programme will begin as soon as possible following completion. To this end the National Director for Training and the CTA have planned three Training Programmes to begin on the 3rd December, 1988. These are:-

1. Mechanical - A Practical Course on Skills Awareness for Graduate Engineers.
2. Auto. Mechanics - Basic Practical Course for Vehicle Maintenance Fitters.
3. Elect./Instruments - Basic Practical Course for Instrument Technicians.

Each programme will be limited to (16) participants (ideally 4 from each location) to allow for ease assessment of Trainee Performance and Validation of the modular units used.

REPORT

A joint report will be prepared by the National Director for Training and the CTA.

PROGRAMME : The introduction to a Modular System of Training to be developed at the National Sugar Training Centre, Sennar.

DURATION : Twelve days- 15th to 28th Nov., 1988 (Inclusive).

A I M : To provide a uniform understanding of one specific model for a Modular Training System to be used as a basis for developing the various Training Programmes and courses to be established at the National Sugar Training Centre.

LOCATION : The National Sugar Training Centre, Sennar.

PARTICIPANTS : All Counterparts and Workshop Instructors of the Training Centre.

Plus : Nominated Training Officers from the four (4) Public Sector Sugar Mills.

Plus : Any visitors from Kenana Sugar Training Centre, (as participants or observors).

LANGUAGE : The language of the programme will be ENGLISH.

OBJECTIVE : At the completion of the programme each participant will have prepared a Modular Unit based upon the principles and guidelines set out by the programme presenter.
The individual Modular Units will be integrated into a complete Learning Package prepared to International specifications, codes of practice and standard format as a group activity.

UNIDO

Subject Structure.

No.	%	Subject Fields.	Subjects.
1.	5	Introduction to the System Approach to Training:-	a. The development of a Modular System. b. Definitions and Terminology. c. The key characteristics of a Modular System.
2.	5	The Modular Concept :-	a. The philosophy of phased development of skills using Training Modules.
3.	10	Training Needs Assessment:-	a. Training Population Analysis. b. Preparing a Trainee Specification c. Job Specifications. d. Identification of Training Needs.
4.	50	Developing a Modular Training Package:-	a. Identifying a Modular Unit. b. Specifying the objective of a Modular Unit. c. Job analysis. d. Task analysis. e. Skills analysis. f. Identifying the steps of work within a Modular Unit. g. Analysing the steps of work. h. Identifying the Learning Elements within a Modular Unit. i. Writing the objectives for a Learning Element. j. Determining the contents of a Learning Element. k. Designing Assignments and Progress checks for Learning Elements. l. Preparing Performance Tests. m. Preparing Instructional Units for future development into Learning Elements.
5.	25	Implementing a Modular Training System:-	a. Preparing Instructor Guidance Material. b. Preparing Trainee Guidance Material. c. Managing the implementation of a Training Programme. d. Evaluating Trainee Progress and Performance. e. Validation of Training Material.

ANNEX C

SYLLABUS

PROGRAMME: STAFF DEVELOPMENT

COURSE: INSTRUCTIONAL SYSTEMS DEVELOPMENT

LOCATION: THE NATIONAL SUGAR TRAINING CENTRE, SENNAR

DATE/TIME: 11 FEB 89 THROUGH 3 MAR 89, 0700-1400.

AUDIENCE: NTC TRAINING STAFF AND TRAINING OFFICERS AND COUNTERPARTS OF SUGAR ESTATES.

LANGUAGE: PRESENTATIONS WILL BE IN ENGLISH.

OBJECTIVES:

To provide a standardize approach to the design and development of all Training Programmes conducted for the National Sugar Estates. Upon completion of the course, each participant will be able to:

- o Conduct a training needs analysis
- o Perform a job analysis
- o Validate job requirements
- o Design a learning element
- o Prepare a written criterion-referenced test
- o Prepare a performance test
- o Validate a training program
- o Prepare OJT evaluation instruments
- o Manage a training program

COURSE OUTLINE:

1.0 Introduction

- 1.1 Why train?
- 1.2 Why do organizations not train?
- 1.3 The cost effectiveness of training.
- 1.4 ISD overview
- 1.5 Definitions

2.0 Analysis

- 2.1 Determining training needs
- 2.2 Analyzing needs data
- 2.3 Conducting Job Analyses
- 2.4 Validating Job Requirements

3.0 Design

- 3.1 Job Specifications
- 3.2 Preparing modular learning packages
  - o methodology
  - o writing objectives
  - o preparing criterion-referenced tests
  - o writing trainee centered learning elements
  - o writing instructor/trainer guides
  - o preparing A/V materials
  - o preparing demonstration models/equipment

4.0 Validate

- 4.1 Train-the-Trainer/instructor
  - o methodology
  - o presentation techniques
  - o testing and evaluating trainees
  - o managing the training
- 4.2 Conduct pilot programme
- 4.3 Revise program as necessary

5.0 Implementation

- 5.1 Schedule training
- 5.2 Notify target population
- 5.3 Prepare workshop/facility
- 5.4 Conduct the training
- 5.5 Test trainees
- 5.5 Report results

6.0 Evaluation

- 6.1 Trainer evaluation
- 6.2 Trainee evaluations
- 6.3 OJT progress reports
- 6.4 Supervisor verification
- 6.5 Certification

7.0 Administration

- 7.1 Trainee records
- 7.2 Class rosters
- 7.3 Attendance records
- 7.4 Test results
- 7.5 Reporting

ANNEX D.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION.

THE NATIONAL SUGAR TRAINING CENTRE

SENNAR

Seminar held at the Training Centre on 8th February 1989.

TITLE: The current development situation of the Centre and the further programmed development in co-operation with the MATS Teams.

In attendance:

Mr. Fadlabi	- Director of the Centre
Mr. Osman El Tahir	- H.O.D. - Mechanical
Mr. P.N.R. Rao	- MATS Team Leader and Training Advisor, Guneid.
Mr. Abdul Gadar Ahmed Abass	- Training Officer, Guneid.
Mr. D. Banks	- MATS Factory Engineer and Training Advisor, Assalaya.
Mr. Moubarak M. Salah	- Training Officer, Assalaya.
Mr. M.N. Krishna Murthy	- MATS Team Leader and Training Advisor, New Halfa.
Mr. R.L. Clanton	- UNIDO Training Methodology Consultant.
Mr. L. Lygdman	- UNIDO Senior Technical Expert.
Mr. J. Bye	- UNIDO Chief Technical Advisor.

The Seminar was jointly chaired by Mr. Fadlabi and Mr. Bye.

A G E N D A

1.0	Welcome	Mr. Fadlabi
2.0	General outline of the Project.	Mr. Fadlabi
3.0	The Developing Situation	
	3.1. Instructor Training	Mr. Bye
	3.2. Further Recruitment Policy	Mr. Fadlabi Mr. Bye
	3.3. Future Training Programme Development.	Mr. Clanton
	3.4. Physical Developments	
	At the Centre	Mr. Bye
	In Company	Mr. Bye

3.5. The Development Strategy — Mr. Bye, Mr. Fadlabi

3.6. The Overall Philosophy — Mr. Bye

4.0. Maintenance Management Goals — Mr. Lygdman

5.0. Open Discussion

The Objective - To identify Training Priorities and a Unified Approach.

SUMMARY

1. In his opening remarks the Director of the Centre welcomed all the visitors to the Centre referred to the conspicuous absence of any representation from the Sennar Sugar Mill and also regretted the absence of Mr. Suliman Koko the Training Officer from New Halfa whose apologies for absence were noted.

2. Early emphasis was placed by the Director on the need to build up a high level of co-operation between the MATS Teams and their appointed Counterpart Training Officers with the Training Centre in order to strengthen the training activities at the individual Sugar Mills.

The visiting participants were invited to make specific requests for assistance from the Centre.

3. 3.1. Instructor Training would be the focal issue for immediate attention (Bye) however this concept needed assistance from the meeting to resolve priorities to provide most effective service to the Sugar Mills in the short-term and lay a foundation for long-term planning.

Some documentation had been made available within the past few days which needed analysis before long-term programme planning could be undertaken.

3.2. (a) Mr. Fadlabi re-affirmed the recruitment policy of the Centre in only accepting suitably qualified and experienced candidates for recruitment and training as Instructors indicating that if the best applicants at interview did not meet specific criterea then no appointment would be made.

(b) Mr. Bye developed the concept of having a group of full-time Instructors at the Centre as the core of the training infrastructure and by taking the best operatives/workers/supervisors for training in a limited area of their own occupation then a number of trained on the job Instructors could be brought into action fairly quickly.

Continuation sheet No. 3

Various interjections were made, such as:

Krishna Murthy - The overall policy would seem alright but there were several very urgent needs identified in his report to the Centre Director.

The Centre must deal with people from the Sugar Mill besides continuing the development programme.

D. Banks - The size of the task ahead may be best addressed by establishing Training Departments at each Sugar Mill to cover all training activities as a preliminary to training at the Centre.

There is a distinct shortage of resoures at the Sugar Mills to undertake this task.

Biggest problem - What incentive could be used to recruit trainers?

Krishna Murthy - An indication of support from Top Management would help and the next meeting should include the Director Generals whose very presence would show a commitment to training.

P.N.R. Rao - Certain aspects of training could only be covered IN-PLANT is pure terms of **COST EFFECTIVENESS** particularly Plant Operation, Process and Quality Control since a Pilot Plant would be far too expensive for the needs of the industry at the Training Centre.

From the general discussion several points were raised to be held for further consideration under other items.

3.3.- Mr. Clanton discussed the need for full co-operation in the co-ordination of training development and training activities.

- Top Management must be fully committed to training and identify/support the role to be played by the Centre.
- The results of training must be seen to be an improvement in performance allowing the gain to be recognised as something tangiable.
- When the role of the Centre has been precisely defined then if would be essential to prepare a "**Training Policies and Procedures Manual**" which would require full approval and be 'signed off' by Top Management.

3.4.- Mr. Bye referred to an outline proposal he had prepared for extensions to the existing facilities at the Centre. This had been discussed by the [illegible], the Donors, SPIC and the Consultant Architects along with the Director and C.T.A. when informal approval was given to the Architects to proceed with an Initial Design Proposal.

- The rationale, analysis details and proposal had been submitted to UNIDO and whilst the full Quantitative Survey has been distributed by them the CTA had not yet received approval and clearance the details could not be made available.

UNIDO

Continuation sheet No. 4

- Sketch plans were presented to indicate the extent of the proposed development of the physical facilities.

- Refering back to para 3.2. and certain points tabled during the discussion it was evident that none of the visiting participants had the slightest notion of the Terms of Reference of the UNIDO Input at the Centre. It was resolved that these would be circulated before the next meeting.

- The main item for further consideration being the establishing of Training Departments with acceptable facilities to carry out Basic Training on Site.

- It is most evident that considerable expansion is needed to the reference in Para 8.1. of the Prodoc, - local Inputs - quote - Adequate training facilities for the four training departments of the four Sugar estates will be provided - unquote.

  This matter has obviously a well guarded secret from everyone not directly associated with the UNIDO Input.

- Items for further consideration were:

  i. Should the Training Officers be on the NSTC Budget?

  ii. What form of link needs to be established between the Training Officers and the D.D.G's of the Sugar Mills.

  iii. Attempts should be made to create a direct link of the Sugar Mills.

  iv. Create a new Job Title - replace Training Officer with TRAINING MANAGER.

3.5. - The C.T.A. referred to the Prodoc section 5, Para 5.9., item 3 - an extract quote, reference the report on Phase I - "no training would yet be provided for the sugar estate personnel" going on to explain that the present training programmes at the Centre, together with earlier programmes were being run for the specific purpose of:

  i. Evaluating the Instructional Materials prepared by the Staff of the Centre.

  ii. Evaluating the existing training facilities (accomodation and equipment) and

  iii. Assessing the performance of the Instructors.

- It was noted that any skill upgrading which took place was a bonus which was a result of the particular Development Strategy adopted.

- The Centre Director asked for continued support from the MATS Training Advisors and the Sugar Mill Training Officers by selecting suitable candidates to be trained and by monitoring the performance of the trainees on their return to the work situation.

- A follow-up procedure would be designed by the participants of the present Staff Development Programme.

3.6. - Mr. Bye briefly outlined the underlying philosophy of developing a Modular System of Training whereby selected Modular Units (developed at the Centre) could be combined to build up a tailor-made programme, short course or full scale apprentice training programme.

- It is possible to phase the training into clearly defined compartments or packages by this method.
- The System was built up by translating Job Descriptions into Job Specifications identified in terms of required Modular Units, hence qualifying the actual training need for any Job.
- The precise training requirement of any individual is then identified by allowing "credits" of Modular Units (by assessment or actual completion).
- The ultimate objective being that all personnel would complete the necessary training as a pre-requisite for promotion.

4.0. - Mr. Lygdman presented specific ideas on the development of all aspects of training to be oriented towards maintenance and good house keeping methods. The target being for Management Personnel to be convinced that Maintenance Management Procedures are the real key to arresting the decline in plant performance.

- It was agreed that no radical changes could be made until Senior Supervisors and Managers began to believe in the case for Planned Maintenance and began to practice it with total commitment.
- This led to a broadening of the discussion leading naturally to item 5 of the Agenda.

5.0. Open discussion - The following are some of the main items tabled:

5.1. Stores and Inventory Control Training is needed i.e. Spare Parts Management.

5.2. Instrumentation for all parts of the plants was urgently required - A very costly process - some areas of the mills were running WITHOUT ANY INSTRUMENTS FUNCTIONING.

5.3. Pump Maintenance - a critical area for the industry - was of considerable importance, Mr. Banks was having some success with planned maintenance of pumps.

5.4. Other items mentioned were:

1. Auto-Electricians Training
2. Training for Factory Fitters
3. Training of Irrigation Workers
4. Maintenance of Camico Cane Harvesters
5. Hydraulic Pump Maintenance

6. Hydraulic Systems Maintenance

7. Boiler Maintenance.

5.4. It was decided to circulate a list of priority needs for each Mill in order to rationalise the many areas mentioned to provide a priority timetable of training activities.

5.5. - Further attention was given to the need for urgent training in Boiler Operation and urgent training in Boiler Operation and Maintenance.

- There is a need for some expression of Government Policy concerning Operational Standards, Testing and Certification for Boilers and Pressure Vessels.

- Some authority is required to monitor Boiler Maintenance Management. This could be vested in an Institution such as the National Sugar Training Centre.

6.0. RESOLUTIONS

The following items were **RESOLVED:**

6.1. This type of meeting should continue on a monthly basis.

6.2. Date of next meeting 12th March 1989.

6.3. The C.T.A. would provide copies of the relevant sections of the UNIDO/SPIC Agreement.

6.4. Based on the discussions with respect to item 3.2., the Training Officers would prepare individual proposals outlining the requirements necessary to establish a credible Training Development at his particular Sugar Mill. This matter could be discussed further for inclusion in the Phase II Proposal.

6.5. A PILOT PLANT is not a necessary item since training could be carried out wholly in-plant and thus removing what was seen as an extravigance and by far the least cost effective aspect of the whole training proposal.

6.6. It will be necessary to have a Training Policies and Procedures Manual approved in the near future.

6.7. The Training Officers and MATS Training Advisors would support to the best of their ability the present development activities at the Centre.

6.8. The education of Supervisors and Managers in Maintenance Management Procedures is an aspect which would help in promoting the idea of giving the Centre maximum support.

6.9. A priority list of Training Programmes/Short Courses would be established.

6.10. All training should be administered by the Centre with the Director being the one person responsible for co-ordinating all aspects of training for the industry.

6.11. The Centre should go ahead immediately and establish a 1 year Off-the Job Apprentice Training Scheme.

MAJOR CONCLUSIONS

By the Project C.T.A. and recorder of these notes

1. There is an enormous wealth of good will and positive motivation focussed on the desire to succeed by all concerned with the training situation within the Sugar Industry of Sudan.

2. There is a certain degree of backwardness and lack of confidence, best described in English Terms as - "Nobody is prepared to grasp the Nettie"-

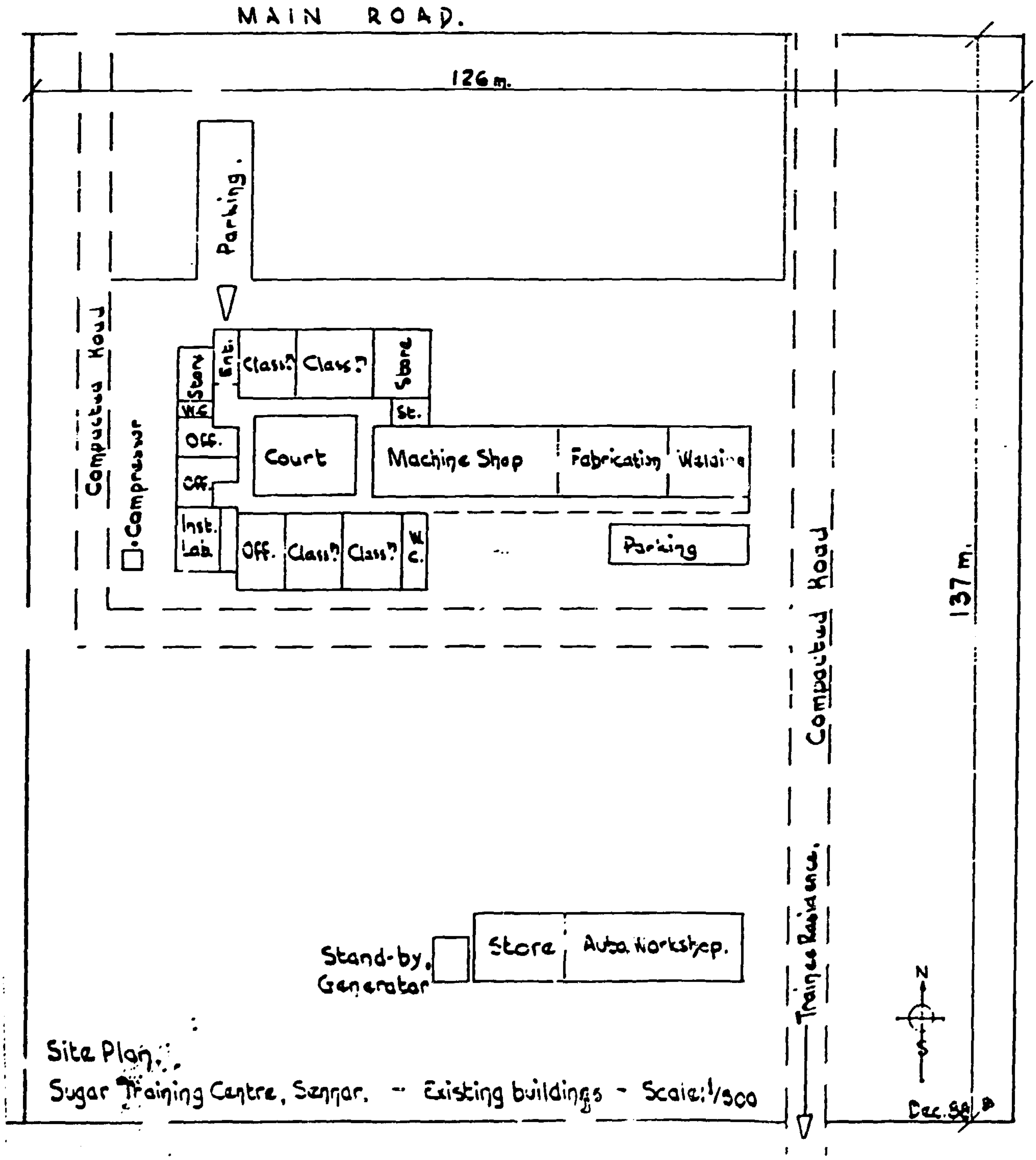
3. This is no longer the case. It is evident to all those seriously concerned with the Sugar Industry that unless TRAINING becomes a most desireable and necessary part of the production process the gradual decline in production efficiency will continue to accelerate.

4. Unless Management are convinced immediately for the need of training in all areas then they automatically identify themselves as the major conttributors to the eventual destruction of one of the nations greatest natural areas of economic growth.

5. One final observation is necessary in an attempt to attain complete co-ordination of effort is that the Centre must exert more influence on the developmental situation since a particular model of "MODULAR TRAINING" has been set in place at the Centre. Yet there is, as yet, not a complete appreciation and understanding of the overall philosophy and presentation format. This must be addressed at a further meeting.

ANNEX E

SKETCH OF EXISTING FACILITIES



Site Plan.
Sugar Training Centre, Sennar. - Existing buildings - Scale: 1/500

ANNEX F

LIST OF

AUDIO/VISUAL AIDS

Transparencies in Box 13

Transparencies in Roll 05

Overhead Projector (Working) 01

- Gakken
    - Model GPJ-530 R
    - Serial No. 25785
    - Motor 15W
    - Lamp
        - 220V/650W DYR GE-USA 87
        - 220V/650W C E-E USHID
        - 230V/650W B-C
    - Fuse 5A

Film Projector 16 mm (Working)

- Bell & Howell
    - TQ II 1658 Specialist
    - Model A
    - Serial No. 50700
    - Lamp for film
        - 24V/250W EMM SYLVA
    - Lamp for sound
        - 4V/0, 75A Thorn C29 P30S
    - Fuse T 4A/250V
    - Directamotion Part No. 014128
    - Loudspeaker

Carousel Projector S-AV2000 (Working) 01

- Kodak
    - Type G 502890
    - Lamp
        - Halogen 24V/250W
            - Bellaphot A1/223 64655
    - Fuse 220/250V T1,6A

Carojusel Projector S-AV1000 (Working) 01

- Kodak
  - Type 355485
    - 110/250V-190W
  - Lamp
    - Bellaphot 0650 1A 64640
      - 24V/150W
- Fuse 240V/4A

Carojusel Projector S (Working) 01

- Dodak
  - Type 296138
    - 110/250V-180
  - Lamp
    - Bellaphot 0650 1A 64640
      - 24V/150W
- Fuse 250V/4A

Cassette Recorder (Not Working) 01

- Philips Stereo N 2405
- Loudspeaker (2 off)
- Microphone (2 off)

Epidiascope (Not Working) 02

- Liesegang E9 Super
  - 16cm x 19cm
  - Lamp
    - 9E 9280 733 05102
    - Philips HPI-TD 400W/F FC2
- Fuse 5, 5A Kait
- Starter
  - ST. 400 for HQ1-400W
    HQ1L-400W
    HQ1-TS-400W
    HQ1-1000W 83200
    HQ1L-1000W 83100
- Socket for Starter
  - Type T.E.1 A5019

LIST OF SPARE PARTS AS ORDRED TO THE AUDIO/VISUAL AIDS

Overhead Projector	Gakken		
	Lamp	220V/650W DYR GE-USA 87 or 220V/650W C E-E USHID or 230V/650W B-C	06
	Fuse	5A	10
Film Projector 16mm	Bell & Howell		
	Lamp	24V/250W EEM SYLVA	06
	Lamp	4V/0, 75A Thorn C29 P30S	06
	Fuse	T 4A/250V	10
Carousel Projector	Kodak	S-AV2000	
	Lamp	Halogen 24V/250W Bellephot A1/223 64655	06
	Fuse	220/250V T 1,6A	10
Carousel Projector	Kodak	S-AV1000	
	Lamp	Bellephot 0650 1A64640 24V/150W	08
	Fuse	250V/4A	18
Epidiascope	Liesegang E9 Super		
	Lamp	9E 9280 733 05102	04
	Fuse	5, 5A Kalt	10
	Starter	ST. 4000 for HQ1-400W HQ1L-400W HQ1-TS-400W HQ1-1000W 83200 HQ1L-1000W 83100	04
	Socket for Starter	T.E.1 A5019	04

ANNEX G

REFERENCE MATERIALS LIST

LIBRARY BOOKS

The Books are divided into the following sections:

1.	Fitting and Machining	(F.M.)
2.	Welding and Plate/Sheet Metalwork	(W)
3.	Automotive and Diesel	(A)
4.	Plant Maintenance	(P.M.)
5.	Engineering Drawing	(E.D)
6.	Sugar Engineering, Processing and Chemistry	(S.E.P)
7.	Instrumentation, Electrical and Electronic	(I)
8.	Training Methodology and Training General	(T.M)
9.	General (includes administrative, academic, supervisory, basic subjects etc.)	(G)

Books in the library are marked with the Section Symbol (E.G.P.M.) and the book number.

FITTING & MACHINING

S.N.	DESCRIPTION	QTY.
1.	'General Shop' Goodheart & Willcox	1
2.	"Exploring Metalworking" J. Walker	1
3.	"Modern Metalworking Walker, Goodheart, Willcox	1
4.	"Machining Fundamentals J. Walker	1
5.	Basic Proficiency in Metalworking"ABB Arabic	1
6.	Grundfacne F.D. Metallgewerbe ABB.	1
7.	"Construction in Metal ABB.	1
8.	"Manual for operation & Maintenance of Milling Machines	1
9.	"Fundamentals of Engineering Mechanics Levinson	2
10.	"Metal-cutting Tool Production " palay	2
11.	"Benchwork Makiyenko	2
12.	"Machine Tool Design. V01-1	1
13.	"Machine Tool Design V01-2	1
14.	" " " " V01-3	1
15.	" " " " V01-4	1
16.	EITB Booklet FYT-3 Machining Processes	1
17.	EITB Booklet FYT-3/52 Tool Grinding	1
18.	EITB Manual Module H_2 Turing Part 1	1
19.	EITB Manual Module H_{23} Turing Part 2	1
20.	" " " H_4 Milling Part 2	2
21.	" " " H_{29} Milling Part 2	1
22.	" " " H_5 Grinding Part 1	1
23.	" " " H_{31} Grinding PT. 2 V01.1	1
24.	" " " H_{28} Boring	1
25.	" " " H_1 Machining for Tool Making & Experimental work.	1
26.	EITB Manual Module H_{26} Inspection & Measurement	1
27.	" " " H_3 Mechanical Fitting Part 1	1
28.	" " " H_{25} Mechanical Fitting Part 2	1
29.	" " " H_{24} Instrument Fitting	1
30.	EITB FYT booklet No. 1 Terminology, Tools Technigies	1
31.	EITB Training Module H_{24} Instrument Fitting	1
32.	EITB Handbook for Part "A" of first Year Training Engineering Crafts	2
33.	EITB FYT. Handbook for first YR Training - Men & Technicians	1
34.	EITB Training Element A3 Capstan Bathe	1

S.N.	DESCRIPTION					QTY.
35.	EITB Training Element			A4	Turret Bathe	1
36.	"	"	"	A7	" "	1
37.	"	"	"	D3	Work Holding	1
38.	"	"	"	F5	Tool Holders	1
39.	"	"	"	F8	" "	1
40.	"	"	"	F11	Stops & Trips	1
41.	"	"	"	F14	Knurling Tools	1
42.	"	"	"	G6	Capstm & Turret Bathes	1
43.	"	"	"	G7	Production Exercises	1
44.	"	"	"	B2	Limits & Fits	1
45.	"	"	"	B3	Workshop Galculations	1
46.	"	"	"	C1	Micromers	1
47.	"	"	"	C2	Gauges	1
48.	"	"	"	C3	Bore Gauges	1
49.	"	"	"	C4	External Gauges	1
50.	"	"	"	D1	Metals	1
51.	"	"	"	D4	Drills Reamers etc.	1
52.	"	"	"	D5	Boring Beres	1
53.	"	"	"	D7	Turning Tools	1
54.	Elementor Lehrgang Metall. Ausbldg. Absch. 1"					1
55.	ABB "General Instructions on Turning"					1
56.	ABB - "Measurement"					1
57.	Intems "Technology - Metal Part 1"					5
58.	Intems "Workshop Exercises Metal"					6
59.	Machine Elements "Dobrouolsky"					2
60.	EITB Training Element No. D.8. Tops & Diesetc					1
61.	" " " " D.9. Sharpening Tools					1
62.	EITB Training Element No. F9 Speeds & Feeds					1
63.	" " " " F10 Coolant & Swarf					1
64.	" " " " G.1 Safe Working					1
65.	Instructions for Machinists & Fitters V01-1 Shell					1
66.	" " " " " V01-11 Shell					1
67.	" " " " " VO.-111 Shell					1
68.	Tool Post Grinders P. 19681					1

INSTRUMENTATION

S.N	DESCRIPTION	QTY.
1.	Process Instruments & Control Handbook Considine	1
2.	"Transistor Circuit Design" Texas Instruments	1
3.	"Electronic Engineers Handbook" Fink	1
4.	"Semi-conductor Data Library Vol.6" Motorola Inc.	1
5.	"Code for Temperature Measurement - Part 2" B.S.I	1
6.	" " " " Part 5	1
7.	" " " " T.62 B.S.I	1
8.	"Methods for the Measurement of Flind Flow in Pipes Part 2" B.S.I.	1
9.	"Methods for the Measurement of Flind Flow in Pipes Part 3 B.S.I	1
10.	"Designing with TTL Integrated Circuits" Morris & Miller Texas Instr.	1
11.	"Instrument Technology" Vol.1" E.B Jones	1
12.	"Handbook of Applied Instrumentation" Considine	1
13.	"Instrumentation & Control Manual" Lotus-Foxbora	15
14.	"Instrument Trainees Course Manual" Lotus-Foxbora	14
15.	"Instrumentation Course Textbook HVA	1
16.	"Electrical Distribution" HVA Textbook	1
17.	"Measuring & Control Equipment HVA Textbook	1
18.	"Meet en Regelen" Dow.	1
19.	"Instrumentation" Dow.	1
20.	"Transport Van Vloeistoffen 4.S.W." Inhoud Deel 3	1
21.	"Hoofd Stuck X 3 Appeudages" Dow Manual (3Parts)	1 Each
22.	"Eitb Fyt Handbook" Electrical & Electronic Techniques	1
23.	Basic Electronics" Grob	1
24.	Intems - "Electricity" (90-217-5000-7)	1
25.	Eitb Manual Module G22 - 1 Rotating Equipt. Vol. 1	1
26.	" " " G22 - 2 " " " 2	1
27.	" " " G2 - 1 " " " 1	1
28.	" " " G2 - 2 " " " 2	1
29.	" " " J2 Electrical Maint.	1
30.	" " " G3 Electrical Fitting I	2
31.	" " " G23 Electrical Fitting II	1
32.	Instrument Instructors Course Manual - Lotus - 5 Vols.	1 Set
33.	Eitb Manual Module G.I Static Equipt. Vol.I	1
34.	" " " G.I. Static Equipt. Vol.II	1
35.	" " " G21 Static Equipt. Testing	1

S.N.	DESCRIPTION	QTY.
36.	Eitb Manual Module J22 Electrical Maint. PT.2	1
37.	" " " G27 Rotating Equipt. PT. II	1
38.	" " " G4 Electrical Assembly	1
39.	" " " G24 Electrical Inspection	1
40.	"Basic Electricity Kaufman	1
41.	Foxbore Instrumentation Instructions 13FA.	1
42.	Foxbore Instrumentation Instructions 12A.	1
43.	Foxbore Instrumentation Instructions 69TA	1
44.	" " " 135Z	1
45.	" " " 11AM	1
46.	" " " 11GM	1
47.	" " " 120F	1
48.	" " " 130	1
49.	" " " 102	1
50.	" Process Control Instr.	3
51.	" Instrumentation for Sugar Processing	1
52.	" Process Instrumentation for the Sugar Indy.	1
53.	Eitb Training Element - Module G.1.	1
54.	" " " " G2	1
55.	" " " " G3	1
56.	" " " " G4	1
57.	" " " " G21	1
58.	" " " " G22	1
59.	" " " " G23	1
60.	" " " " G24	1
61.	" " " " J1	1
62.	" " " " J22	1
63.	Eitb Booklet 3/41 Wiring & Soldering	1
64.	Eitb Booklet 3/40 Coil Winding	1
65.	"Instruction Manual - Instrument Mechanic " Shell	1

AUTGMOTIVE

S.N.	DESCRIPTION	QTY.
1.	Instructional Guide for motor Vehicle Mechanics PT. 1 Shell	2
2.	" " " " " " PT. 2 Shell	2
3.	"Automotive Service Technology "Book 1" Tempest	1
4.	"Automotive Service Technology "Book 2" Tempest	1
5.	"Principles of Wheel Alignment Service Bacen	1
6.	"Electrical Systems - FOS - 20B "John Deere	1
7.	"Automotive Electrical Equipment" Grouse	1
8.	"Operation Guide SEB4.5415-01 for Caterpillar Engine 3408/3412	2
9.	"Lucas - CAV T. Manual C2127.E" Lucase	6
10.	"Lucas - CAV T. Manual 2124	6
11.	"Automotive Chassis & Body" Crouse & Anglin	1
12.	"Automotive Tune-up" Crouse & Anglin	1
13.	"Automotive Mechanics" Crouse 7th Edition	1
14.	"Motor Vehicles" Artamonov.	1
15.	"Vehicle Mechanics - Body, Chassis Work" Vol.1 Shell Part Harcourt	1
16.	Vehicle Mechanics - Body, Chassis Work Vol.II part Harcourt	1
17.	Vehicle Mechanics - Body, Chassis Work Vol.III Shell Part Harcourt	1
18.	"Automotive Emmission Control" Crouse & Anglin	1
19.	Diesel Mechanics " Schulz	1
20.	Engine Mechanics - Engine Theory" Shell	1
21.	MF. Tractor 185 Operators Instructions	2
22.	Automobile Mechanics Intents (90 - 27 - 4000 - 1)	6
23.	Caterpillar Parts Book 3304 Engine Nos.285272	1
24.	John Deere "Hydraulic Manual" FOS. 10 B.	1
25.	" " "Shop Tools Manual " FOS. 51. B.	1
26.	" " "Fuel Injection Manual" TM. 1064	1
27.	" " "Preventative Maintenance Manual FMO. 161 B.	1
28.	" " "Tractor Systems Manual" FMO. 101 B	1
29.	" " "Agricultural Machinery Safety " FMO. 181 B.	1
30.	Shell "Instructional Guide for Diesel Mechanics Vol.I	2
31.	Shell "Instructional Guide for Diesel Mechanics Vol.II	2
32.	Automobile Transmission-servicing & Overhaul Staten Abbey	1
33.	Automobile Steering Braking & Suspension Staton Abbey	1

S.N.	DESCRIPTION	QTY.
34.	Motor Vehicle Engines Khovakh	2
35.	Automotive Mechanics - Metric May & Crouse	1
36.	Instructional Guide - Motor Mechanics "Figures" Shell	1
37.	John Deere T.M. 1065-4230 Tractor	1
38.	John Deere P.C. 1294-4230 Tractor - Partsbist	1
39.	Lubrication & Maint. Guide D.4 Tractor - Caterpillar	1
40.	Lubrication & Maint. Guide D.7 Tractor Caterpillar	1
41.	Lubrication & Maint. Guide D.7G Tractor Caterpillar	1
42.	Operators Handbook - Ford Tractors	1
43.	Air Cooled Diesel Engines	1
44.	Service Manual 120 G. Grader - Caterpillar	1
45.	" " D.7 Tractor - Caterpiller	1
46.	" " D.4 Tractor - Caterpillar	1

SUGAR ENGINEERING & PROCESSING

S.N.	DESCRIPTION	QTY.
1.	"Heat Transfer" Inachenko	1
2.	"Centrifugal & Axial Flow Pumps" Stepanoff	1
3.	"Engineering Thermo Dynmics" Krillin	2
4.	"Cane Sugar Handbook" Speneer Meade	1
5.	"Mechanics of Crushing Sugar Cane" Murray & Holt	1
6.	"System of Cane Sugar Factory Control" Cloyton	1
7.	"Erection & Maintenance of Cane Mills & Gearing" HVA	1
8.	"Technucal Manual - Juice Extraction"	1
9.	"Technical Manual - Cane Handling & Preparation"	1
10.	"Sugar Cane Factory Analytical Control"	1
11.	"Modern Development of Rolling Mills"	1
12.	"Sugar engineering - Book 1" HVA	1
13.	"Steam Generation Equipment + Notes on Supervisors Responsibilities	1
14.	"Sugar Manual - Pnerto Rico" Gilmore 1962	1
15.	"Baggasse Boilers" HVA	1
16.	"Horizental Centrifugal Pumps" Sulzer	1
17.	"Sugar Processing Manual - HVA	1
18.	"Manual for the Sugar Chemists Cowx - Equipment & Macly" HVA	2
19.	"Manual for the Sugar Chemists Cowx - Cane Sugar HVA	1
20.	Training Manual Sugar Technology" HVA	1
21.	Try Manual for Sugar Chemists - Boiler Feedwater Physics, etc.	1
22.	"Mellors Modern Inorganic Chemistry Parkes"	1
23.	"Chemical Engineering" Kafarov.	1
24.	Laboratory Manual - Queensland Sugar Factories	1
25.	"International Standards for Drinking Water"	1
26.	"Introduction to Cane Sugar Technology Jenkins	1
27.	"Sugar Machinery" HVA	1
28.	"Laboratory Manual" HVA	1
29.	"Mechanical Engineering" Marks Standard Handbook	1
30.	"Training Manual - Sugar Processing & Technology" HVA	1
31.	Laboratory Work Shell	1
32.	General Chemistry Vol.I Shell	1
33.	General Chemistry Vol.II Shell	1
34.	Physical & Chemical Tests Shell	1

GENERAL

S.N.	DESCRIPTION	QTY.
1.	New English Dictionary" Webster	1
2.	English Readers Dictionary	1
3.	Arithmetic Vol -I of Gens Subjects Shell	2
4.	Algebra Vol - 2 of Gens Subjects Shell	2
5.	Answers to Volumes 1.4 Gens Subjects Shell	2
6.	Geometry Vol -3 Gens Subjects Shell	3
7.	Physics Vol - 4 Gens Subjects Shell	3
8.	Management by Objectives Booklet	4
9.	Industrial Safety HVA Ethiopia	1
10.	Guide to the literature of the Sugar Industry - Schalit	1
11.	Advanced Level Physics Nelkon & Parker	1
12.	Jealth & Safety at Work Act 1974 British Safety Council	1
13.	Technical Manual - Air-conditioning - Vehicles & Basic Principles	1
14.	Polythene Pipe & Sheet _ Engineering & Installation Manual	1
15.	Guideline to Training of Employees	1
	Job Specifications & Summaries of Training Needs	
16.	"Safety" Intems (90-217-7500-X)	5
17.	Elementary Mathematics Dorofeev.	1
18.	Mathematics for Engineers & Scientists Jeffery	1
19.	Technology - Wood - 1" Intems	4
20.	Workshop Exercises - Wood - Intems	3
21.	ITB "Code Safety of Practice for Engineering Training Centres	1
22.	ITB Code of Safety Practice for Engineering Training Trainees	1
23.	Technignes for Technical Teaches Shell	1
24.	Operative Personnel Selection Shell	1
25.	Intems "Workshop Mathematics"	1
26.	Apprentice Law - Sudan	1
27.	Materials Handbook Brody	1
28.	Websters new collegiate Dictionary	1
29.	Arabic - English Dictionary	1
30.	Machinery Handbook	1

TRAINING METHODOLOGY & TRAINING GENERAL

S.N.	DESCRIPTION	QTY.
1.	Apprentice Training Dept. of Labour	1
2.	EITB Apprentice First Year Training Dept.	1
3.	EITB Booklet No 9 Training Technician Engineers	1
4.	" " " 14 Training Technicians	1
5.	" " " 3 Training Adult Operators	1
6.	" " " 4 Training Juvenile Operators	1
7.	" " " 5 Training Professional Engineers	1
8.	" " " 20 Training Graduate Business Professionals and Business Techncian	1
9.	" " " 3/19 Training Fork Lift Operators	1
10.	Intems "Visual Learning Materials"	2

ENGINEERING DRAWING

S.N.	DESCRIPTION	QTY.
1.	Basic Engineering Drawing Rlodes & Cook	1
2.	engineerir.g Drawing Bogolyubov.	1
3.	Geometrical & Engineering Drawing Exercises Part 2 Green	1
4.	Exercises in Machine Drawing "Bogolyubov."	1
5.	Technical LDrawing, Blueprint reading and Freehand Sketching" Intems	2
6.	Technical Drawing Course Guide Intems	1
7.	Technical Drawing Intems	1
8.	EITB Training Element B-1 1st-43rd Angle Projections etc.	1
9.	Geometrical & Engineering Drawing Exercises PT. I Green	1
10.	Geometrical & Engineering Drawing Exercises PT. 3 Green	1
11.	engineering Drawings Communication, & Design Coolry	1

WELDING & PLATE/SHEETMETAL WORK

S.N.	DESCRIPTION	QTY.
1.	"Welding" John Deere Technical Manual FOS 52B	2
2.	"Welding" Workbook No. 10 by Miller	1
3.	"Forging practice" Kamenschikov	2
4.	EITB Manual Module D.3 "Pipe & Tube Fabrication"	2
5	" " " F21 "Advanced Pipe & Tube Welding"	1
6.	" " " D.2 "Thin Plate Working Part 1"	1
7.	" " " D22 "Thin Plate Working Part 2"	1
8.	" " " D.1 "Thick Plate Working Part 1"	2
9.	" " " D21 "Thick Plate Working Part 2"	2
10.	" " " F.1 "Oxy-Gas Fuel Cutting & Gauging Arc. Cutting & Gauging	1
11.	EITB Manual Module F5 "Oxy-Acetyline Welding"	1
12.	EITB Booklet No. 3/16 "Oxy-Acetyline Welding"	1
13.	" " " 3/14 "Electric Aro Welding"	1
14.	" " " 3/60 "Spot Welding"	1
15.	A.B.B. Handbook "Welding"	1
16.	A.B.B. Handbook "Sheet Metal"	1
17.	Entectic notes total - 82 pages in 4 plastic folders	41 Set
18.	Smitweld Welding notes 1 set of 7 pages	1 Set
19.	UTP "Welding Wear"	1
20.	BOC "Welding - Equipment"	1
21.	UTP "Electrode Manual"	1
22.	Oerlikon Welding Handbook	1
23.	Morelisse Welding Generator Manual	1
24.	Training Element 'O' Arc Welders	1
25.	" " A-12 Arc Welders	1
26.	EITB Training Element A.13 Arc Welding	1
27.	" " " B.7 " "	2
28.	" " " B.8 " "	1
29.	" " " D.12 " "	1
30.	" " " D.13 " "	1
31.	" " " G.12 " "	1
32.	" " " G 13 " "	1
33.	" " " G.14 " "	1
34.	" " " G.15 " "	1
35.	" " " G.16 " "	1
36.	" " " G.17 " "	1

S.N.	DESCRIPTION			QTY.
37.	EITB Training Element	G.18	Arc Welding	1
38.	EITB Training Module	D.1	Thick Plate 1	1
39.	" " "	D.2	Thin Plate 1	1
40.	EITB Training Module	D.3	Pipe & Tube	1
41.	" " "	D21	Thick Plate II	1
42.	" " "	D22	Thin Plate II	1
43.	" " "	F	Oxy-welding & Cutting	2
44.	" " "	F.1	OXy-Welding & Cutting	1
45.	" " "	F.5	Oxy-welding & Cutting	1
46.	" " "	F.2	Pipe TubeWelding	1
47.	EITB FYT Booklet No. 2 Fitting Forging & Handskills			1

PLANT MAINTENANCE

S.N.	DESCRIPTION		QTY.
1.	"Planned preventative Maintenancd in Sugar Factories"	HVA	1
2.	"Shift Instructions"	HVA	1
3.	"Type, Installation, Maintenance of Valves"	HVA	1
4.	"Symbolen Voor Hydraulische & Pneumatische Installaties"		1
5.	"Organisation & Management of a preventative Maintenance Programme HVA.		1
6.	"Desiners Handbook No. 2 - Dry Bearings & Materials "Glacier"		1
7.	"Pipe line Componeuts Isometric Pipe Plan Reading"		1
8.	EITB Manual Module J.1 "Mechanical Maintenance PT. 1		2
9.	" " " J.21-1 "Mechanical Maintenance PT. 2 VOL. 1		1
10.	EITB Manual Module J.21-2 "Mechanical Maintenance PT. 2 VOL. 2		1
11.	EITB Manual Module J.3. "Maintenance of Factory Services PT. 1		1
12.	EITB manual Module J.23-1 "Maintenance of Factory Service PT. 2 VOL. 1		1
13.	EITBManual Module J.23-2 "Maintenance of Factory Service PT. 2 VoL.		1
14.	"Shell Instruction Manual for Maintenance Mechanics VOL. 1 "Shell"		1
15.	"Elementary Course Manual on Lubrication" Shell		1
16.	"Basisleergang Constructievakken" Smecoma		1
17.	Principles & Maint. of Mechanical Seals & Centrifugal Pumps		1
18.	"Baggasse Boilers" HVA		1
19.	"Assembly Practice" Krysin		2
20.	"Lubrication Matters - Cane Mills " Centralube 7		1
21.	"Maintenance - Lancaster Flow Drain Tops P. 17018		1
22.	"Reducing Valves" Quitetite P-19895		1
23.	EITB Training Module J1 Mechanical Maint. - I -		1
24.	" " " J21 Mechanical Maint. - II -		1
25.	" " " J3 Factory Maint. - I -		1
26.	" " " J23 Factory Maint. - II -		1
27.	Maintenance Planning in Manufactury estabs 4 No.		1

CHECK LIST FOR SYLIABI AND CURRICULA

(TITLE)

S.N.	DESCRIPTION	SOURCE
1.	Syllabus Basic Meter Mechanics Course	STC
2.	Syllabus Diesel Mechanics Upgrading Course	STC
3.	Syllabus Auto Electrical Upgrading Course on Caterpiller, M/F.J.D.	STC
4.	Syllabus Basic Automotive Electricians Course	STC
5.	Syllabus Instrument Technicians Course	LOTUS
6.	Syllabus Potential Supervisors Course in Sugar Engineering (3 years)	STC
7.	Syllabus Potential Supervisors Course in Sugar Processing (3 years)	STC
8.	Curriculum Plant Maintenance Course	HVA
9.	Syllabus Plant Maintenance Course for Sugar Corporation Technicians	VTC
10.	Introduction to Plant Maintenance - Syllabus	STC
11.	Syllabus Boiler Operators Course (Arabic)	STC
12.	Syllabus Basic Fitters Course	VTC
13.	Curriculum Basic Fitters Course (3 months)	STC
14.	Syllabus Capstan Operation Setting and sequential Controlled	TRG. SERVICES
15.	Principles and Practices on Supervision	M.D.P.G.
16.	Syllabus Physics for HTS Sugar Technicians (Arabic)	STC
17.	Schedule Introduction to Supervisory Skills	MDPC
18.	Syllabus Mechanical Installation Foremen's Course	
19.	Syllabus for Pipe Welding etc..	

ANNEX H

SSTC ENROLLMENT FIGURES

1981 = 11	1985 = 113
1982 = 23	1986 = 108
1983 = 90	1987 = 68
1984 = 75	6/88-2/89 = 149

ANNEX I

EQUIPMENT AND MATERIALS PURCHASE LIST

TRAINING PROGRAM DEVELOPMENT DEPARTMENT

PRIORITY	DESCRIPTION/ RATIONAL	SPECIFICATIONS/ EQUIVALENT	QUANTITY	COST EST. (US $)	ACTUAL
1	19" Television with attached VHS VCR		2	$2,000	
2	VHS Portable Video Camera	Sony	1	$1,200	
3	Tripod for Video Camera		1	$ 125	
4	Carrying Case Video Camera		1	$ 50	
5	Zoom Lens 28-80mm range		1	$ 300	
6	VHS tape editor W dubbing capability		1	$ 600	
7	Blank VHS tapes		100	$ 500	
8	Drafting Table with chair		1	$ 350	
9	Drafting paper		10 rms	$ 50	
10	Drawing/artist pen set		2	$ 100	
11	IBM PS 2 Computer w/color monitor, 20mb hard disk, graphics board, mouse, 3 1/2 ext. drive, & 5 1/4 ext. drive		1	$2,000	
12	IBM Laser Printer		1	$2,500	

13	Scanner - ABATRON SCAN 300/FB or equiv.	1	$2,500
14	Video Builder authoring software	1	$ 850
15	PowerPoint Design Software or equiv.	1	$ 500
16	DataShow Computer Projector or equiv.	1	$1,600
		total	$15,225

ADDITIONAL REQUIREMENTS

Overhead Projectors portable	2	$ 600
Transparency Maker	1	$ 250
Camera-35mm slide	2	$ 350
Slide Development Lab Equipment	1	$ 500
Slide Stand for Stills	1	$ 100
Slide Projector with Audio Cassette	1	$ 400
Filmstrip Projector with Audio Cassette	1	$ 350
Flipchart Stands	3	$ 150
Flipchart Paper	50	$ 350
Flannelboard with related attachments	1	$ 225
Whiteboard with Pen Set	1	$ 250

REFERENCE MATERIALS REQUESTED BY

TABIR BIRAIR, BUSINESS INSTRUCTOR

BRILY, PRICE AND PRIOR MANUALS

SPRING STREET,
PADDINGTON STATION,
LONDON SW7

1. FINANCIAL ACCOUNTING

2. ORGANIZATIONAL MANAGEMENT

3. MANAGEMENT ACCOUNTING

4. FINANCIAL MANAGEMENT

5. COST ACCOUNTING

6. AUDITING

PERSONAL COURSE FOR BANKERS

BY E.P. DOYLE
I.S.B.N. 0907135234
W.M. HARRISON F.I.B.
NORTHWICK PUBLISHING
14 BEVERE CLOSE
WORCESTER
WR 3704

ANNEX J

PROFILE OF PARTICIPANT

Basic requirements

NAME Sennar Instructional Staff

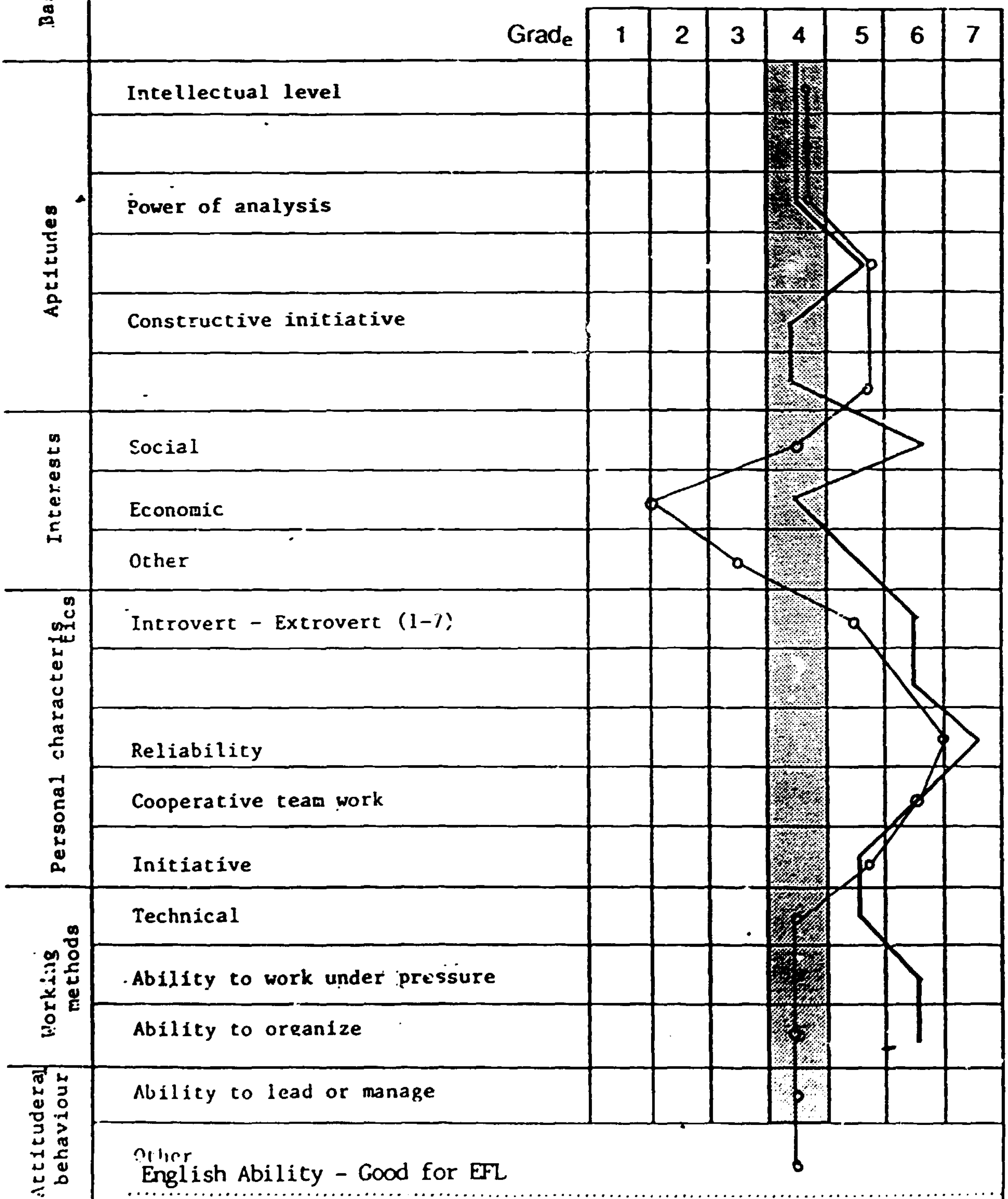
POST New Recruits
Group 1 (2 Individuals)

AGE 25 - 30

SEX MALE

ACADEMIC BACKGROUND: Polotechnic Graduate or Equiv.

GENERAL APPEARANCE: Good



Observations Instructional staff not provided with proper safety clothing for construction ie: safety shoes, overalls, etc.

Years of relevant experience 3 - 10 years

Present functions. Sennar Sugar Training Center Instructors

ANNEX K

PROFILE OF PARTICIPANT

Basic requirements

NAME Sennar Instructional Staff

AGE 25 - 42

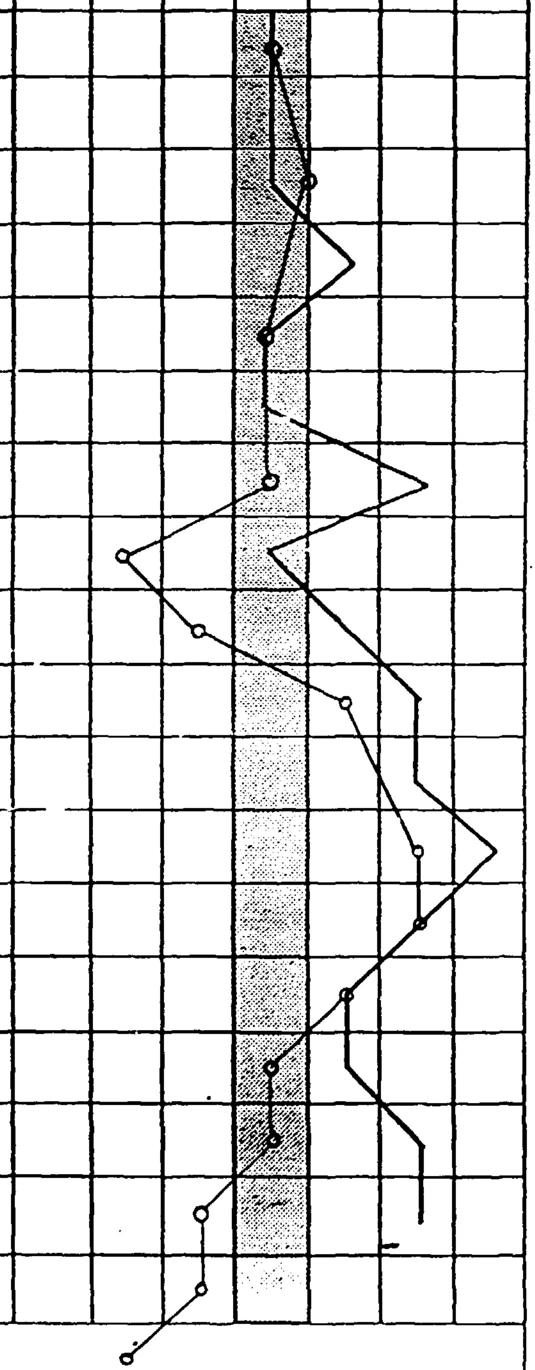
SEX Male

POST New Recruits
Group 2 (4 Individuals)

ACADEMIC BACKGROUND: Polotechnic Graduate or Equiv.

GENERAL APPEARANCE: Good

Grade 1 2 3 4 5 6 7



Aptitudes

Intellectual level

Power of analysis

Constructive initiative

Interests

Social

Economic

Other

Personal characteristics

Introvert - Extrovert (1-7)

Reliability

Cooperative team work

Initiative

Working methods

Technical

Ability to work under pressure

Ability to organize

Attitudenal behaviour

Ability to lead or manage

Other

English Ability-Poor, Must have further English training

Observations Instructional staff not provided with proper safety clothing for workshop instruction, i. e.: safety shoes, overalls, etc.

Years of relevant experience 5 - 20

Present functions: Sennar Sugar Training Center Instructors

PROFILE OF PARTICIPANT

Basic requirements

NAME Sennar Instructional Staff

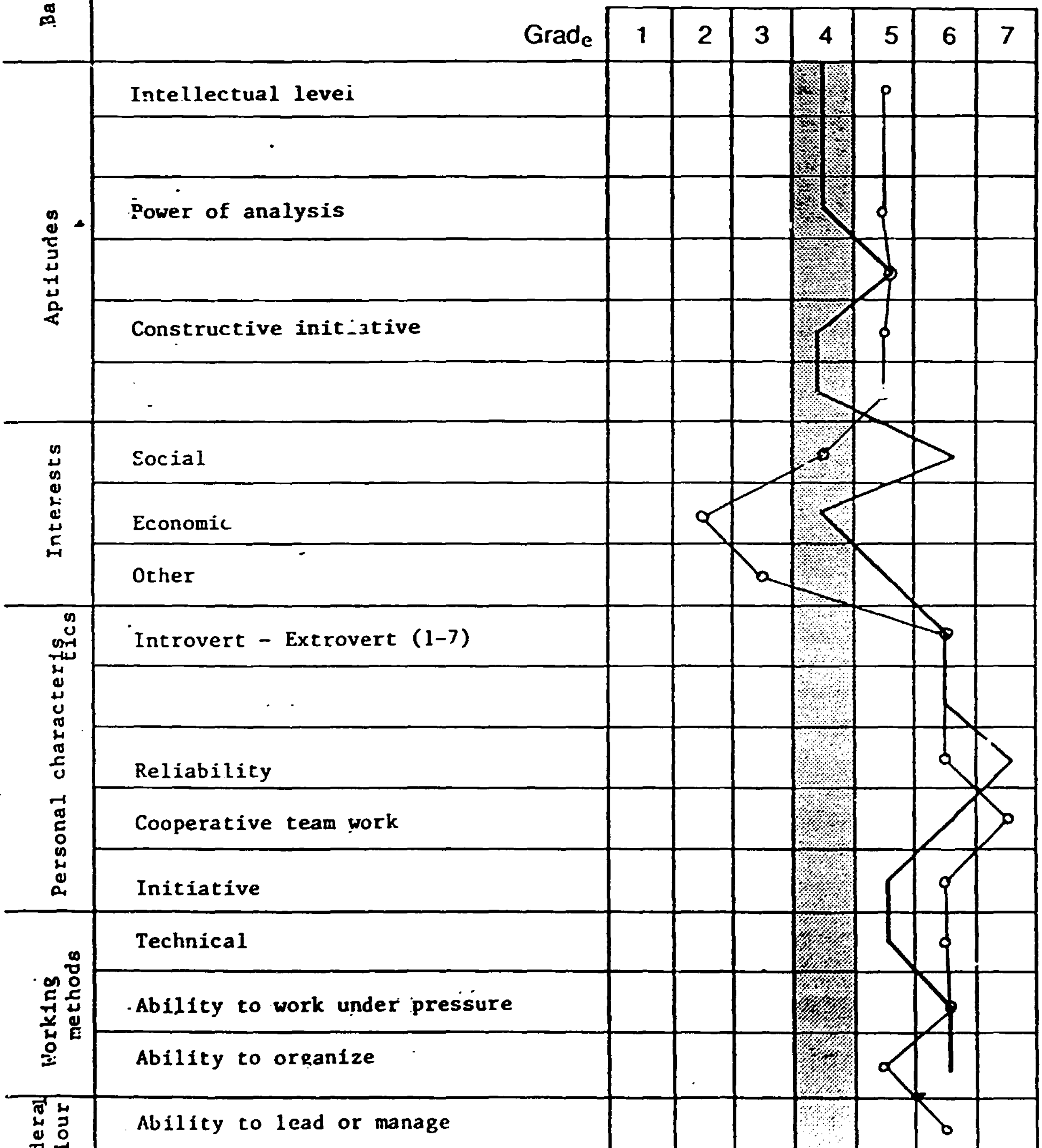
POST Training Staff
Group 3 (9 Individuals)

AGE 23 - 28

SEX Male

ACADEMIC BACKGROUND: Polotechnic Graduate or Equiv.

GENERAL APPEARANCE: Good



Other
English generally good, 2 - 4 Individuals may need further training

Observations Some Instructors have bought own workshop clothing for safety, i. e.: safety shoes, overalls, etc.

Years of relevant experience 5 - 20

Present functions:
Sennar Sugar Training Center Staff

ANNEX M

PROFILE OF PARTICIPANT

Basic requirements

NAME Sugar Estates Training Officers

POST Guneid and Assalaya training Coordinators Group 4 (3 Individuals)

AGE 25 - 35

SEX Male

ACADEMIC BACKGROUND: Polotechnic Graduate or Equiv.

GENERAL APPEARANCE: Good

	Grade	1	2	3	4	5	6	7
Aptitudes	Intellectual level							
	Power of analysis							
	Constructive initiative							
Interests	Social							
	Economic							
	Other							
Personal characteristics	Introvert - Extrovert (1-7)							
	Reliability							
	Cooperative team work							
	Initiative							
Working methods	Technical							
	Ability to work under pressure							
	Ability to organize							
Attitudinal behaviour	Ability to lead or manage							

Other

English - Good

Observations

Years of relevant experience 5 - 15

Present functions: Training Coordination at Sugar Estates

① **JOB DESCRIPTION** **Page:** ...... **of** ......

Job Title: Instructor/Trainer

Occupational Area: Training

Job No./Code: ....

Company: Sennar Sugar Training Center

Field of Work: Instruction

Department: Instruction

② **Description of Functions:**

Performs job and task analysis on occupations in field of instruction. Designs and develops training programmes based on the job analysis. Teaches or trains others in a formalclassroom or on-the-job in order to help them to improve their job performance. Maintains effective communications with supervisory and management personnel in their field of instruction.

③ **Organisational Pattern: (Responsible to/Responsible for)**

Responsible to the department head. Responsible for all instruction in his field.

④ **Conditions of Work/Standards:**

Works at Sennar Sugar Training Center or at one of the public sugar estates as assigned.

Designs, develops and conducts all training to international standards.

⑤ **Entry Requirements:**

Must be able to communicate effectively in Arabic. Ability to read and write English is desireable.

Should be able to develop, design and conduct training programmes in the field of instruction in a timely manner.

① **JOB DESCRIPTION** **Page:** ...... of ......

Job Title: Department Head **Occupational Area:** Training

Job No./Code: ....

Company: Sennar Sugar Training Center **Field of Work:** Curriculum Development for Training

Department: Training Programme Development Department

② **Description of Functions:**

As the head of Training Programme Development Department, the department head should be familiar with and have practical experience in

(1) determining organizational training needs
(2) job and task anlysis
(3) curriculum development and training methodology
(4) training of trainers
(5) evaluation of training and
(6) managment and administrative information retrival systems

③ **Organisational Pattern: (Responsible to/Responsible for)**

Reports directly to the National Director ofthe sugar training center. Responsible for all curriculum development at the Center and the sugar estates.

④ **Conditions of Work/Standards:**

Works with the public sugar estates and must maintain close contact estate managers and training personnel, insures all curriculum developed at the Center and at each sugar estate is not only rlevant to an occupation, but meets international standards for job training.

⑤ **Entry Requirements:**

Must be able to read and write in English and Arabic. Must be familiar with a system and modular approach to training.

Should be able to design and implement ourses for trainers and instructors.

REPORT ON OPERATION AND MAINTENANCE OF VEHICLES AND AGRICULTURAL EQUIPMENT

by E. Pauli
Expert

EXPLANATORY NOTES

Currency

On the 26th October 1988 the Government of Sudan (G.O.S.) officially released the value of the Sudanese Pound (L.S.) to float following the free market. The UN exchange rate remained at 4.4. L.S./$ U.S. during the duration of the mission, whilst the official free or "real" rate fluctuated between 11.5 to 13.5 L.S./ $ U.S.

The "real" rate was used everywhere (except UNDP), including also UN recommended hotels.

Abbreviations

A & AMS	Automotive and Agricultural Machines Section
CAT	Caterpillar
G.O.S.	Government of Sudan
ILO	International Labour Organization
M	Meters
MES	Modules of Employable Skill
M.F.	Massey Ferguson
NSTC	National Sugar Training Centre - Sennar
SPIC	Sugar Project Implementation Committee
UNIDO	United Nations Industrial Development Organization
UNDP	United Nations Development Programme
VTC	Vocational Training Centre

INTRODUCTION

Throughout the whole period of the mission from the 13th November to 17th February the expert, accompanied at all times by his main counterpart visited:

a. The A & AM Sections (users & maintenance) of all four sugar mills.

b. The Caterpillar & John Deere agent and training centre.

c. Ministry of Agriculture - Masaad Tractor drivers and maintenance training centre.

d. Ministry of Labour:

    1. Tamboul Tractor drivers Training Centre.

    2. V.T.C. Wad Medani

    3. V.T.C. Khartoum (2) (Ex GTZ)

    4. V.T.C. Khartoum (1) (Ex GTZ)

e. Khartoum Polytechnic

    Automotive trades - Higher Tech. Diploma Unit

f. Kenana Sugar Training Centre (Private sector)

g. The four Public Sector Sugar Mills (Assalaya, Geneid, New Halfa, Sennar)

From the above visits, the reports of previous missions, and meetings within the NSTC with visitors from the Sugar Industry, the expert extracted the information leading to this report.

The purpose of this report is to form a guideline for the running of Phase II of the Project, in the automotive and agricultural equipment section.

The main direction of the original Terms of Reference of the expert was followed.
Diversions came about unplanned, which caused a change of activities. These were not recorded on the experts TOR but are recorded on the project documentation and were part of the projects objectives.

The two main diversions consist of:

1. Running the second part of a staff development programme on behalf of the C.T.A., who had to absent himself to attend unplanned meetings with UNIDO's DDG, Ministry of Industry an SPIC in Khartoum.
2. An on-the-job evaluation of the counterparts, by running training courses. It was decided by the CTA to start training and simultaneously evaluate the counterparts, to help selecting candidates for further training, and at the same time validating the facilities and equipment.

All main objectives were attained. some details were left voluntarily undefined, not to restrict excessively experts who will participate in Phase II. There is no doubt that the general situation was analyzed and the basic preparation for Phase II completed.

Poor communications and a certain lack of information required some personal research and some knowledgeable guesses. These must have been in the right direction as the final figures correspond closely to those of independent studies.

A marked shortage in V.T.C. and the rather low standards of most of the few existing, excludes the use of such an external facility to rely on to solve the problems of the sugar industry.

RECOMMENDATIONS

1. The creation of the right conditions in the industry for training to be:
   a. Attractive to personnel
   b. Successful, by personnel being able to implement the learnings on their job.

   NOTE: For more details on this point please refer to the Recommendations Section of Mr. Tom Wright's report (1983). "An assessment of training needs and a training plan for the Sudan Sugar Industry", point 1.2.3. Institutional Issues. Recommendations No. 35 & 36 are still valid to a great extent. For easy reference an extract of the above is to be found as Annexe VI.

2. The creation of clear job descriptions within the Automotive and Agricultural Machines operation and maintenance general areas standardized in the whole of the Sugar Industry in the country.

3. For technical reason the head of the Automotive and Agricultural Machines section in NSTC, when appointed, must have the decisional power within his section with a clear delegation of authority and reponsibilities.

4. Training of trainers, development, adaptation and translation of training material and hand-outs must constitute the first big step of Phase II. (See Annexe X)

5. Training/upgrading of supervisors in both technical and supervisory/management skills must precede the training of operators/technicians.

6. Should a further four trainers be found for the Automotive and Agricultural Machines Section, as originally foreseen for Phase I, they must be recruited as soon as possible thus approaching the planned inertia for the programme.

7. To obtain the best possible impact on the mills one has to concentrate on three points:

a. Multiplier effect in training.

b. Stopping the damage at the origin, i.e.:

- operator training
- timely maintenance.

c. Constant and competent supervision.

8. Present training facilities are grossly inadequate. Enlarged and comprehensive facilities have to be established. See annexed drawing (XII) and Quantitative Analysis (VII).

9. A special course for storekeepers on stock control and drafting orders establishing what to order and how much to order - Reading of manuals.

10. Having envisaged the size of the Auto and Agri machine section will attain in NSTC, it should have its own internal administrator and secretarial assistance.

11. A maintenance department and budget have to be established within NSTC to look after the regular upkeep/maintenance and regular of the Auto and Agri machines section. (Within the provision of the training centre as a whole).

12. Training should be carried out as much as possible at the mills through the establishment of "training facilities" at each plant, run by plant personnel trained both technically and in instructional methods, and by trainers from NSTC.

13. **Streamlined and clearly defined procedures have to be established for all routines within the operating system involving the Auto & Agri machines department.**

14. **A follow-up system for trainees has to be established to analyze the impact of training programmes on the job and thereby their suitability to the industries requirements, establishing any alterations or supplementary training which might be needed.**

15. **A number of fully qualified technicians from NSTC will have to go on regular rounds of the mills to give the training officers the necessary backing.**

16. **A reliable communications system with a confirmation of message received has to be established between NSTC, the four mills and UNDP.**

17. **The introduction of female teachers in such fields as electrical maintenance and drawing reading and interpretation, will result in more discipline and a healthy competition with the male teachers.**

18. **Having seen the large number of different types of machines it is better to concentrate training on selected machines only, at least during the initial stages (1-2 years).**
See Annexe XIII - items marked with *.

19. Sutrac-Caterpillar agents - indicated they could be willing to train, for the NSTC (at minimum cost) an operator instructor and a maintenance instructor in their Wad Medani base over a period of about 6/9 months.

20. The introduction of a quality controller/tester course in coordination with the establishment of an independent checking, in and out, of all machines in the workshop of the mills.

21. The introduction of a training course for bodywork repairs for vehicles. The assumption is that an operator who has a decent looking machine will be proud of it and will look after it better (Attitudinal behavioural patterns).

22. The equiping of the NSTC A & AM workshop with all the necessary tools and equipment (without unnecessary sophistication) to train in the areas of basic artisan's skill level.

23. All machines should have a permanent driver/operator specially trained to operate that machine.

Seasonal drivers/operators, and changing drivers/operators from one machine to another, greatly increases machine damage and premature wear.

24. Isolated living conditions at the mill with very limited housing, shopping, health or recreational facilities will represent severe problems for phase II. The possibility of living in Wad Medani and commuting with a project shuttle every day has to be seriously considered.

25. Present transport in the form of 2 Land Cruisers is totally inadequate. Far cheaper, to buy and run, roomier, more comfortable and fast would be vehicles such as Peugeot 505 SW 4x4 or Toyota Tercel SW 4x4. For a team of 8 or 9 specialists and their counterparts to move around the 4 mills and the capital it is felt that some 5 or 6 such vehicles will be needed.

26. Some special tools are a must to enable technicians to work safely on machines. The extraordinarily large variety of machines on the 4 mills requires a study to be done on this subject alone. It can be very costly to buy them all (many hundreds of thousands of US$), as recommended by manufacturers and it can be even more expensive not to buy any. A study should be completed on this subject and proposals put forward. An example of an as yet unfinished list for Caterpillar alone is attached as Annexe XV.

<u>BRIEFING IN VIENNA - UNIDO - SEE ANNEXE XIV</u>

BRIEFING AND PROGRAMME IN KHARTOUM

Upon arrival in Khartoum on the 19th November 1988 the expert found his way to a hotel and managed to contact UNDP halfway through the next working day. Then Mr. Ismail (UNIDO in UNDP) took charge and took the expert to SPIC where the expert met:

- Mr. Badr el Din Habbani - Chairman of SPIC who welcomed the expert and after a brief introduction passed him on to;

- Mr. M. A. Hassan - Deputy Chairman of SPIC, who went into greater details of the SPIC purpose and the National Sugar Training Centre's purpose in Sennar.
  He also filled in a bit of the public sector in the sugar industry past.

- A brief meeting was held with Mr. Elahi, advisor to the Chairman.

- The expert was also introduced to a number of people present at the time in SPIC. Mention should be made of Mr. Jaafar Husein, of the Ministry of Industry, which he represents on the SPIC and STC boards. And of Dr. Basheer, Senior Dean, University of Gezira and Chairman of the Technical Committee of the NSTC.

NOTE: It was Mr. Jaafar Husein who accompanied the expert to the Ministry of Foreign Affairs where an administrative personnel strike was ongoing, and succeeded in obtaining the necessary travel permit.
Having obtained the travel permit in the morning, the expert travelled alone to Sennar with the car the CTA had left behind for him.
The expert arrived one day later than the other expert due to the delays in obtaining his travel permit.

ACTIVITIES

For the first ten days after his arrival in the NSTC (National Sugar Training Centre - Sennar), the expert was occupied full-time in running Staff Development Courses started by the CTA - due to the unplanned visit of UNIDO's DDG, Mr. Wisebach, to Khartoum, the CTA had to go to Khartoum leaving the course he had started.

The above course was an introduction to "Modular Training", as developed by the ILO in conjunction with the MES (Modules of Employable Skill) programme which we run for instructors and training officers from the Sugar Mills (See Annexe II)

During this course each individual and groups completed satisfactorily exercises consisting of analysis and build-up of programmes related to their field of competence.

<u>NOTE:</u> The CTA and the Expert could not meet or even discuss the course due to lack of communications. In spite of this the course continued without problems due to the previous experience in similar employment using the standardized MES approach.

During the various group discussions related to training methods and their implementation one worrying question/doubt was brought up by the whole group, namely whether the various supervisors and managers would allow the application on the job of the learnings from training.

There appears to be some resistance by a number of managers to send people for training.

A report on this course is to be found in the CTS's report as he was in charge of it, a copy of it is attached for convenience as Annex II.

It is worth noting that the privately owned sugar mill, Kenana, also sent two participants to the course. One training officer and the automotive trades instructor.

According to the Phase I plan, there were supposed to be 25 counterparts, including four training officers, one for each mill. This should have resulted in six or seven for the A & AMS and four training officers.

The counterparts available were two training officers, one from New Halfa and one newly nominated in Assalaya and three in NSTC. With this limited number of people it was decided to follow the CTA's recommended programme of running test courses to evaluate both material and personnel. The first two courses were planned to start on the 10th of December, using as basis the learning and project work of the affore-mentioned staff development programme.

During the time before the 10th, visits were made to the Assalaya, Kenana and Geneid Sugar Mills. (see separate section).
The remaining time was dedicated to planning and preparing the courses ahead.

When the course started there was a great shortage of trainees - three mills sent no-one, later investigations revealed that in spite of three messages having been sent to the three mills (in total nine messages) none had been received.

It should be noted this problem reoccurred also later. On the driver training course starting on the 4th of February 1989, not one participant turned up in spite of the course having been announced four weeks before.

This prevented the programmed validation of the instructor and the material he had adapted and completed.

FINDINGS

1. **Facilities:**

The facilities in the NSTC for the A & AMS are about 200 m3 this includes office, classroom, vehicles W/S and electrical W/S.

With about 2600 people to be trained, without counting personnel turnover, the enormity of the problem is immediately obvious. (See Annexe X)

Of the four mills, only one, New Halfa, has a minute training centre running successfully for several years. It operates with only (2) full-time instructors and part-time technicians from the plant as instructors. Its capacity is 30 trainees divided in fitting, basic electricity and basic Auto-mechanics.

The trainees participate for a 2 year period to theoretical and practical courses mainly by mill technicians on an overtime basis using as guidance manuals and books from both Ministry of Education and Ministry of Labour. The facilities are minimal, consisting of three small classes (approx. 4 x 5) and 10 work benches fitted with vices in the open air. The total area is approximatively 90 to 100 m2.
Although the surface is only fust being scratched, the direction and spirit are right.

The other 3 mills have no training facilities or equipment.

2. Tools and Equipment:

The present equipment and hand tools available in the NSTC permit reduced ad hoc training on a very small scale. Some is worn out or damaged.

A few tools are available from store and are drawn if and when necessary. Often a missing part prevents the use of the whole.

A list of what is available is attached as Annexe XI.

3. Training function in the mills W/S:

The training officer post was recently filled in Halfa, unfilled in Sennar already existed in Geneid and Assalaya.

The role of the training officers was just as a post box, receiving and passing on messages related to courses. No job satisfaction and no future could be seen for training officers.

Workers in the mills, in most cases, pick up the knowledge of how to work by working with their predecessor for a while. Where the original knowledge came from, is not clear. It might have been discovered in an empirical manner in the first place and then passed on, with or without intuitive or reasoned changes.

4. General situation of the W/Ss in the mills:

All W/Ss are under just a roof with no sides and all operations are carried out in a very dusty atmosphere.

This is not true of Halfa - the W/S is in a go-down with a badly broken roof and walls, directly downwind of the mill, so that it is snowing bagase inside the W/S 24 hrs a day. (As long as the mill is working)

All the W/Ss are divided in sections specializing in different machines. These are one for light vehicles, one for tractors, one for trucks, one for trailers, one for earth moving and heavy agricultural machines, a tyre section, and a welding and machining section.

The equipment of the sections is quantitatively little and qualitatively reduced to a bad condition in most cases, although originally the quality was often good.

Housekeeping is generally quite bad.

Supervisors usually attain their position by promotion from the shop floor and do not hold qualifications, other than experience (not always good).

Although the above might not seem very positive, it is felt that the workers on the shop floor, considering the training, facilities, tools and available materials, are managing extremely well. It must be pointed out at this stage that in the Geneid W/S, although conditions are basically the same as the other three W/Ss, the quality of work is noticeably better. This appears to be attributable to a greater involvement of the supervisors in the work on the shop floor.

Immagination and ingenuity is obviously used and problems which in other places are not even identified, here are solved, even with modifications to the machines.

The serious problem area is the availability of spares. This area is one of the worst. Often wrong parts are ordered, parts which are requested by the W/S are not ordered, but large stocks are available of parts which will probably never be needed. (Item 9 on recommendations)

Quality control is a source of obvious troubles. The origin or cause of problems is often not identified, and when the machine is repaired, there frequently appears to be no further inspection.

A thorough inspection of machines, both coming in the W/S and leaving the W/S is badly needed. It should be rund independently of the W/S sections, and could be under the direct control of the W/S manager. The inspectors could check the complaints of the user, prepare a job card for the relevant W/S section, and then check the machine again after the work has been completed to establish:

a. whether the repair was done satisfactorily.

b. whether the original problem of the machine was solved.

c. that the machine has no other problem and is fit and safe to be released to go to work.

5. Trainers situation in NSTC:

One week before the end of the UNIDO expert's assignment in phase I there is only an ad interim chief of the A & AMS and two instructors. The job at hand, is to build up the facilities and material to train approximately 2600 operators/drivers, maintenance technicians and their supervisors.

About 1000 to 1200 of the above 2600 are seasonal workers with an average turnover of about 30% season = 360 persons per year.

Even if only driver/operator training, and maintenance training needs are to be satisfied; there is a requirement of 14 to 16 instructors permanently in NSTC. This would not acceptable as there is a need for instructors to visit the mills before and after courses, thus almost doubling the number of instructors.
This figure can be slightly reduced by using more "on-the-job" training. To cover the total training needs, including follow-up, and by training people also on the job, it is felt that a figure of 25 to 30 trainers is needed in the A &AMS.

This is without a time constraint, just fulfilling technical needs.

It is also commonly accepted that of these people who reach a good level of skills or competence, a large part (maybe as much as 50%, leaving to private industry, Gulf States etc.) will go to work abroad and have to be replaced by people who, of course, need training.

For more details see the supplement to Annexe X.

CONCLUSIONS

1. **Facilities**

   An extension of the present buildings of the A & AMS in NSTC should be mandatory. Proposed drawings with dimensions have been passed on to SPIC's architects to develop a proposal. This should include separate sections for:

   1. Electrical shop
   2. A & AM fitting shop
   3. L.V., Truck and Tractors engines
   4. L.V., Truck and Tractors transmissions
   5. L.V., Truck and Tractors Chassis shop
   6. Diesel Systems shop
   7. Hydraulic Systems shop
   8. General Plant section

9. Plant Engines
10. Plant Transmission
11. Body repair
12. Inspection Area
13. Wash and Lubrication area

Except for 12 and 13 all others need a closed, relatively dust free, area and an outdoors but covered area.

The whole lot should be surfaced and drained (for washing and cleaning as well as rain).

The need for all the different sections comes from a number of reasons.

1. At some stages many different courses will be running at the same time.

2. Even when courses are not running the specific shop can be undergoing preparation for a course.

3. Specialized equipment has to be kept together in its area of specialization without unauthorized persons having access to it.

4. Materials, tools, wall-charts, not appertaining to the course will distract trainees from their course.

The expert's outlined W/S layout proposal is attached as Annex XII.

NOTE: One extra section has been r :ommended to accomodate body repairs, 2 x . - x 9) m2.
Justification: seeing the dilapidated appearance of many machines, it is not surprising they get treated rather roughly by both operators and maintenance crew.
If an effort was done to improve not only the true condition but also the appearance of the machines, this will result in more care being taken by quite a few persons. It then becomes easier to identify and correct those who do not.

Once a substantial investment is put into the construction and equiping of the A & AMS, it will be necessary also to have regular maintenance of the facilities. This has to be part of a greater plan for the whole training centre and has to have as an objective the keeping of the training centre in a condition almost as new.
This of course needs the cooperation of all involved, trainers, trainees, cleaners, administration etc., all working together guided by clear rules, submitted to discipline and with the assistance of good supervisors.

In the interest of training, it must be noted that it is desirable that the living accomodations for the trainees are important in creating a comfortable and constructive atmosphere conducive to learning.

Whilst on the subject of accomodation and living conditions it should also be pointed out that the NSTC personnel and advisors have problems in this area, that maintenance is bad, resulting in accomodation of a very poor standard, made worse by the lack of shopping facilities and recreational facilities of any type whatsoever.

There is no doubt that working performance is negatively affected by the above situation.

2. Training of trainers, preparing/adapting training material

Before training programmes of any size can be even considered, a suitable body of trainers has to be formed (see Quantitative Analysis Supplement - Annexe X). It is not enough to have updated technicians, they must also know how to put the message across so that the trainees learn. Furthermore, they will need a number of training aids to help them transfer the knowledge to the trainees first, and then to make the trainees practice it so as to fix it in their memory.

All this requires much in the way of know-how, materials and organization. In other words knowledge and preparation.

The skills required to do this, need learning first, and then practicing under supervision to attain a sufficient standard to be able to face a class competently.

All these aspects are tackled and explained in the recommendations from the training methodology specialist. This will extend also in the CTA's recommendations and include such other aspects as the training facilities at the sugar mills, how they should organized, coordinated and run.

It must be noted that by using a modular training system much time will be saved in translating and adapting material as it will be interchangeable between various trades.

3. Organization within the A & AMS

Considering the number of trainees and the subjects which have to be taught, it is obvious the work load will be great.

For the system to work smoothly, there will be a need for an analysis of all operations to be carried out, and a clear distribution of who should do what, when and its relation to others. It is obvious that this can not only be within the A & AMS, but has to be for the whole NSTC for it includes not only the class and W/S teaching sessions but also all the other aspects such as accomodation, food, transport, payments, communications, first-aid, stationary, etc.

The training centre has to work as a well coordinated machine.

This can only be achieved with an evenly and organized spread of the work load according to a well defined and clear plan.

4. Priorities

It is obvious that it will not be possible to tackle all areas from the word Go!
Areas of priority have to be selected. Three criteria are suggested as the means to decide which will be the priority areas.

1. Prevention is better than cure, i.e. use it properly and maintain it in time.
2. Make sure that 1 above is done, i.e. supervision.
3. Concentrate on selected machines, to start with. (See Annexe XIII machines with *)

The above means that we have to make sure that the middle management and supervisors are ready to guide and back up the workers at their job.

To achieve a situation where prevention is the prime objective make sure that each supervisor, at whichever level he is, is fully conversant with the work of his subordinates, so as to help them and guide them in their work when the need arises.
Only then can we train the workers. This means the A & AMS must make sure that the supervisors have an up-to-date knowledge of all the machines, their operation and maintenance.

This can be achieved by running courses made up of selected information from the operators/mechanics/electricians courses and condensed, according to needs.

Some practice will also be needed.

Once the training can be run this way the next step which is the FOLLOW-UP will be a lot easier.

5. Follow-up

To ensure courses are satisfying the needs of the user (sugar mills), frequent follow-up visits will have to be done at the places of work. Checking with the supervisors is a must, and any problems have to analysed, to see how the imput has to changed to suit the job. To be able to do this, the work to be done by each individual has to be clearly defined and summarized in job descriptions.
This enables the preparation of specific training packages for every job, to guarantee the performance of the worker to a given standard in a given condition.

6. Inspection procedures

The need for an independent quality check has been expressed by several people during the visits to the mills.
In other cases there have been situations where everybody was pointing the finger to someone else, whenever machines came

to a stop. This especially is the case of machines going in and out of the W/S.

For this reason it is felt the suggestion of quality control teams, operating independent of the W/S or the user, is a welcome one. Courses can be run to satisfy this need.

7. Communications

During the period of the mission there have been innumerable cases of radio messages not having reached their destination. In one occasion a total of 9 radio messages was sent to 3 mills and none was traced.

Recently on the 4th of February this resulted in not one (zero) trainees arriving for the start of a new course. This was announced four weeks in advance.

It is also obvious that a training calender will have to be drawn up at least 3 months in advance.

As far as the radio is concerned the solution could be a system whereby a message will be transmitted every 2 days until a confirmation of message received comes back.

8. Drivers/Operators

All sugar estates have large numbers of seasonal drivers. This causes a lot of dammage to the machines, and it is difficult to pin the fault on a driver. He will always blame someone else.

The only way around this problem is by having permanent employees appointed to one machine. One machine - one group of operators. The limitations are obvious. It will never be possible to have less than 3 operators/machine. But surely it is better than five or seven or more. Good supervision and maintenance should do the rest.
This should also reduce training cost. See the projected number of seasonal operators/drivers over a 5 year period in Annexe X, section IIIB.

9. Condition of bodywork of Machines

The average condition of bodywork on machines is quite bad. (That's when they have one - it is sometimes even missing). It is hard for a driver on a machine or anybody to have respect and be expected to look after a tatty machine. It is also difficult for a supervisor to see if any more damage has been made when the vehicle is in a bad condition.
For this reason it is felt that a body repair section should be established within the NSTC.

LIST OF ANNEXES

ANNEX (I)

LIST OF PEOPLE MET

SPIC

Chairman	Mr. Badr El Din Habbani
Dep. Chairman	Mr. M.A. Hassan
Advisor	Mr. Elahi
Ministry of Industry Rep. on SPIC & NSTC Boards	Mr. Gaafar Hussein
Senior Dean of Gizira Univ. and Chairman NSTC	Dr. Bashir

SENNAR SUGAR MILL

General Manager	Mr. Abbas Al Aubeid
Dep. G. Manager	Mr. Bakri
W/S Manager	Mr. Ismail Ishaq
W/S Mgr. Adviser	Mr. Kim
Training Adviser	Mr. Lomax

ASSALAYA SUGAR MILL

Dep. Gen. Manager	Mr. Osman Abuidris Arrya
W/S Manager	Mr. Abdel Rahman Haj Hassan
W/S Mgr. Adviser	Mr. Dennis Walker
Training Adviser	Mr. Dere Bouks
Agri. Eng.	Mr. Salah Ahmed Idris
Training Officer	Mr. Mubarak Mhmd Salih

GENEID SUGAR MILL

W/S Manager	Mr. Ice
Agri. Eng.	Mr. Mhmd Hamidi

NEW HALFA SUGAR MILL

General Manager	Mr. Atta Mhmd Hassan
Dep. G. Manager	
Agri. Manager	Mr. Hatim Mahjoub
W/S Manager	Mr. Mhmd Suleiman Ahmed
W/S Mgr. Advs.	Mr. V.P. Singh
Training Officer	Mr. Sulaiman Koko
Training Officer Adviser	Mr. Krishna Murthi

KENANA SUGAR MILL

Training Centre Dep. Manager	Mr. Ibrahim Ahmed Idris
Training Officer	Mr. El Faqui Hashim

SUTRAC

CATERPILLAR & JOHN DEERE AGENT

Training Manager	Mr. Ali Sheikh
Dep. Training Manager	Mr. Mhmd Mousa

MASSEY PERGENSON

Regional Serv. Mngr	Mr. Terry Mederoft
Rep. for Sudan	Mr.

KOMATSU

TAMBUL

TRACTOR DRIVING TRAINING CENTRE

Director	Mr. Abdel Majid El Sheikh
Director of Trn.	Mr. El Tijani Yassin Hassan

MUSAAD

TRACTOR DRIVING & MAIN. TRG. CENTRE

Director	Mr. Mhmd Salah el Din
Advisor	Mr. Giuseppe Perotta

MINISTRY OF INDUSTRY VTC Khartoum 2

Director	Mr. Adam Mhmd Adam
Dep. Director	Mr. Hassan Fatha el Bab

MINISTRY OF INDUSTRY VTC Khartoum 1

Deputy Director	Mr. Abdel Wahab Mhmd Osman

KHARTOUM POLYTECHNIC
HIGHER TECH TRG. INSTITUTE

Senior Instructor & Chief of W/S	Mr. Ali Salah

I.L.O - TURIN INTERNATIONAL CENTRE
FOR VOCATIONAL TRAINING

Chief External Fellowship Office	Mr. Ahmad Heir

ANNEX II

FIRST STAFF DEVELOPMENT TRAINING COURSE

NOTE:

Due to unforeseen programme changes the course ended on the 1st of November, 1988 instead of the 24th of October.

After the first week the course was run by Mr. E. Pauli and Mr. J.O. Berglund.

INTRODUCTION TO A MODULAR TRAINING SYSTEM

National Sugar Training Centre, Sennar.

Staff Development Training Programme.

PROGRAMME PLAN.

Title: **The Introduction to a Modular System of Training to be Developed at the National Sugar Training Centre, Sennar.**

Date: NOVEMBER, 1988

J.Bye.UNIDO. C.T.

UNIDO

PROGRAMME : The introduction to a Modular System of Training to be developed at the National Sugar Training Centre, Sennar.

DURATION : Twelve days- 15th to 28th Nov., 1988 (Inclusive).

A I M : To provide a uniform understanding of one specific model for a Modular Training System to be used as a basis for developing the various Training Programmes and courses to be established at the National Sugar Training Centre.

LOCATION : The National Sugar Training Centre, Sennar.

PARTICIPANTS : All Counterparts and Workshop Instructors of the Training Centre.

Plus : Nominated Training Officers from the four (4) Public Sector Sugar Mills.

Plus : Any visitors from Kenana Sugar Training Centre, (as participants or observors).

LANGUAGE : The language of the programme will be ENGLISH.

OBJECTIVE : At the completion of the programme each participant will have prepared a Modular Unit based upon the principles and guidelines set out by the programme presenter.
The individual Modular Units will be integrated into a complete Learning Package prepared to International specifications, codes of practice and standard format as a group activity.

UNIDO

Subject Structure.

No.	%	Subject Fields.	Subjects.
1.	5	Introduction to the System Approach to Training:-	a. The development of a Modular System. b. Definitions and Terminology. c. The key characteristics of a Modular System.
2.	5	The Modular Concept :-	a. The philosophy of phased development of skills using Training Modules.
3.	10	Training Needs Assessment:-	a. Training Population Analysis. b. Preparing a Trainee Specification c. Job Specifications. d. Identification of Training Needs.
4.	50	Developing a Modular Training Package:-	a. Identifying a Modular Unit. b. Specifying the objective of a Modular Unit. c. Job analysis. d. Task analysis. e. Skills analysis. f. Identifying the steps of work within a Modular Unit. g. Analysing the steps of work. h. Identifying the Learning Elements within a Modular Unit. i. Writing the objectives for a Learning Element. j. Determining the contents of a Learning Element. k. Designing Assignments and Progress checks for Learning Elements. l. Preparing Performance Tests. m. Preparing Instructional Units for future development into Learning Elements.
5.	25	Implementing a Modular Training System:-	a. Preparing Instructor Guidance Material. b. Preparing Trainee Guidance Material. c. Managing the implementation of a Training Programme. d. Evaluating Trainee Progress and Performance. e. Validation of Training Material.

UNIDO

Subject Structure.

No	%	Subject Fields.	Subjects.
6.	5	Follow-up and Feedback:-	a. Evaluating Efficiency and Effectiveness of Training. b. Designing and Carrying out follow-up procedures after Training.

METHODOLOGY

In order to achieve the objective of the programme the following procedures will be adopted:-

25% of time engaged in Seminar-Lecture activities.

75% of time occupied by supervised project work.

i.e. Individual and Group Projects will be assigned and whilst the time allocation may vary through the duration of the programme, as necessary, the ultimate aim is to spent 30% of total time available on Group Activities and 45% on Individual Project Activities.

The pattern of time allocation will be:-

07.00 to 07.30 -	Seminar, discussion etc. to consolidate the previous days assignment activities.
07.30 to 09.00 -	Presentation of subject material.
10.00 to 14.00 and 17.00 to 19.00 -	Group and Individual Projects.

PROJECT ASSIGNMENTS

The Individual and Group Assignments will be selected and supervised as follws:-

The assignments will be concerned with the detailed development of Modular Units and Modular Unit Learning Packages.

The final sessions of the programme will be devoted to the presentation of the materials developed as a basis for assessment and evaluation.

INSTRUCTIONAL PRACTICE

The application of the training materials and presentation techniques developed during the programme will begin as soon as possible following completion. To this end the National Director for Training and the CTA have planned three Training Programmes to begin on the 3rd December, 1988. These are:-

1. Mechanical - A Practi[illegible] Course on Skills Awareness for Graduate Engineers.
2. Auto. Mechanics - Basic Practical Course for Vehicle Maintenance Fitters.
3. Elect./Instruments - Basic Practical Cou[illegible] for Instrument Technicians.

Each programme will be limited to (16) participants (ideally 4 from each location) to allow for ease in Assessment of Trainee Performance and Validation of the Modular Units used.

REPORT

A joint report will be prepared by the National Director for Training and the CTA.

J. BYE, OCT. 88

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION. SI/SUD/86/003 TRAINING COMPONENT OF THE SUGAR REHABILITATION PROJECT

NATIONAL SUGAR TRAINING CENTRE - SENNAR

PROGRAMME

WEEK No (2) FROM. 19th Nov. TO 24th Nov.

Time	SAT	SUN	MON	TUE	WED	THUR
07.00 to 09.00	Developing Modular Training Package. - Instructional Units BYE	Implementing Mod. Training System. -Instructor Material. BYE	Implementing Mod. Training System. - Trainee Guidnce. Material. BYE	Implementation and Follow-up. Evaluating Trained Performance and Training Efficien-cy. BYE	Designing Follow-up System. BYE	PRESENTATION
10.00 to 12.00	P R O J E C T B / P / B	P R O J E C T B / P / B	P R O J E C T B / P / B	P R O J E C T B / P / B	PRESENTATION	PRESENTATION
12.00 to 14.00	P R O J E C T B / P / B	P R O J E C T B / P / B	P R O J E C T B / P / B	P R O J E C T B / P / B	PRESENTATION	CLOSING REVIEW
17.00 to 19.00	P R O J E C T B / P / B	P R O J E C T B / P / B	P R O J E C T B / P / B	P R O J E C T B / P / B	PRESENTATION	
Chairman						

Language of the Programme: ENGLISH

UNIDO

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION. SI/SUD/80/003 TRAINING COMPONENT OF THE SUGAR REHABILITATION PROJECT

NATIONAL SUGAR TRAINING CENTRE - SENNAR

PROGRAMME WEEK No (1) FROM. 12th Nov. TO 17th Nov.

Time	SAT.	SUN.	MON.	TUE.	WED.	THUR.
07.00 to 09.00	Introduction to the Systems Approach to Training BYE	Training Needs Assessment. Trainee Specification - Job specification. BYE	Developing Modular Training Package. - Identifying MU. - Objectives - Job Analysis. BYE	Developing Modular Training Package. - Task Analysis. - Skill Analysis. - Steps of Work. BYE	Developing Modular Training Package - Identifying Elmnt. - Writing Objctvs. BYE	Developing Modular Training Package. - Assignments. - Prfrmnce Task. BYE
10.00 to 12.00	The Modular Concpt. BYE	Group Project Assignment Session BYE/POULI/BURGLAND	PROJECT BYE/POULI/BURGLAND	PROJECT BYE/POULI/BURGLAND	PROJECT BYE/POULI/BURGLAND	PROJECT BYE/POULI/BURGLAND
12.00 to 14.00	PRIVATE STUDY	Individual Project Assignment Session BYE/POULI/BURGLAND	PROJECT BYE/POULI/BURGLAND	PROJECT BYE/POULI/BURGLAND	PROJECT BYE/POULI/BURGLAND	PROJECT BYE/POULI/BURGLAND
17.00 to 19.00	PRIVATE STUDY	PROJECT WORK BYE/POULI/BURGLAND	PROJECT BYE/POULI/BURGLAND	PROJECT BYE/POULI/BURGLAND	PROJECT BYE/POULI/BURGLAND	TUTORIAL BYE/POULI/BURGLAND
Chairman						

Language of the Programme: ENGLISH

- 595 -

STAFF DEVELOPMENT TRAINING PROGRAMME

COURSE TITLE :- THE INTRODUCTION TO A MODULAR SYSTEM OF TRAINING TO BE DEVELOPED AT THE NATIONAL SUGAR TRAINING CENTRE

LIST OF PARTICIPANTS

S.N.	NAME	OCCUPATION	ADRESS
1	Moh. Ali Elfadlabi	D.G. N.S.T.C.	N.S.T.C.
2	Osman Eltahir Ali	Head of Mech. Eng. Dept.	"
3	Mudawi Elsadig Mudawi	Head of Elect.& Instrumentation Dept.	"
4	Mohamed Abbas Mohamed	Machine shop Instructor	"
5	Ibrahim Mohamed Abdu	Head of Auto.& Agri. Equipment Dept.	"
6	Mohamed Elhassan Atiat Alla	Admin. Manager	"
7	Mahgoub Widat Alla	Elect. Instructor	"
8	Eltayeb Hassan Elsheik	Auto. Instructer	"
9	Adil Eldaw Elamin	Field Inspector	S.S.C.
10	Awad Mohamed Shagag	Agricultural Equip. Instructor	N.S.T.C.
11	Moubark Mohamed Salih	Traing officer	A.S.C.
12	Suliman Koko	" "	N.H.S.C.
13	Yahia Ahmed Yahia	Machine shop Instructor	K.S.T.C.
14	Fadl Elmoula Sarour Taha	Auto. Instructor	K.S.T.C.

Appr.

N.S.T.C. = NATIONAL SUGAR TRAINING CENTRE
S.S.C. = SENNAR SUGAR COMPANY
A.S.C. = ASSALAYA SUGAR COMPANY
N.H.S.C. = NEW HALFA SUGAR COMPANY
K.S.T.C. = KENNANA SUGAR TRAINING CENTRE

ASIA//

ANNEX III

NATIONAL SUGAR TRAINING CENTRE

AGR. EQUIPMENT & MOTOR VEHICLE SECTION

LIGHT VEHICLE DRIVER/OPERATOR COURSE

PROGRAMME TITLE	:	Safely loading, unloading and operating light vehicles.
DURATION	:	Two weeks
PARTICIPANTS	:	8 drivers, two from each Sugar Company.
ENTRY REQUIREMENTS	:	Physically fit (good eye sight and hearing, no movement impediments or illnesses). Being able to read and write, 2 years experience with a general driving licence.
OBJECTVE	:	After completing successfully this training course the trainee will be able to: A. Clean the vehicle totally inside and outside in the recommended manner. B. Check his own vehicle before and after use following the recommended procedures. C. Load and unload the vehicle safely and correctly distribute the load according to weight, volume and nature of goods. D. Drive the vehicle safely, correctly and economically.
LIST OF LEARNING ELEMENTS	:	Safety - vehicle knowledge - washing vehicle body - cleaning the underneath - cleaning car interior - cleaning engine compartment - loading goods. Vehicle economical driving - braking distance - stopping the engine - daily inspection - tyres.
NOTE	:	A. The course is designed in a modular unit system. B. Eye and reaction test are introduced the first day. C. Practical and theoretical tests covering the course contents will be held in the last two days. D. Handouts will be given to the trainees.

LIST OF MATERIALS

(OPERATOR TRAINING PROGRAMME)

QTY	DESCRIPTION
5	Shampoo bottle
10	Soft brush
10	Wire brush
10	Spraytin graphite
3	Roll of insulation tape
15	Toilet soap
5	Vacuum cleaner
6	Buckets
5	Vinyl cleaner
10	Meters cloth
5	Plastic bags
5	Furniture polish
1	Compressor Air hand pump
6	Lamp 220 V
6	Electric switch
1	Roll of electric wire
3	Vehicles for practice sessions
1	Green wood paint (small)
1	Red wood paint (small)
1	Yellow wood paint (small)
1	Black wood paint
1	Stopwatch

AGRIC EQUIPMENT & MOTOR VEHICLE SACTION

MOTOR VEHICLE - DRIVERS OPEARTORS TRAINING

PROGRAMME

4.2 - 9.2.1989

Time	Sat.	Sun.	Mon.	Tus.	Wen.	Thu.
7:00 To 9:00	Adminsteation	Vehicle Knowldge Theory	Vehicle Check Theory	Driving Theory	Driving Practice	Driving Vehicfle Practice
10:00 To 12	Eye test and reaction Test	Vehicle Knowldge Practice	Check List Forms Duplicat	Washing Vehicle Theory	Cleaning Car interior Theory	Cleaning Engine Theory
12:15 To 1:30	Safety	Vehicle Knowldge Practice	Check List Froms duplicat	Washing Vehicle Practice	Cleaning Car interior Practice	Cleaning Engine Practice
1 1:30	Cleaning & Tyding Workshop and Class					

Asia/:::

AGRIC. EQUIPMENT & MOTOR VEHICLE SECTION

MOTOR VEHICLE DRIVERS - OPEARTORS TRAINING PROGRAMME

FROM 1[illegible].2 to 16.2.1989

Time	Sat.	Sun.	Mon.	tus.	Wen.	thu.
7:00 To 9:00	Tyre Pressure Theory	Brake Distance Theory	Loading Unloading Theory	Parking Vehicle Theory	Theoratical Test	Open Discussion
10:00 to 12	Practice	Brake Distance Practice Practice	Loading & Unloading Practice	Parking Vehicle Stop the engine Practice	Practice Test	Discussion
12:15 1:30	Cleaning & Checking The engine Practice	Vehicle Checking Practice	Practice	Practice	Practice Test	
1:30	CLEANING & TYDING WORKSHOP AND CLASS					

Asia/:::

ANNEX IV

NATIONAL SUGAR TRAININC CNETRE - SENNAR

AGR. EQUIPMENT & MOTORVEHICLE SECTION

AUTO ELECTRICIAN COURSE

PROGRAMME TITLE	:	Maintenance of Ignition System.
DURATION	:	Three weeks
AIM	:	To provide the trainee with knowledge and skills necessary for servicing car ignition systems.
LOCATION	:	The National Sugar Training Centre - Sennar
PARTICIPANTS	:	Auto-electric fitters - two from each Mill.
LANGUAGE	:	Arabic
OBJECTIVE	:	At the completion of the programme the trainee will be able to check safely and correctly the ignition system and service its more common components and adjust them according to the manufacturer's settings.

MODULAR UNIT TITLES/DESCRIPTION:

1: Ignition system theory.

2: The ignition system components and their function how the ignition system works.

3: Testing ignition coils.
Operating principle of ignition coil - primary & secondary coils tests - output test.

4: Testing condensers
condensers faults - testing for leakage - testing for capacity series resistance test.

5: Distributor service
Distributor function - distributor cap & rotor - advance mechanisms - contact points service - dwell angle

6: Spark plugs
Identifying types of spark plugs - checking, cleaning and gapping spark plug.

LEARNING ELEMENTS:

- safety
- spanners, wrenches - kinds and sizes (B.E.M.P.)
- using spanners/wrenches (E.M.P.)
- engine - main parts and function
- operation of 4-stroke petrol engine
- ignition system
- applying electro magnetism theory to the ignition system
- coil and condenser
- ballested ignition system
- distributor contact breaker dwell angle.
- distributor cap, rotor and high tension cables
- spark plug
- removing and installing spark plugs
- analysing spark plug face
- replacing and selecting spark plugs
- cleaning and gapping spark plugs
- distributor - vacuum advance mechanism
- distributor - mechanical advance mechanism
- removing, cleaning and installing high tension cables
- checking coil polarity
- ignition timing using control lamp
- simple method of locating faults in the ignition system
- servicing contact breaker points
- checking high tension circuit
- setting points gap with a dwell angle tester
- checking ignition coil
- checking and replacing condenser
- replacing contact breaker of the ignition system
- checking contact breaker arm tension

EVALUATION:

The trainee's performance will be evaluated in theory and practice. A practical and theoretical test will be held by the end of every week during the course.

TIME TABLE:

The attached time table shows the activities during the working hours. Evening sessions not shown are optional. Trainees can come in the evening for revision and practice, under the condition that they are not entitled to extra payment.

AGR. EQUIPMENT & MOTOR VEHICLE SECTION

AUTO-ELECTRICIAN PROGRAMME

WEEK NO. (1)

TIME	SAT. 4	SUN. 6	MON. 7	TUS. 8	WED 9	THUR. 10
07:00 TO 09:00	Administration	Engine - Main Parts & Function	Electrs. Magnet-ism Theory	Ballasted Ignition System	Distributor Mechanical Advance	Practice
10:00 TO 11:45	Safety	Operation of 4 Stroke Petrol Engine	Coil & Condser	Distributor ((B)) DA	Distributor Vaccum Advance	Practice
12:00 TO 01:45	Tools	Ignition System	Review	Distributor Cap. Rotor and HT	Practice	Test
01:45	CLEANING/TYIDING UP WORKSHOP & CLASS ROOM					

- 603 -

AGR. EQUIPMENT & MOTOR VEHICLE SECTION

AUTO-ELECTRICIAN PROGRAMME

WEEK NO. (2)

TIME	SAT. 12	SUN. 13	MON. 14	TUE. 15	WED. 16	THUR. 17
07:00 TO 09:00	- Spark Plug - Removing and installing Spark Plugs.	- Replacing and selecting Spark Plugs. - Cleaning and gapping Plugs.	- Removing Cleaning and installing HT Cables. - Checking Coil Polarity.	Ignition Timing using Control Lamb.	Simple method of locating Faults in the Ignition System	Practical Test
10:00 TO 11:45	Practice	Practice	Practice	Practice	Practice	Practical Test
12:00 TO 01:45	Practice	Practice	Practice	Practice	Practice	Test Theory
01:45	CLEANING/TYIDING UP WORKSHOP & CLASS ROOM					

AGR. EQUIPMENT & MOTOR VEHICLE SECTION
AUTO. ELECTRICIAN PROGRAMME
WEEK NO. (3)

TIME	SAT.19	SUN.20	MON.21	TUE.22	WED.23	thur.24
7:00 To 8:00	Servicing Contact Breaker Points Replacing Contact Breaker of the Ignition System	Setting Points Gap Checking Contact Breaker Arm tension	CheckingHT Circuit Checking Ignition Coil	Checking& Replaci Condenser	Review	Test
10:00 To 11:45	Practice	Practice	Practice	Practice	Review d timingl Rractical	Discussion
12:00 to 1:45	Practice	Practdice	Practice	Pracxtic	Practice	
1:45 TO "*==	CLEANING/TYIDIDNG UP WORKSHOP & CLASS ROOM					

ANNEX V

NATIONAL SUGAR TRAINING CENTRE - SENNAR

AGRIC. EQUIPMENT & MOTORVEHICLE SECTION

BASIC LIGHT VEHICLE TRAINING COURSE

FOR MECHANICS

PROGRAMME TITLE	: Light vehicles preventive maintenance.
DURATION	: Six weeks. From 10.12.1988 to 19.1.1989.
AIM	: To provide the trainee with knowledge and skill necessary for carrying out light vehicle preventive maintenance.
LOCATION	: The National Sugar Training Centre - Sennar.
PARTICIPANTS	: Sixteen Auto-mechanics from the four (4) public sector Sugar Mills (4 each).
ENTERY REQUIREMENTS	: The trainee should be able to read and write and should have a minimum of two years experience. He should physically be fit.
OBJECTIVE	: At the completion of the programme the trainee will be able to understand and execute safely and correctly preventive maintenance on light vehicles. He will also be able to use basic tools correctly respecting safety measures while carrying out preventive maintenance as recommended by the manufacturer.

Modular Unit Titles / Descriptions
1/ Light Motor Vehicle General- Informations :- Identification of light Motorvehicle,Motor Vehicle general designs and Engine Operating cycle . 2/ Checking and Servicing Engine cooling system. 3/ Checking and Servicing Engine Lubriciation system. 4/ Checking and Servicing Engine Fuel system . 5/ Checking and Adjusting Engine Valves Clearnance. (Inlet & Exchaust) . 6/ Checking and Adjusting the clutch pedal free Travel . Checking and Bleeding clutch Hydraulic system . 7/ Checking Topping & Chengine the Transission Oil (Gear-Boor & Transfer Gase) . 8/ Checking the Operation of the propeller shaft drive . Greasing : Universal Joint Crosses , splined sleeves & centre Bearing . 9/ Servicing the Steering system :- Checking the steering wheel play Checking and topping up the oil level in the steering rod joints. 10/ Servicing the Brake system : Checking topping & Bleeding the Break Hydraulic system . Adjusting Breaks & Changing Break Shose . 11/ Checking the Running Gear . Examne Visually the frame .main and auxiliary Springs, Shock absorbers , and wheels . Checking and Adjusting the toe - in of the front wheels. Check the caster camber at front wheel . Greasing of the suspension joints .

AGR. EQUIPMENT & MOTOR VEHICLE SECTION

LIGHT VEHICLE PREVENTIVE MAINTENANCE PROGRAMME

week no :(1) from 10.12 to 15.2.1988

Time	Sat.	Sun.	Mon.	Tue.	Wed	Thur
7:00 to 9:00	Adminstraftion	Motor Vehicle main parts Theory Slides	Engine main parts &'Function Theory	Operation of 4- stroke I.C Eng. Theory	Valve Opera- mechanism Valve Timing Checking valve Theory	Identify lifting Devices & support stands Lifting up Cars using mobile Jacks Theory
	BREAKE FAST : ONE HOUR					
10:00 to 11:45	Introduction Meaing of maintenance Safety	Motorvehicle main parts Practice	Practice	Practice	Practice	Practice
	Breake ¼ Hour					
12:00 to 1:30	Adminstration	Adminstration	Practivce	Practice	Practice	Practice
1:30 to 2:00	Cleaning and tyiding up workshop and Class					

AGRC. EQUIPMENT & MOTOR VECHICLE SECTION
LIGHT VEHICLE PREVENTIVE MAINTTENANCE PROGRAMME
WEEK NO. (2)1 7.12 TO 22.12.1988

Time	Sat.	Sun.	Mon.	tue.	wed.	thur.
7 To 9:00	Removing & inst alling Valve cover adjusying valve adjusying valve Clearance theory	Review Engine Theory	Cooling System Theory	Cleaning radi- Checking & Topp- ing coolant lev- el checking System for tighting	V-belts adju- Thermostat de- sign and fun- ction	Iubrication Principles
	Break Fast					
10:00 To 11:45	Practice Theory	Valve Practice	Draining & refill Hoses	Practice	Cooling System Review	Open discussion Clean shop
	Break					
12:00 To 1:3	Practice	Practice	Practice	Practice	Practice	
1:30	Cleaning and tyiding up workshop and Class					

Asia/:::

AGR. EQUIPMENT & VEHICLE SECTION
LIGHT VEHICLE PREVENTIVE MAINTENANCE PROGRAMME
WEEK NO. (3) FROM 24.12. TO 29.12.1988

Time	Sat.	Sun.	Mon.	Tue.	Wind.	Thur.
7:00 To 9:00	Engine Oils Sae viscosity Class Fication	CHRISTMAS	Engine lubrication System. Thedory	Changing/Topping up Engine oil Checking oil Pressure	Changing/Toping up transmission oil Chassis lubrication Checking Propeller shaft	Engine Lubrication System Review
	Break fast one Hour					
10:00 To	Practice		Practice	Engine oil filters Replacing/Cleaning Oil filters Practice	Practice	Practice
	Break					
12:00 To 1:30	Practice		Practice	Practice	Practice	
CLEANING & TYIDING UP WORKSHOP & CLASS						

Asia

AGR. EQUIPMENT & MOTOR VEHICLE SECTION
LIGHT VEHICLE PREVENTIVE MAINTENANCE PROGRAMME
WEE NO (4) FFROM 31.12.1988 To 5.1.1989

Time	Sat.	Sun.	Mon.	Tue.	Wind.	Thur.
7:00 To 9:00	Fueld System Petrol & Diesel Theory		Cleaning the Fuel tank and fuel lines Practice	Bleeding the diesel engine fuel system (line pump) Practice	Removing Car Air Filters Installing Car Air Filters Practice	Review
		BREAK FAST ONE HOUR				
10:00 To 11:45	Practice	INDEPENENCE	Cleaning/Replacing diesel fuel filter Practice	Bleeding the Diesel engine Fuel system (elistributor pump) Practice	Dry Air Filt- ers Servicing	Open discuusion Cleaning Shop
		Break				
12:00 To 1:30	Practice		Practice	Practice	Oil Bath Air Filters Servicing	
1:30 to 2:00	Cleang and tyiding up workshop and Class					

Asia/:::

AGR. EQUIPMENT & MOTOR VEHICLE SECTION

LIGHT CEHICLE PREVENTIVE MAINENANCE PROGAMME

WEEK NO.(5)FROM 7.1. To 12.1.1989

Time	Sat.	Sun.	Mon.	Tue.	Wen.	Thur.
7:00 To 9:00	Removing and futting wheels Practice	Adjusting parking brakes Practice	Topping up brake fluid Practice	Adjusting wheel bearing drum brakes Practice	Adjusting wheel bearings Practice	Changing brake fluid in the hydrallic brake Practice
Brake Fast One Hour						
10:00 To 11:45	Practice	Practice	Practice	Practice	Practice	Practice
		Brake				
12:00 1:30	Practice	Practice	Practice	Practice	Practice	Practice
1:30 To 2:00	Cleaning and tyiding up warkshop and class .					

:B:

- 219 -

AGR. EQUIPMENT & MOTOR VEHICLE SECTION

LIGHT VEHICLE PREVENTIVE MAINTENANCE PROGRAMME

WEEK NO.(6) 14.1. To 19.1.1989

Time	Sat.	Sun.	Mon.	Tue.	Wed.	Thur.
7:00 To 9:00	Engine Lub. System Review Theory	Brake/system Practice	Air filters Maintenance	Test Theory	Practical Test	Filling Evaluation forms by the Trainees
Breake Fast One Hour						
10:00 To	Changing Engine Oil &	Brake system	Valve adjustment Reviw	Test	Practical Test	Discussion

To 12:00	Engine Oil & Filter Practice	Practice	Reviw Practice	Theory	Test Theory	Discession
	Breake ½ Hour					
12:15 To	Cooling system Review	Adjusting Clutch Free	Valve adjuste- Review		Practice Test	
1:30 To 2:00		Cleaning and Tyiding up warkshop and class				

s/s

AGRIC. EQUIPMENT & MOTOR VEHICLE SECTION

To : The General Director

Subject : Light Vehicle Preventive Maintenance Training Programme

The above Programme was held from 10.12.1988 to 19.1.1989 on purpose of testing the (MLS) System and the training materials involved.

The head of the dept. Did the Programme Plan and general supervision Instructor Eltayb Elshiek conducted the Course. Instructor Awad Shgag assisted in preparing and transilating the learing elements he also did some lessons. The expert Eddy Pauli was giving advice from the beging to the end of the Programme, he also participated with a lesson on steering alignment.

PARTICIPANTS

Five trainees from Sennar mill and one from the training Centre. At the end of the course the trainees had undergone theoretical and practical tests, and were given certificates.

The trainees were given a chance to evaluate the course in writting by filling evaluation forms, and through open disussion.

In brief they were satisfied with theortical Knowledge they have achieved, but they complained from the short of practice and the absence of new Equipments and training materials.

DISCUSSION

1: The time allotted for preparation was very short for the learning elements are to be studied before application.

2: Shortage of photocopy paper didn't help on prepairing the handouts planned to be given to the trainees. Short notes written on the Blackboard were given instead.

3: Lack of training materials didn't help Trainees to develop the necessary Skill needed to carry the preventive Maintenance. Lack of training materials also let most of the course to be theoretical rather than practical and sometimes it deviated from maintenance to repair for the same reason.

4: Looking through the learning elements of the (ILO), they depend to a great extend on the availability of training materials and equipments.

CONCLUTION

The trainees have gained some Knowledge, but not much of an employable Skill.

Regarding the test of the system it is very difficult to rely on this programme's result.

Extract from Mr. T. Wright's 1983 Report

(iii) Instructors (full-time)

RECOMMENDATION 33

If will be required at the central institute for technician level are graduate intake trainees.

(iv) Full-time instructors for vocational level entants in sugar estates.

RECOMMENDATION 34

10 in each of the Public Sector Estates. Kenana would need 50 if it intends to train all of its requirements for vocational level entry but, at present, it relies substantially on the Vocational Training Centre.

1.2.3 Institutional Issues

Investment in training cannot normally be cost-effective unless the institutional structure of the organization it is intended to serve is itself able to function effectively.

In a free enterprise system this is assured because the business that is not able to function effectively simply goes out of business.

In the Sudan Sugar Industry there are many barriers to effective operation which training cannot unlock. Until these barriers are removed no training should take place. It would fail and training would lose its repute.

The main issues are as follows:

(1) Operational blockages identified by Tate and Lyle Technical Services Ltd.

RECOMMENDATION 35

24 organizational faults were mostly identified independently by this Mission and all were listed by Tate and Lyle Technical Services Limited in their Report. These are listed in Section 5.1.1 of this Report. All should either be rectified or a firm decision made on each before training of any sort can take place. Until this is done no training should take place.

(2) Bitterness and Loss of Morale by Current Managers and Staff

This results from a feeling of being let down. They feel that they achieved good performance mid 1970's but that Government interference late 1970's and early 1980's led to failure.

Notes and Comments

Failure was due to financial constraints outside Sugar Estate control and now Tate and Lyle recommend the Government to bring in expatriates to put this matter right. Managers regard this as an unfair reflection on themselves (see 1.2.5 for possible remedy).

At a lower level wages have been frozen at far less than the private sector.

Many people have jobs on-the-side and are only hanging on for their pension rights.

RECOMMENDATION 36

The causes of loss of morale must be examined and a formula defined for its improvement.

Whilst morale is at this low level due to causes that training cannot rectify, training would be a waste. Wages and pensions need urgent attention.

(3) Irrigation

Special mention needs to be made of irrigation since the Ministry of Industry suggests that it should be brought under the control of Sugar Estates and the World Bank Pre-Appraisal Report recommends otherwise due to lack of experienced technical personnel to maintain the system.

The Mission made a special study of this subject because of the immense training implication. The subject is discussed fully in Section 5.1.2 (2).

Supply of water is the most critical input of the whole Irrigation system. A hold-up of a few days can lose an Estate up to £SD 1 million. Under the present pattern of supply, if all Public Sector factories were geared to rated production, Sennar would be losing £SD 7.5 million, Assalaya £SD 7.5 million and Guneid £SD 4.25 million due to losses of water (after allowing for inefficient usage in the Estate) due entirely to inefficient supply by the Ministry of Agriculture or of the electricity supplies.

Annex VII

TOOLS AND EQUIPMENT IN STORE

NO.	DESCRIPTION	QTY.	CONDITION
I	Starter Spanner (7/16 x ½ — 9/16 x 5/8)	6 new	
2	Valve Spanner Sockets on pairs (2/16 — 2 3/8)	IO	
3	Valve Spring compressor	2	
4	Thickness Gauge 20 Blades	I set	
5	Thickness Gauge 22 Blades	I set	
6	Type Fitting Machine	I	
7	Sump Plug Spanner (with two sides) for Recessed square & slotted screw	8	
8	Double end open spanner 6x7mm	2	
9	Double end open spanner 8x9mm	I2	
IO	Double end open spanner IOxIImm	I	
II	Double end open spanner I2xI3mm	I	
I2	Double end open Spanner I6xI7mm	I	
I3	Double end open spanner I8xI9mm	2	
I4	Double end open spanner 20x22mm	2	
I5	Double end open spanner 2Ix23	2	
I6	Double end open spanner 24x2	3	
I7	Doube end open spanner 30x32	2	
I8	Tools cabinet Elora type I000	4	
I9	Screw driver No 6I6 280 x 9 mm	4	
20	Screw driver 75 x 9 mm	5	
2I	Screw driver Phillips No. 560 35mm length	8	
22	Adjustable Hook Spanner (20mm - 24 mm	6	
23	Spark Plug wrench on pairs 3/8x7/16, ½x9/16, 9/16x5/8, II/I6x3/4	8	
24	Torque wrench Elora	2	
25	Four way rim wrench	4	
26	Set of Anguler screw Driver No 740-55	I set	
27	Brake Spring Puller	2	
28	Piston ring Expander 50-I00mm	2	
29	Piston ring Expander 90-I40mm	2	
30	Quick Roting Clamping Tongs 7	2	
3I	Brake Spring Plier 360 mm	2	
32	Valve Spring lifter No 233 Elora	I	
33	Valve Plier Elora 234	I	
34	Wooden Valve Grinder	5	
35	Hose Clamp Plier Elora	2	
36	Battery Terminal Brush	I	
37	Groove scraper	2	
38	Groove Scraper	2	
39	Piston Groove Scraper	2	
40	Triangulator Scraper	2	

NO.	DESCRIPTION	QTY.	CONDITION
4I	Flat Scraper	2	
42	Piston ring compression tool Elora	7	
43	Chain W/Hoisting length I.50 m.	3	
44	Brake Spring plier	6	
45	Triple Grip puller for Gears I50x80mm	2	
46	Triple Grip Puller 300x300mm	4	
47	Stud Extractor $\frac{1}{2}$	3	
48	Twin Grip puller for Bearing (200xI50mm)	2	
49	Triple Grip puller 500x500mm	2	
50	Adjustable Reamer with Guides	I	
5I	Tyre leaver Elora different sizes	24	
52	Distiller	I	
53	Pressure Gauge Pocket size	I	
54	Crowling Mats	3	

TOOLS & EQUIPMENT IN W/S

NO.	DESCRIPTION	QTY.	CONDITION
I	Mechanic's Tool box consist of :-	3	used Tools
I:	A set of six open end wrenches from 6x7 mm to I6xI7mm		
2:	A set of four open end wrenches from I"/8x3"/I6 to ½x9/I6		
3:	A set of six wring spanner 6x7mm to I6xI7mm		
4:	Set of sockets (I2 piece) 3"/8 - I"		
5:	set of sockets		
6:	Two screw drivers 6" & 8"		
7:	Adjustable Spanners 8"		
8:	Plier		
9:	Scriber		
I0	Chiesel		
II	Centre punch		
I2	Feeler gauge		
I3	Hammer 400 g		
I4	Screw driver (electric)		
I5	Contact Breaker file		
I6	Wire Brush		
I7	Hack saw		
2	Three Screw drivers 3", I9", I2"	3	
3	Phillips screw driver 3"	I	
4	Crowling Mats	3	
5	Quick Ail Grip	2	
6	Valve Spring lifter	2	
7	Piston ring comp. Tool	2	
8	Circlip Plier	3	
9	Circlip (bend Plier)	2	
I0	Grease Gun	2	
II	Lubricating Oil hand pump	I	
I2	Drilling hand Machine (I3mm dia max)	I	Electric
I3	Set of HSS drills (4mm - I3mm)	I set	
I4	Tyre pressure Gauge 4.5kp/cm^2 max	I	
I5	Piston ring Expander	4	
I6	Air Foot pump	2	
I7	Brake Spring Plier	2	
I8	Angular Screw drivers No. 740-55	I set	
I9	Torque wrench (Elora) (0 - 20) kpm	3	
20	Engine compression gauge (Petrol)	I	
2I	Solderning Iron (electric) 220V - 325W	2	
22	Oil Filter Tool	I	
23	Plastic Hammer	2	

NO.	DESCRIPTION	QTY.	CONDITION
24	Copper Hammer	2	
25	Rubber Hammer	2	
26	Valve seat Grinding Machine	I	Working condition does it work ?
27	Valve Grinding machine	I	Working condition
28	Set of sockets 20 pieces IO - 30 mm	I set	
29	External Micrometer I" - 2"	I	
30	External Micrometer 3" - 4"	I	
3I	Wooden Bench with Anvils	54	The tables needs fixing
32	Mobile Jacks	2	
33	Mobile engine hoist (Haco) I000 kg	I	not working
34	Mobile engine hoist (Haco) 500 kg	I	not working
35	Battery charger Allen	I	old
36	Distrubutor tester Allen	I	old
37	Ignition Coil Tester	I	not working
38	Armature tester	I	

Annex VIII

COUNTRY - SUDAN

PROJECT - SF/SUD/86/003

SECTION - AUTOMOTIVE AND AGRICULTURAL MACHINES

Recommended List of Tools and Equipment to be ordered for the Continuation of Phase I

Progres. no. line	ILO E.P.G. no	Description	Quant.	Observations
		HANDTOOLS		
1		Three layer tool box with a. Metric socket set 8mm - 23 mm b. Metric ring and open end spanner set 8-23 c. Spark plug spanner d. Engineers pliers (180 mm) e. Long nose off set pliers (200 mm) f. Vice grip pliers 250 mm g. Screw driver set flat blade (100 - 175 - 250 mm) h. Screw driver set Phillips (no 2 & 4) i. Ball pain hammer (110 gr & 500 gr) j. Plastic hammer with spare heads k. Set of punches (pin, tapered, centre, diamond) l. Feeler gauges 0.05 - 1 mm m. Hacksaw frame & 5 blades n. Engineer's steel ruler 30 cm. o. Scriber p. Set of files (3 flat - 1 1/2 round - 1 round) q. Wire brush r. Set Allen Keys (2 - 10 mm)	4	
2		Hand operated oil syringe 500 cc.	2	
3		Vernier caliper 130 mm	4	
4		Oil can pump (hand held & operated 50 cc)	4	
5		Tyre pressure gauge graduated in: 0 - 10 bar 0 - 10 k/cm2 0 - 150 Psi	2	

Progress no. Line	ILO E.P.C.no	Description	Quant.	Observations
		EQUIPMENT		
1		Surface plate 400 x 250 mm	1	
2		Assorted chains 20 m (8/10 mm round wire)		
3		Assorted shackles x 10	10	
4		* Small gantry crane approx. 250 cm lift & 200 cm wide - on 30 cm round metal wheels	1	
5		Chain block and tackle - lifting capacity 1000kg	1	
6		* Axle stands for light vehicle (car) - carrying capacity approx. 1000 kg - tripod structure	8	
7		* Axle stand as 6 above but 5000 kg	8	
8		* Rigid tow bar 3''/75 mm round with 3''/75 mm fixed towing rings at each end	2	
9		Fluorescent red signal triangles - as per police rules	4	
10		* Tool trolleys 40 x 60 cm - 2 levels - height 100 cm on small castors/wheels (approx. 10-12 cm round)	4	
11		* Wheel blocks/chocks for 13'' wheels	4	
12		* Wheel blocks/chocks for 16'' wheels	4	
13		* Wheel blocks/chocks for 20'' wheels	4	
14		50 litre metal barrels for storage of daily consumption liquids in w/s store (diesel - petrol - parafin - SAE 30 - 40 - 50 - 90 - 140)	8	
15		200 litre drum for collection of waste fluids	3	
16		* 1/2 - 200 litre drums for rubbish collection	6	
17		* Rack for horizontal storage of 8 x 50 litre drums (as in 14 above)	1	
		* = All items marked with an asterisk can be fabricated in NSTC.		

Progress. no. Line	ILO E.P.G. no.	Description	Quant.	Observations
18		* Oil measuring cans set 1/2 ltr - 1 ltr - 4 ltr	3	
19		* Funnels for pourring liquids 150 mm to 20 mm	4	
20		* Shop pans 450 x 300 x 100 mm made of 1 mm sheet steel	5	
21		* Shop pans 600 x 450 x 120 mm	5	
22		* Shop pans 900 x 600 x 150 mm	3	
23		6 mm nylon rope	100 m.	
24		15 to 20 mm nylon rope	100 m.	
25		Metal storage cabinets 210 x 100 x 40 cm with 5 adjustable shelves	4	
26		Steel filing cabinet with 3 locking drawers with hanging files	1	
27		Hanging files for 26 above	100	
28		* Set of heavy duty metal shelves 200 x 100 x50 cm.	4	
29		High pressure water washing machine (simple with no additives and steam) working pressure approx. 100 - 1200 bar. 220/240 V - 50 Cycles	1	
30		35 mm slide frames	500	
31		Caroussel for 30 above	6	
		* = All items marked with asterisk can be fabricated in NSTC.		

Annex IX

COUNTRY - SUDAN
PROJECT - SF/SUD/86/003

SECTION - AUTOMOTIVE AND AGRICULTURAL MACHINES

Recommended List of Tools and Equipment and some Consumables For Phase II, including a supplement with the relevant pages from a fabory catalogue

Electrical Supply - Volts single 220/three phase 4/5 frequency 50 Hz.
* All with English and Arabic Operation-Workshop and spares manuals. 2 copies each

Progresi. No. Line	ILO E.P.G. No	Description	Quant.	Observations
01	5.1.1	Centre Latha	1	
02	5.1.2	Latha accessories for 01 above	1	
03		Hexagonal steel bar in 3m length 10 mm	4	
04		Hexagonal steel bar in 3m length 12 mm	4	
05		Hexagonal steel bar in 3m length 14 mm	4	
06		Hexagonal steel bar in 3m length 16 mm	4	
07		Hexagonal steel bar in 3m length 18 mm	2	
08		Hexagonal steel bar in 3m length 20 mm	2	
09		Hexagonal steel bar in 3m length 24 mm	2	
10		Hexagonal steel bar in 3m length 30 mm	2	
11		Phosohov bronze bar 30 mm	6m	
12		Phosohov bronze bar 60 mm	4m	
13		Phosohcv bronze bar 90 mm	2m	
14		Nylon bar 30 mm	8m	
15		Nylon bar 60 mm	5m	
16		Aluminium bar 50 mm	6m	
17		Aluminium bar 90 mm	2m	
18		High Tensile steel vod 6 mm	10m	
19		High Tensile steel vod 8 mm	10m	
20		High Tensile steel vod 10 mm	10m	
21		High Tensile steel vod 14 mm	6m	
22		Tools - a selection for 2 years		
a.		Knurling tools		
b.		Tool holders with quick release for tool tip replacement		
c.		Tool tips for all current turning operations eg. roughing ents. - parting - facing - threading - finishing - boring - internal threading, etc.		

Progresi. No. Line	ILO E.P.G. No	Description	Quant.	Observations
23		Brake shoe grinder	1	with spares for 2 yrs
24	5.1.5	Drilling Machine - Piller type with accessories	1	
25	5.1.6	Machine Vice - H.D.	2	
26 a.	5.1.9	Pedestal grinder H.D.		
b.		with 3 + 3 spare grinding stones and	1	
c.		18 extra cutters for wheel dresser		
27	5.1.9	Pedestal Grinder - Butler	3	
28	5.1.12	Cylinder Honing Kit	1	
29	5.1.13	Cylinder Ridge Remover Set	1	
30		Adjustable hand operated valve seat cutting machine with set of expanding pilots from 7.85 mm to 15 mm	1	with spare cutting tools (5)
31		Air compressor - Two stage 220 psi 15 Ka/cm^2 - Adjustable pressure regulation Electrical drive motor 3.75/4 Kw	1	
		Three phase Two phase starting - Overhead Protection 500 l. air tank with drainage		One set of spare belts
32		Self coiling (spiral type) 6 mm I.D. air line in lengths of approx. 8 m (stretched length) fitted with male and female bayonet fittings (quick release)	28	Heavy Duty
33		Female bayonet (suitable for 32 above) threaded to fit 1/2" I.D. air line for wall fitting	40	Heavy Duty
34		Air line pressure regulator 0-15 Ka/cm^2 with water separator Suitable for 1/2" I.D. air line as 33 above	20	Heavy Duty
35		Air blow gun - with male fitting for bayonet as 32 above	40	
36		Tyre inflator fitted with pressure gauge 0-10 bar/0.10 Kg/cm^2/0-150 psi	3	

Progresi. No. Line	ILO E.P.G. No	Description	Quant.	Observations
37		Tyre pressure gauge - diel type calibrated 0-10 bar/0-10 Kg/cm^2/0-150 psi	2	
38		As 37 above but of the slidina tube type	2	
39	5.4.33	Washing Type spray gun with 1/2 litre cleaner container	3	
40	5.1.37	Crack repair kit	1	
41	5.1.40	Cylinder head support stand - Set of 2	8	
42	5.2.1	Twist drill set "inch"	5	
43	5.2.2	Twist drill set "metre"	10	
44	5.2.3	Twist drill set - Morse Taper "inch"	2	
45	5.2.4	Twist drill set - Morse Taper "metre"	3	
46	5.2.5	Reducing sleeve set for morse tapers	1	
47	5.2.7	Die and tap stock set "metre"	2	
48	5.2.15	Die and tap stock set UNF	1	
49	5.2.15	Die and tap stock set UNC	1	
50	5.3.2	Inside Micrometer "inch" 2" - 12"	3	
51	5.3.3	Inside Micrometer "meter" 50-300 mm	3	
52	5.3.4	Outside Micrometer 0-4"	3	
53	5.3.5	Outside Micrometer 0-100mm	3	
54	5.3.6	Outside Micrometer 2"-6"	1	
55	5.3.7	Outside Micrometer 50-150 mm	1	
56	5.3.8	Outside Micrometer 0-1"	50	
57	5.3.9	Outside Micrometer 0-25 mm	50	
58	5.3.12	Depth micrometer 0-6"	3	
59	5.3.12	Depth micrometer 0-150 mm	3	

Progresi. No. Line	ILO E.P.G. No	Description	Quant.	Observations
60	5.3.14	Telescopie gauge set	3	
61	5.3.15	Universal Surface Gauge	6	
62	5.3.16	Surface plate 300 x 250 mm	6	
63		Surface plate 450 x 600	2	
64	5.3.17	Combination set	1	
65	5.3.18	Screw Pitch Gauge Set Witw/UN/Metric	25	
66		Feeler strip set 12" long and 300 m	1	with spring scale
67		Set of mechanic's feeler renaes 0.05 - 1 mm	50	
68		Set of mechanic's feeler inches	20	
69	5.3.20	Strait edge	3	
70	5.3.21	Engineers's level	2	
71	5.3.22	Dial gauge "inch" 1/2" travel	8	
72	5.3.23	Dial gauge "meter" 12 mm travel	8	
73	5.3.24	Magnetic base and stand for 71 and 72 above	6	
74	5.3.25	Vernier baliser 11"/280 mm inside and out	50	
75		Cylinder bore gauge 3-8" to depth of 10"	1	
76	5.3.29	Cylinder bore gauge 21/2 6"	1	
77	5.3.30	Cylinder bore gauge 50-150 mm	2	
78	5.4.1	Arbor press	2	
79	5.4.2	Hydraulic Press - 50 Trs	1	
80	5.4.3	Multi Purpose protable gantry	1	
81	5.4.4	Portable crana	1	
82	5.4.5	Chain sling	2	

Progresi. No. Line	ILO E.P.G. No	Description	Quant.	Observations
83	5.4.6	Chain sling	2	
84	5.4.7	Chain sling	4	
85	5.4.8	Chain sling	4	
86		Sh..... (Assorted) for chains above	10	
87	5.4.9	Car Hoist electric motors operated by cables with safety stops	1	
88	5.4.12	Garage jack - 6 ton	2	
89	5.4.13	Garage jack - 2.5 ton	2	
90	5.4 15	Bottle jack - 20 ton	1	
91	5.4.16	Tripod Axle stand 1 1/2 ton	16	
92	5.4.17	Tripod Axle stand 5 ton	8	
93		Workshop trolleys platforms with fast connection for front wheels and pulling handle	6	
94	5.4.21	Sack truck	2	
95	5.4.27	Vulcanizer	1	
96	5.4.29	Lubrication equipment	1	
97	5.4.31	Heavy duty laver type grease gun	5	with nozles for <u>ALL</u> current nipples
98	5.4.32	Oil measure set	3	
99	5.4.50	Garage Kreeper	5	
100	5.4.51	Vice	30	
101		Vice opening 240 mm - Heavy duty	5	
102		Electric hand drill - 500 W. Single phase speed variable to 3000 RPM chuch up to 13 mm drills	1	
103		Heavy duty Hand drill 800 W Double handle - vibrating Suitable also for masonry	1	

Progresi. No. Line	ILO E.P.G. No	Description	Quant.	Observations
104		Flexidrive about 1.5 m long with chuck 10 mm capacity		spare inner cable
105		Set of small grinders and rotary cutters to work in conjunction with 104 above	3	
106	5.4.56	C clamp set	3	
107	5.4.57	Oil stone	2	
108	5.4.58	Soldering gun 200 W	2	
109	5.4.99	Soldering iron 300 W	1	
110	5.4.64	Connecting rod Alignment tester and Straightener	1	
111	5.4.67	Electric etcher	1	
112	5.4.68	Brake cylinder howing kit	1	2 sets of spare stones
113		Inspection lamp - Neon tude. in shock resistent transparent plastre tubular holder with min. 8m wire	20	with spares
114	5.4.71 a.	Double flaring kit metre	3	
	b.	Double fla-ing kit US	1	
115	5.4.72	Tube cutter	3	
116	5.4.73	Al. ark welder portable	1	
117	5.4.74	Welders apron	3	
118	5.4.75	Welders gloves	5	
119		Oxy. Acetilene welding set comprising	1	
a.		- Cylinder troller (for 2 cyl.)		
b.		- 2 acetilene cylinders		
c.		- 4 oxygen cylinders		
d.		- 2 regulators - 1 ocy and 1 acetilene		
e.		- welding torch with exchangable tips		
f.		- 2 torch tip cleaners no. 1-12		
g.		- 2 pairs of gogles with spare lenzes (2)		
120	5.4.81	Bench fitted Sheaving machine	1	1 set spare bldes

Progresi. No. Line	ILO E.P.G. No	Description	Quant.	Observations
121		Nozle tester-setter (hand operated with catch tank and pressure gauge)	2	
122	5.4.90	Injector impact extractor suitable light vehicles - truck and Caterpillar	1	
121	5.4.88	Nipple forming tool for diesel H.P. lines	1	
122	5.4.95	Nozle cleaning Kit	15	
123	5.4.96	Injector dismantling jig	5	
124	5.4.97	High pressure steam cleaner	1	Spares for 2 yrs
125		Cleaning tank for automotive parts - with agitator operated by compressed air - with baskets/trays All stelle construction to work with caustic soda solution Tank size approx 1200 x 800 x 800 mm	1	with 200 kg caustic soda in sealed bags
126	5.4.100	Number Stamp Set - Punch	3	
127	5.4.101	Petrol/Combustible liquid storage containers 20 l. - metal	20	
128	5.4.102	Battery charger on wheels with - Quick charger - Strater booster - Battery test - 6 - 12 - 24 Volt output	1	
129	5.4.103	Body Repair Press Kit	1	with spare rubber pads (3 sets)
130		Spray gun for paint with 1/2 kg suction cup	3	
140		Air line for above 30 m with bayonet as rev. 32 above	30 m	
141		Disposable Painter's respirator/filter	150	
142	5.4.105	Cylinder liner Extractor/fitter	1	
143 a.		Five Extinguishers - All categories 10 kg	30	
b.		- With recharging Kits and instructions for one complete recharge for all 30 extinguishers		and well fixing brackets

Progresi. No. Line	ILO E.P.G. No	Description	Quant.	Observations
144	5.4.110	Work Platform	12	
145	5.4.111	Parafin blow lamp	2	
146	5.4.113	Hoisting Pulley block	2	
147	5.4.115	Sender/Grinder	1	
148		As above but heavy duty with 24 - Cutting disks 12 - Grinding cups	1	
149	5.4.117	Suction Gun	4	
150	5.4.119	Vacuum cleaner with 50 spare bags for dust collection	1	
151	5.4.123	Battery Charger - <u>but max 30 cells</u>	1	
152	5.4.124	Battery charging accessories set but for <u>max 5 batteries</u>	1	
153	5.4.126	Drive on soft toe in-out indicator	1 pair	
154	5.4.128	First aid Kit	3	
155	5.5.1	Sockets Sets - 12 point 8-22 mm 1/2" drive	15	
156	5.5.1	Socket Set - 12 point 5/16 - 1 1/4 inch 1/2" drive	15	
157	5.5.2	Socket Sets - 3/4" drive		
a.		12 points AF 7/8 - 2"	2	
b.		12 points 22-50 mm	2	
158	5.5.3	Socket Set 1" drive		
a.		AF 1 7/8 - 3 1/8	1	
b.		Metric 36 - 80 mm	1	
159	5.5.4	Socket Set 3/8" drive		
a.		AF 3/16 - 1/2"	15	
b.		Metric 4 - 13 mm	15	
c.		BA 10 - 1	3	
160	5.5.5	Ring and Open end spaner Set AF 5/16 - 1" inch	54	
161	5.5.5	Metric 8-22 mm	108	
162	5.5.5	Whit. 3/16 - 1/2 W.	5	

Progresi. No. Line	ILO E.P.G. No	Description	Quant.	Observations
163	5.5.6	Tool box	120	
164	5.5.7	Spark plug spanner Set - 4 different types	3	
165	5.5.9	Miniature Open end Spaner Set AF 3/16" - 7/16"	5	
166	5.5.9	Miniature Open end Spaner Set Metrie 4 - 7.5 mm	15	
167	5.5.10	Side cutting pliers 6.5" long	20	
168	5.5.11	Engineer pliers	120	
169	5.5.13	Long nose offset pliers 8" long	30	
170	5.5.14	Vice grip plier - 10 inch long	30	
171	5.5.15	Set of screw drivers	120	
172	5.5.16	Set of screw drivers cross no. 2 and 4	120	
173		Set of screw drivers short, 2 straight 2 cross	60	
174	5.5.17	Off set screw driver set - straight and cross	5	
175	5.5.18	Insulated screw driver Set 3 straight and 2 cross	20	
176	5.5.19	Ball D... hammer Set 100 gr and 500 gr	120	
177	5.5.20	Plastic hammer	50	100 spare .....
178	5.5.21	Centre punch	120	
179	5.5.22	Pin Punch Set	120	
180	5.5.23	Cold Chisel	120	
181		Diamond Chisel	120	
182	5.5.25	Three edge scraper	30	
183	5.5.27	Hack saw 12"	120	
184	5.5.28	Measuring tape	120	
185	5.5.31	Scriber	120	
186	5.5.33	File Set	120	

Progresi. No. Line	ILO E.P.G. No	Description	Quant.	Observations
187	5.5.34	Dividers	30	
188	5.5.35	Wire brush	120	
189	5.5.36	Inside caliper	15	
190	5.5.37	Outside caliper	15	
191	5.5.38	Valve grinding stick	48	
192		Torque wrench in ft/lb and KGm 15 - 20 1/2" drive	2	
193		Torque wrench 3/8" drive ft/lb and Kgm 1-10	2	
194		Torque wrench 3/4" drive ft/lb and Kgm 7-45	1	
195		Angle wrench 1/2" drive	1	
196	5.5.42	Heavy duty spaner Kits	2	
197	5.5.43	Strap wrench	3	
198	5.5.44	Transmission wrench set	2	
199	5.5.45	Lever set	20	
200	5.5.47	4 way brace	3	
201	5.5.48	Allen key set - inch 1/16" - 3/4"	20	
202	5.5.48	Allen key set - metrie 1.5 - 22 mm	20	
203		Allen key set - metrie 1.5 - 12 mm	60	
204	5.5.49	Stud remover set	17	
205	5.5.51	Circlip plier set	30	
206		Wire stipping pliers - approx 150 mm long	10	
207		Brake spring pliers set 200 and 350 mm long	5	
208		Hammer cross pein 1000 gr	14	
209		Hammer cross pein 2000 gr	14	
210	5.5.77	Sledge hammer 4000 gr	2	
211	5.5.54	Rubber mallet	20	

Progresi. No. Line	ILO E.P.G. No	Description	Quant.	Observations
212	5.5.55	Vice grip wrench set	4	
213	5.5.57	Valve sering compressor set	2	
214	5.5.58	Piston ring compressor set	2	
215	5.5.59	Piston ring expender set	2	
216	5.5.60	Piston groove cleaner set	2	
217	5.5.63	Pin Punch Set	6	
218	5.5.64	Cold chisel set	10	
219	5.5.65	Wheel hub puller set	1	
220	5.5.66	Puller set	2	
221	5.5.67	Special puller set	2	
222	5.5.68	Ignition file set	24	
222	5.5.69	Pick up magnetic flexible tool	6	
223	5.5.70	Bolt cutter	1	
224	5.5.71	Battery service tool kit	2	
225	5.5.74	Snips set	4	
226	5.5.75	Stud Extractor	10	
227	5.5.76	Gasket cutting punch set	12	
228	5.5.78	Circlip plirs	3	
229	5.5.79	Steering ball joint separator set	2	
230	5.5.80	Puller set	3	
231	5.5.81	Slide hammer puller set	3	
232	5.5.82	Battery Carrier strap	10	
233	5.5.83	Engineer's scraper set	3	
234	5.5.84	Solderless terminal kit	1	
235	5.5.85	Mirror for inspection	2	
236	5.5.86	Body workers tool set	2	

Progresi. No. Line	ILO E.P.G. No	Description	Quant.	Observations
237	5.5.87	Suspension coil spring retaining tools	1	Set
238	5.5.88	Spark plug top set	1	
239	5.5.89	Hook spanner set	1	
230	5.5.95	Brake adjusting tool set	3	
231	5.5.96	Tyre valve tool	10	
232	5.5.100	Pop vireter - lazy tongs type	1	
233	5.5.103	Flared nut wrench set	5	
234	5.5.111	Impact screw driver set	1	
235	5.5.112	Thread restorer file set	10	
236	5.6.13	Engine knock stetoscope	3	
237	5.6.14	Cylinder compression tester	2	Petrol diesel-cars and trucks
238	5.6.15	Vaccuum and fuel pressure gauge	2	
239	5.6.16	Combined V/A tester	1	
240	5.6.17	Battery starter tester	1	
241		Stroboscopie light suitable for timing Petrol and diesel engines with all connections	3	
242	5.6.24	Ohmmeter - diode tester	2	
243	5.6.25	Hand tachometer	2	
244	5.6.26	Cooling system tester	2	
245	5.6.32	Contact spring balance	2	
246	5.6.37	Hydraulic systems tester	1	
247	5.7.6.	Cork gasket sheeting - assortment		
		m^2 1.5 mm	10	
		m^2 2.5 mm	15	
		m^2 3.5 mm	10	

Progresi. No. Line	ILO E.P.G. No	Description	Quant.	Observations
248	5.7.7	Asbestos width 6 mm	1	
249	5.7.8	Dakenstrong sheet - jointing material		
		m^2 0.5 mm	8	
		m^2 1.5 mm	8	
		m^2 3 mm	8	
250	5.7.9	Gasket cement	40	
251	5.7.10	Hallite high pressure jointing heat resistent and graphite impregnated		
		m^2 1.5 mm	2	
		m^2 3 mm	2	
252	5.7.12	Valve grinding compound	100	
253	5.7.13	Resin core solder	25	
254	5.7.14	Acid core solder	25	
255		General purpose Electrodes - Rutile		
a.		2.5 mm dia	1000	
b.		3.5 mm dia	1000	
256		Gas welding rod supplies - mild steel		
a.		1.5 mm dia	50 kg	
b.		2.5 mm dia	100 kg	
257	5.7.17	Bronze welding rod supply	1	
258	5.7.24	Magnet - Bridge type	10	
259	5.7.25	Automotive electrical accessories asin 5.7.25 but		
a.		- one comolete set LUCAS	1	
b.		- one comolete set BOSCH	1	
c.		- one comolete set Japanese	1	
260	5.9.1	Steel filing cabinet - suspension	3	
261	5.9.2	Steel storing cabinet	27	
262		Steel desk with plastic top and three locking drawers - 1 large and 2 small Top size 150 x 75	14	
263		Robust steel .... desk chair with moulded plywood seat and back	30	
264	5.8.1	4 Stroke petrol engine model	1	
265	5.8.3	4 Stroke diesel engine model	1	

Progresi. No. Line		ILO E.P.G. No	Description		Quant.	Observations
266		5.8.5	Planetary gear model		1	
267		5.8.6	Gear box model		1	
268		5.8.18	Fuel pump and nozle model		1	
269		5.6.23	Tach - Dwell tester		1	
270			Galvanized iron nails - 3 cm long		1 kg	
271			Magnetic compass (indicating north)		10	Simple and cheap
272		5.6.22	Armature testing growler		1	
273			Simple galvanometer		1	
274			Engine electrical diagnostic unit Small and portable		1	Similar to 5.6.10 but small and portable
275	a.		Assorted hose clips	10 - 15 mm	20	
	b.			15 - 20 mm	20	
	c.			20 - 30 mm	25	
	d.			30 - 40 mm	30	
	e.			40 - 50 mm	30	
	f.			50 - 60 mm	30	
	g.			60 - 70 mm	20	
276	a.		Flexible elastic hose I.D.	5 mm	10 m	
	b.			10 mm	30 m	
	c.			15 mm	30 m	
	d.			1 mm	10 m	
277			Convoluted textile reinforced rubber hose			
	a.		in 1 m length I.D.	40 mm	15	
	b.			50 mm	15	
	c.			60 mm	10	
	d.			70 mm	5	
278			A.V.O. meter		1	
279			Set of concrete drills	6-8-10-12-14 mm	2	
280			Plastic expanding wall plugs			
	a.			6 mm	100	
	b.			8 mm	200	
	c.			10 mm	50	
	d.			12 mm	50	
	e.			14 mm	50	

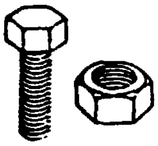
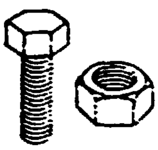
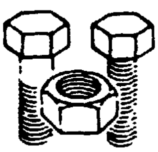
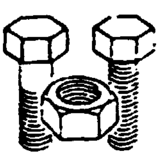
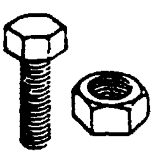
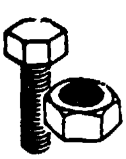
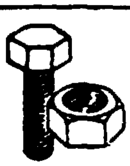
Progresi. No. Line	ILO E.P.G. No	Description	Quant.	Observations
281		Crocodile connectors approx 30 mm long with screw clamp for electric wire	100	
282	5.4.112	Pole shoe screwdriver	1	
283		Complete set of plastified wall charts for the automotive field covering Engines - fuel systems - cooling systems clutches - gearboxes drive axles - dead axles independant suspension front wheel drive - brakes - hydraulic accessories steering systems - tyres - tyre structures treads	1 set	
284		10 x 1 l. Turtle wax for car body	10 l	
285		Magnigying glass - 150 mm with flexible stalk and heavy base	3	
286		500 cc calbirated and graduated glass cylinder	5	
287		Paper masking tape 30 mm wide	20	in rolls
288		Well protected thermometer 20 - 150°C	2	Approx. range
289		Assortment of different radiator caps set at different pressures	2	
290		Old style hand operated liquid insect spray syringe type pump	2	
291		Oil pressure gaunge 40 mm face 0 - 5 Kg/cm^2 - electrical operation	2	
291		As 291 above but mechanical with nylon or similar plastic tube	2	

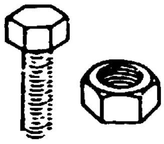
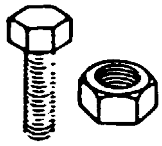
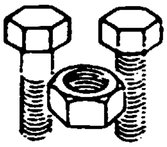
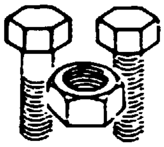
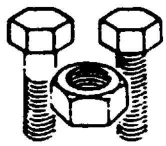
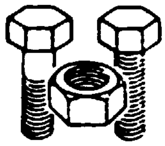
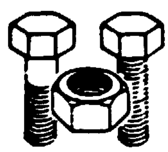
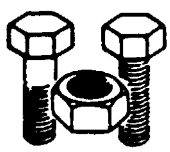
Progresi. No. Line	ILO E.P.G. No	Description	Quant.	Observations
	Fabory no.	Items 293 - 327 use the fabory catalogue no. reference Similar articles of good quality can be acceptable. See Annex VII		
293	9T30	Hex nut and bolt metrie DIN 933/934	1	8.8. Zinc plate
294	N1	Hex nut and bolt metrie DIN 931/933/934 8.8	1	Zinc plate
295	N2	Hex nut and bolt UNF 8.8	1	
296	9T32	Hex nut and bolt UNC 8.8	1	
297	N3	Hex nut and bolt WW DIN 933/934 8.8	1	
298	18T210	Hex set screw metrie DIN 916 CUPPOINT	1	CC 45 M (18T210A)
299	9T80	Nut nylock DIN 985	1	
300	9T81	Nut thermag brass	1	
301	18T176	Grease nipples - Zinc plated	1	
302	18T47	Clip on speed nuts yellow	1	
303	N35	Blind rivet nuts and riveter	1	
304	9T22	Brasse nut and screw - metrie DIN 84/934	1	
305	9T220	Screw DIN 965 black	1	
306	9T219	Screw DIN 7985 black	1	
307	18T 137	Self top screw DIN 7981 zinc plate	1	
308	18T139	Self toping screw DIN 7983 Zinc plate	1	
309	9T27	Hex head screw with waster DIN 7976 Zinc plate	1	
310	9T126	Wood screw DIN 96 4.8 Zinc plate	1	
311	9T62	Chip board screw	1	
312	9T7	Flat washer	1	
313	N25	Split lock washer	1	
314	9T11	Washer DIN 9021 Zinc plate	1	
315	9T15	Copper washer annealed	1	

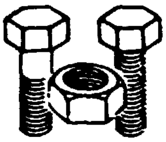
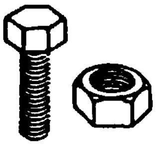
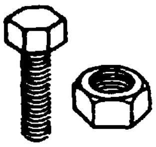
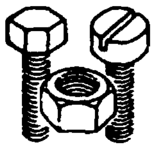
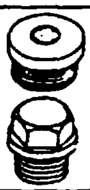
Progresi. No. Line	ILO E.P.G. No	Description	Quant.	Observations
	Fabory no.	Items 293 - 327 use the fabory catalogue no. reference Similar articles of good quality can be acceptable. See Annex VII		
316	9T54	Fiber washer	1	
317	18T85	O. ring metrie	1	
318	18T86	O. ring inch	1	
319	9T88	Bushing - aromet (rubber)	1	
320	9T89	Plue - rubber	1	
321	9T13	Countersune screw seat - brass nickel plate	1	
322	9T3	Toothed lock washer - Type AZ - Zinc plate	1	
323	9T159	Starlock fixing washers	1	
324	9T16	Coter pin DIN 94	1	
325	N5	Plates/cups	1	
326	18T250	Assorted springs	1	
327	N31	BP rivets and gun	1	

One set of each item ticked in the (Type No.) column of the Fabory Catalogue, or similar (COpies of relevant pages follow).

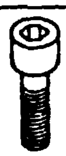
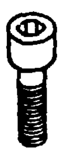
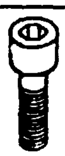
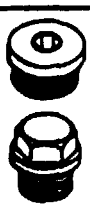
ZESKANTBOUTEN, TAPBOUTEN EN MOEREN
HEXAGON BOLTS, SCREWS AND NUTS
VIS A TETE HEXAGONALE ET ECROUS
TORNILLOS HEXAGONALES Y TUERCAS
SECHSKANTSCHRAUBEN UND MUTTERN

ARTICLE	TYPE NR	COMPOSITION	TOTAL PCS
 METRIC DIN 933/934 8.8 ZINC PLATED	9 T 30 ✓	M5x12 - x16 - x20- x25 M6x12 - x16- x20 - x25 - x30	320 Nuts incl.
 METRIC DIN 933/934 8.8 ZINC PLATED	9 T 230A (9 T 30A)	M8x20 - x25 - x30- x35 M10x25 - x30- x35	86 Nuts incl.
 METRIC DIN 931/933 DIN 934 8.8 ZINC PLATED	N 1 ✓	M5x16 - x20 - x25- x30 M6x16 - x20- x25 - x30 - x40 - x50 M8x20 - x25 - x30 - x40 - x50 - x60	644 Nuts incl.
 METRIC DIN 931/933 DIN 934 8.8 ZINC PLATED	N 6	M10x20 - x25 - x30 - x40 - x50 M12x30 - x40 - x50 M14x50 - x60 M16x40 - x50 - x60	166 Nuts incl.
 METRIC DIN 933/934 8.8 ZINC PLATED	N 14	M5x16- x20 M6x16 - x20 - x25 M8x20 - x25 - x30 M10x30 - x40 M12x30 - x40	410 Nuts incl.
 METRIC DIN 933/934 8.8 Yellow zinc plated Geel gepassiveerd Pass. jaune	9 T 39	M5x10 - x20 M6x12 - x30 M8x20 - x40 M10x30 - x40	190 Nuts incl.
 METRIC DIN 933/934 STAINLESS STEEL A2	9 T 75	M6x16 - x20 - x25 M8x20 - x25 - x30 M10x25 - x30 - x40	138 Nuts incl.

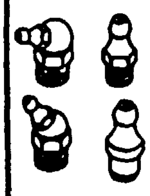
ARTICLE	TYPE NR	COMPOSITION	TOTAL PCS
 METRIC DIN 933/934 STAINLESS STEEL A2	N 51	M5x16 - x20 M6x16 - x20- x25 M8x20 - x25 - x30 M10x30 - x40 M12x30 - x40	410 Nuts incl.
 METRIC DIN 933/934 BRASS MESSING LAITON	9 T 34	M5x12 - x16 - x20 - x25 M6x12 - x16 - x20 - x25 - x30	300 Nuts incl.
 METRIC FINE DIN 960/961 DIN 934 8.8	9 T 29	M8x1x30 - M8x1x40 M10x1x30 - M10x1x40 M10x1.25x30 - M10x1.25x40	76 Nuts incl.
 METRIC FINE DIN 960/961 DIN 934 8.8	N 8	M10x1x25 - M10x1x30 - M10x1.25x25 M10x1.25x30 - M10x1.25x40 - M10x1.25x50 M12x1.25x30 - M12x1.25x40 M12x1.5x30 - M12x1.5x40 - M12x1.5x50 M14x1.5x30 - M14x1.5x40 - M14x1.5x50 M16x1.5x40 - M16x1.5x50	210 Nuts incl.
 UNF 8.8	9 T 31	1/4x5/8 - x3/4 - x1" - x1.1/4 5/16x1" - x1.1/2 3/8x1" - x1 1/2 1/2x1.1/4	126 Nuts incl.
 UNF 8.8	N 2	1/4x3/4 - x1" - x1.1/4 - x1.1/2 - x2" 5/16x3/4 - x1" - x1.1/4 - x1.1/2 - x2" 3/8x3/4 - x1" - x1.1/4 - x1.1/2 - x2" - x2.1/2	508 Nuts incl.
 UNF 8.8	N 7	7/16x1" - x1.1/4 - x1.1/2 - x1.3/4 - x2" 1/2x1" - x1.1/4 - x1.1/2 - x2" 9/16x1.1/2 - x2" 5/8x2" - x2.1/2 3/4x1.1/2 - x2" - x2.1/2	160 Nuts incl.
 UNC 8.8	9 T 32	1/4x5/8 - x3/4 - x1" - x1.1/4 5/16x1" - x1.1/2 3/8x1" - x1.1/2 1/2x1.1/4	126 Nuts incl.

ARTICLE	TYPE NR	COMPOSITION	TOTAL PCS
 UNC 8.8	N 4	1/4x5/8 - x 3/4 - x1" 5/16x3/4 - x1" - x1.1/4 3/8x1" - x1.1/4 - x1.1/2 1/2x1.1/4 - x1.1/2 - x2"	650 Nuts incl.
 WW =DIN 933/934 8.8	9 T 33	1/4x15 - x20 - x25 - x30 5/16x20 - x30 3/8x25 - x35 1/2x30	110 Nuts incl.
 WW = DIN 933/934 8.8	N 3	1/4x15 - x20 - x25 5/16x20 - x25 - x30 3/8x25 - x30 - x40 1/2x25 - x30 - x40 - x50	376 Nuts incl.
 METRIC DIN 933/934 DIN 84 NYLON	9 T 59	(DIN 84) M5x20 - M6x20 - x40 (DIN 933) M8x30 - x50 M10x50	106 Nuts incl.
 METRIC FINE DIN 908/910 Oildrain plugs (Screw plugs) Afdichtpluggen	N 20	12x1.5 - 14x1.5 16x1.5 - 18x1.5 20x1.5 - 22x1.5 24x1.5 - 30x1.5	86

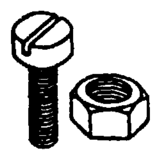
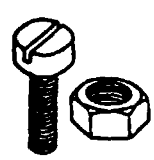
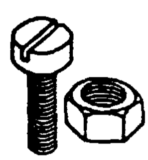
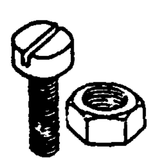
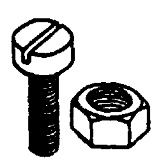
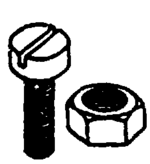
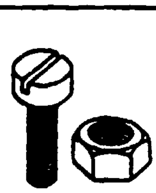
BINNENZESKANTSCHROEVEN EN -STELSCHROEVEN
HEXAGON SOCKET HEAD CAP AND SET SCREWS
VIS A SIX PANS CREUX AVEC ET SANS TETE
TORNILLOS CON HEXAGONO INTERIOR
SCHRAUBEN MIT INNENSECHSKANT

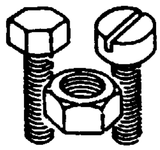
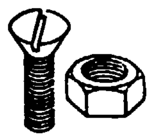
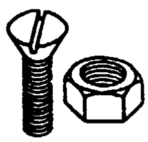
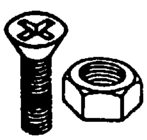
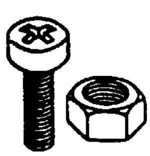
ARTICLE	TYPE NR	COMPOSITION	TOTAL PCS
 METRIC DIN 912 8.8 ZINC PLATED	9 T 35	M6x16 - x20 - x25- x30 M8x25 - x30- x35 M10x25 - x35	95
 METRIC DIN 912 8.8	N 11	M4x10 - x16 - x20 M5x16 - x20 - x25 - x30 M6x16 - x20 - x25 - x30 - x40 M8x20 - x25 - x30 - x40	437
 METRIC DIN 912 STAINLESS STEEL A2	9 T 68	M6x16 - x20 - x25- x30 M8x25 - x30 - x35 M10x25 - x35	85
 UNC 12.9	9 T 36	1/4x5/8 - x3/4 - x1" - x1.1/4 5/16x1" - x1.1/4 - x1.1/2 3/8x1" - x1.1/2	98
 METRIC DIN 7991 8.8 ZINC PLATED	9 T 37	M6x20 - x25 - x30 M8x20 - x25 - x30 - x40 M10x30 - x40	78
 METRIC DIN 916 CUPPOINT Cl. 45 H	18 T 210 (18 T 110A)	M4x5 - x8 - x10 M5x8 - x10 - x12 - x16 M6x8 - x10 - x12 - x16 - x20 M8x12 - x16 - x20 M10x16 - x20 - x25	245
 METRIC/UNC DIN 916 CUPPOINT Cl. 45 H	18 T 110	M4x5 - x10 - M5x10 - x16 M6x8 - x12 - x20 - M8x12 - x20 3/16x1/4 - x3/8 1/4x3/8 - x1/2 - x5/8 - x3/4 5/16x1/2 - x5/8 - x3/4	229
 METRIC FINE DIN 908/910 OILDRAIN PLUGS (SCREWPLUGS) AFDICHTPLUGGEN	N 20	12x1,5 - 14x1,5 16x1,5 - 18x1,5 20x1,5 - 22x1,5 24x1,5 - 30x1,5	86

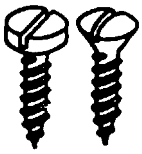
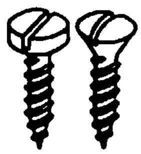
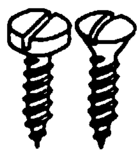
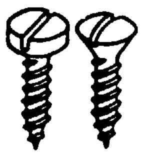
DIVERSE MOEREN - SMEERNIPPELS
DIFFERENT KIND OF NUTS - GREASE FITTINGS
ECROUS DIVERSES - GRAISSEURS
TUERCAS DIFFERENTES - BOQUILLAS
VERSCHIEDENE MUTTERN - SCHMIERNIPPEL

ARTICLE	TYPE NR	COMPOSITION	TOTAL PCS
 METRIC DIN 985 LOCK NUTS NYLON RING ZELFBORGENDE MOEREN ECROUS SECURITE	9 T 80	M4 - M5 - M6 M7 - M8 - M10 M12 - M14 - M16	214
 METRIC FINE/UNF DIN 985 LOCK NUTS NYLON RING ZELFBORGENDE MOEREN ECROUS SECURITE	9 T 81	M10x1 - M10x1,25 M12x1,25 - M12 x 1,5 UNF 1/4 - 5/16 - 3/8 - 7/16 - 1/2	95
 THERMAG BRASS NUTS FOR EXHAUSTS MESSING UITLAATMOER ECROUS D'ECHAPPEMENT	9 T 61	M8 (AF12) - M10 (AF14) M12 (AF17) - M8 M10x1,25 Metric fine 5/16 - 3/8 UNC/UNF	63
 GREASE FITTINGS ZINC PLATED SMEERNIPPELS	9 T 175	45° - 1/8 gas - 1/4 gas 90° - 1/8 gas - 1/4 gas 180° - 1/8 gas - 1/4 gas - 1/4 - 5/16 - 3/8 UNF	97
 GREASE FITTINGS ZINC PLATED SMEERNIPPELS	18 T 176	45° - M6x1 - M8x1 - x1,25 - M10x1 - M10x1,5 Drive in M6 90° - M6x1 - M8x1 - M8x1,25 - M10x1 Drive in M8 180° - M6x1 - M8x1 - M8x1,25 - M10x1 - M10x1,5 Drive in M6 - M8	123
 GREASE FITTINGS ZINC PLATED SMEERNIPPELS	9 T 177	45° - M6x1 - M8x1 - M8x1,25 - M10x1 90° - M6x1 - M8x1,25 180° - M6x1 - M8x1,25 - M10x1,5	120
 SPEED NUTS ECR. RAPIDE YELLOW ZINC PLATED PASS JAUNE	18 T 47	SNP: 1212 - 0176 - 0177 - 0178 SNJ: 1761 - 0116 - 0117 - 0118 - 1895 SNU: 1812 - 1219 - 0536 - 0537 - 1747 - 0538 SNO: 1877 - 1742 SNL: 1856	335

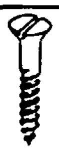
METAALSCHROEVEN EN MOEREN
METALSCREWS AND NUTS
VIS A METAUX AVEC ECROUS
TORNILLOS CON TUERCAS
METALLSCHRAUBEN MIT MUTTERN

ARTICLE		TYPE NR	COMPOSITION	TOTAL
	METRIC DIN 84/934 ZINC PLATED	9 T 17	M3x25 - x40 M4x25 - x40 M5x25 - x40 M6x25 - x40 - x50	550 Nuts ir
	METRIC DIN 84/934 ZINC PLATED	9 T 21	M5x10 - x16 - x20- x25 M6x10 - x16- x20 - x25 - x30	400 Nuts in
	METRIC DIN 84/934 ZINC PLATED	18 T 112 (18 T 112A)	M3x4 - x6 - x8- x10 - x12 M3x16 - x20- x25 M4x6 - x8 - x10 - x12 - x16 M4x20 - x25 - x30	1020 Nuts in
	METRIC DIN 84/934 ZINC PLATED	N 13	M3x12 - x16 - x20 - x25 M4x16- x20 - x25 - x30 M5x20 - x25 - x30 - x40 M6x25 - x30 - x40 - x50	2510 Nuts inc
	METRIC DIN 84/934 STAINLESS STEEL A2	9 T 76	M4x10 - x16 - x20 M5x10 - x16 - x20 M6x16 - x20 - x25	360 Nuts inc
	METRIC DIN 84/934 STAINLESS STEEL A2	N 53	M3x12 - x16 - x20 - x25 M4x16 - x20 - x25 - x30 M5x20 - x25 - x30 - x40 M6x25 - x30 - x40 - x50	1200 Nuts incl
	METRIC DIN 84/934 BRASS MESSING LAITON	9 T 22 ✓	M3x25 - x40 M4x25 - x40 M5x25 - x40 M6x25 - x40 - x50	470 Nuts incl

ARTICLE	TYPE NR	COMPOSITION	TOTAL PCS
 METRIC DIN 933/934 DIN 84 NYLON	9 T 59	DIN 84 : M5x20 - M6x20 - x40 DIN 933: M8x30 - x50 - M10x50	106 Nuts incl.
 METRIC DIN 963/934 ZINC PLATED	9 T 18	M3x10 - x30 M4x16 - x40 M5x16 - x30- x40 M6x16 - x50	490 Nuts incl.
 METRIC DIN 963/934 STAINLESS STEEL A2	9 T 77	M4x10 - x16 - x20 M5x10 - x16 - x20 M6x16 - x20 - x25	360 Nuts incl.
 METRIC DIN 965/934 ZINC PLATED	9 T 20	M3x10 - x20 M4x16 - x30 M5x16 - x30 - x40 M6x16 - x50	480 Nuts incl.
 METRIC DIN 965 BLACK PLATED NOIR	9 T 220	M3x6 - x10 - x16 - x20 - x30 M4x10 - x20 -x30 -x50	525
 METRIC DIN 7985 DIN 934 zinc plated	9 T 19	M3x25 - x40 M4x25 - x40 M5x25 - x40 M6x25 - x40 - x50	550 Nuts incl.
 METRIC DIN 7985 BLACK PLATED NOIR	9 T 219	M3x6 - x10 - x16 - x20 - x30 M4x10 - x20 - x30 - x50	525

ARTICLE	TYPE NR	COMPOSITION	TOTAL PCS
 DIN 7973 STAINLESS STEEL A2	9 T 79	ST 2.9x13 ST 3,5x9,5 - x13 - x19 ST 4,2x13 - x19 - x25 ST 4,8x19 - x25	265
 DIN 7971/7973 NICKEL PLATED	9 T 23	ST 2,9x13 ST 3,5x16 - x19 ST 4,2x16 - x19 - x25 ST 4,8x16 - x19 ST 5,5x25	390
 DIN 7971/7973 NICKEL PLATED	18 T 106	ST 2,9x13 - ST 3,5x13 - x16 - x19 - x25 ST 4,2x13 - x16 - x19 - x25 ST 4,8x16 - x19 - x25 - x32 ST 5,5x19 - x25 - x32 ST 6,3x25 - x38	500
 DIN 7971/7973 NICKEL PLATED	N 12	ST 2,9x13 - ST 3,5x9,5 - x13 - x16 ST 4,2x13 - x16 - x19 - x25 ST 4,8x13 - x16 - x19 - x25 - x32 ST 5,5x19 - x25 - x38	1420
 DIN 7971/7973 STAINLESS STEEL A2	N 57	ST 2,9x13 - ST 3,5x9,5 - x13 - x16 ST 4,2x13 - x16 - x19 - x25 ST 4,8x13 - x16 - x19 - x25 - x32 ST 5,5x19 - x25 - x38	1020
 DIN 7981 NICKEL PLATED	18 T 209 (18 T 109A)	ST 2,9x13 - ST 3,5x13 - x16 - x19 - x25 ST 4,2x13 - x16 - x19 - x25 ST 4,8x16 - x19 - x25 - x32 ST 5,5x19 - x25 - x32 ST 6,3x25 - x38	500
 DIN 7981 ZINC PLATED	18 T 137 ✓	ST 2,9x13 - ST 3,5x13 - x16 - x19 - x25 ST 4,2x13 - x16 - x19 - x25 ST 4,8x16 - x19 - x25 - x32 ST 5,5x19 - x25 - x32 ST 6,3x25 - x38	500
 DIN 7983 NICKEL PLATED	18 T 109	ST 2,9x13 - ST 3,5x13 - x16 - x19 - x25 ST 4,2x13 - x16 - x19 - x25 ST 4,8x16 - x19 - x25 - x32 ST 5,5x19 - x25 - x32 ST 6,3x25 - x38	500
 DIN 7983 ZINC PLATED	18 T 139 ✓	ST 2,9x13 - ST 3,5x13 - x16 - x19 - x25 ST 4,2x13 - x16 - x19 - x25 ST 4,8x16 - x19 - x25 - x32 ST 5,5x19 - x25 - x32 ST 6,3x25 - x38	500

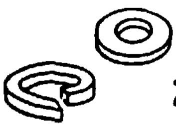
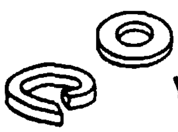
HOUTSCHROEVEN
WOODSCREWS
VIS A BOIS
TORNILLOS PARA MADERA
HOLZSCHRAUBEN

ARTICLE	TYPE NR	COMPOSITION	TOTAL PCS
 DIN 96 4.8 ZINC PLATED	9 T 126	3x20 3,5x20 - x25 - x30 4x20 - x25 - x30 5x30 - x40	425
 DIN 96 STAINLESS STEEL A2	9 T 72	3x12 - x16 4x20 - x25 - x30 - x40 5x25 - x40 - x50	279
 DIN 96 BRASS MESSING LAITON	9 T 122	3x20 3,5x20 - x25 - x30 4x20 - x25 - x30 5x30 - x40	235
 DIN 97 4.8 ZINC PLATED	9 T 125	3x20 3,5x20 - x25 - x30 4x20 - x25 - x30 5x40 - x50	425
 DIN 97 STAINLESS STEEL A2	9 T 73	3x20 - x25 4x20 - x25 - x30 - x40 5x30 - x40 - x50	223
 DIN 97 BRASS MESSING LAITON	9 T 121	3x20 - x25 4x20 - x25 - x30 - x40 5x30 - x40 - x50	223
 DIN 97 - 4.8 ZINC PLATED with caps met kapjes avec capots	9 T 129	4,5x35 - x50 5x40 - x60 6x50 - x60	180 (caps incl.)
 Chipboard screws Spaanpl. schr. Vis agglomerees Zinc plated	9 T 62	3x13 - x17 - x20 3,5x20 - x25 4x20 - x25 - x30 5x40	380

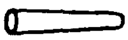
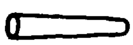
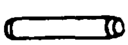
ARTICLE	TYPE NR	COMPOSITION	TOTAL PCS
DIN 9021 SAE REPAIR CARROSSERIE ZINC PLATED	9 T 11	⌀ 4x20 - 5x20 - 6x25 ⌀ 8x30 - 10x30 - 12x36 DIN 9021 - ⌀ 5x18 - 8x25 - 10x30	180
SHIMS RONDELLES DE CALAGE 0,1 mm	9 T 12	⌀ 8x20 - 10x22 - 12x24 - 14x26 ⌀ 16x28 - 18x30 - 20x32 - 22x34 ⌀ 24x36	215
SHIMS RONDELLES DE CALAGE 0,1 mm	9 T 212 (9 T 12A)	⌀ 24x36 - 26x38 - 28x40 ⌀ 30x42 - 32x44 - 34x46 ⌀ 36x48 - 38x50 - 40x50	160
COPPER ANNEALED ROODKOPER CUIVRE	18 T 14	⌀ 5x10x1 - 6x10x1 - 7x10x1 - 8x12x1 ⌀ 9x14x1 - 10x16x1.5 - 10.5x17x1.5 ⌀ 11x17x1.5 - 12x16x1.5 - 12.5x20x1.5 ⌀ 13x18x2 - 14x18x1 - 14x20x1.5 ⌀ 15x20x2 - 16x22x2 - 16.5x24x2 ⌀ 17x24x2 - 17.5x25x2	244
COPPER ANNEALED ROODKOPER CUIVRE	9 T 15	⌀ 18x24x2 - 20x24x2 - 22x26x2 ⌀ 24x30x2 - 26x33x2 - 28x34x2 ⌀ 30x38x2 - 32x40x2 - 35x45x2	90
COPPER ANNEALED ROODKOPER CUIVRE	N 23	⌀ 8x12x1 - 10x14x1.5 - 10x16x1.5 ⌀ 12x16x1 - 12x20x1 5 - 14x18x2 ⌀ 14x20x1.5 - 16x20x1.5 - 16x22x2 ⌀ 18x24x2 - 20x24x1.5 - 22x26x2 ⌀ 24x30x2 - 26x33x2 - 28x34x2 - 30x38x2	705
COPPER ASBESTOS Roodk. asbest Cuivre amiante	18 T 43	⌀ 5x9 - 6x10 - 8x12 - 8x14 ⌀ 10x14 - 10x16 - 12x16 - 12x18 ⌀ 14x18 - 14x20 - 16x20 - 16x22 ⌀ 18x22 - 18x24 - 20x24 - 20x26 ⌀ 22x27 - 22x29	200
COPPER ASBESTOS Roodk. asbest Cuivre amiante	9 T 44	⌀ 24x32 - 26x32 - 26x34 ⌀ 30x36 - 30x38 - 32x38 ⌀ 35x41 - 38x44 - 40x47	85

ARTICLE		TYPE NR	COMPOSITION	TOTAL
	FIBER BAGUES DE JOINT	9 T 151	Ø 3x5 - 4x6,5 - 4,5x8 Ø 5x8 - 5,5x9 - 6x9 Ø 6,5x10 - 7x10 - 8x12	75
	FIBER BAGUES DE JOINT	18 T 101	Ø 5x8 - 6x9 - 6,5x10 - 7x10 Ø 8x12 - 8,5x14 - 9x14 - 9,5x14 Ø 10x14 - 11x17 - 12x16 - 12,5x18 Ø 14x18 - 15x19 - 16x21 - 17x22 Ø 18x24 - 19x23	40
	FIBER BAGUES DE JOINT	9 T 54	Ø 20x24 - 22x26 - 24x28 Ø 25x34 - 26x33 - 28x40 Ø 30x42 - 32x44 - 34x46	12
	DUBO SNAPRINGS BORGRINGEN SECURITE NYLON	9 T 57	Ø 5 - 6 - 8 - 10 - 12 - 14 Ø 16 - 18 - 20	31
	METRIC PACKINGRINGS O-Type O-RINGEN 70° Shore	18 T 85	Ø 5x1,5 - 6x1,5 - 7x1,5 - 8x1,5 - 8x2 Ø 10x2 - 11,3x2,4 - 12x2 - 12x2,5 Ø 13,3x2,4 - 14x2,5 - 15x2,5 - 16x2,5 Ø 18x3 - 20,2x3 - 22,2x3 - 24x2x3 - 26,2x3	17
	INCH PACKINGRINGS O-Type O-RINGEN 70° Shore	18 T 86	Ø 5,28x1,78 - 6,07x1,78 - 7,66x1,78 - 9,25x1,78 Ø 10,78x2,62 - 10,82x1,78 - 12,37x2,62 - Ø 12,42x1,78 - 13,95x2,62 - 15,08x2,62 Ø 17,13x2,62 - 18,72x2,62 - 20,29x2,62 Ø 21,89x2,62 - 23,40x3,53 - 23,47x2,62 Ø 24,99x3,53 - 26,58x3,53	16
	BUSHINGS DOORVOER-TULES PASSE CABLES	9 T 88	Ø 4x6,4 - 5,5x8 - 6,4x9,5 Ø 8x9,5 - 9,5x12,5 - 11x12,5 Ø 12,5x17,5 - 14,2x17,5 - 16x19	21
	COVER BUSHINGS AFDICHT-TULES BOUCHONS DE FERMETURE	9 T 89	Ø 6,4x8 - 8x11 - 9,5x12,7 Ø 11x12,7 - 12,7x16 - 16x19 Ø 19x22 - 20x22 - 22x27	17

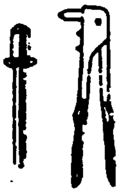
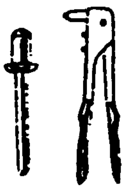
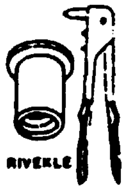
VEER- EN BORGRINGEN
SPRING- AND LOCKWASHERS
RONDELLES GROWER ET DE SECURITE
ARANDELAS ESPIRAL Y DE SEGURIDAD
FEDERRINGE UND SICHERUNGSSCHEIBEN

ARTICLE	TYPE NR	COMPOSITION	TOTAL PC
 DIN 127B ZINC PLATED	9 T 1	Ø 5 - 6 - 8 - 10 Ø 11 - 12 - 14 - 16 - 20	523
 DIN 127B STAINLESS STEEL A2	9 T 70	Ø 4 - 5 - 6 - 8 Ø 10 - 12 - 14 - 16 - 20	527
 DIN 127B DIN 125A ZINC PLATED	9 T 201	Ø 5 - 6 - 8 - 10 - 11	675
 DIN 127B DIN 125A ZINC PLATED	N 25	Ø 5 - 6 - 8 - 10 Ø 11 - 12 - 14 - 16	1400
 DIN 127B DIN 125A YELLOW ZINC PLATED Geel gepass. Pass. jaune	9 T 203	Ø 5 - 6 - 8 - 10 - 12	630
 DIN 137B STEEL	9 T 6	Ø 5 - 6 - 7 - 8 Ø 10 - 12 - 14 - 16 - 20	570
 Toothed Lock washers Type AZ Zinc plated	9 T 3 ✓	Ø 4 - 5 - 6 - 8 Ø 10 - 12 - 14 - 16 - 20	743
 Toothed Lock washers Type AZV	9 T 5	Ø 3 - 4 - 5 - 6 Ø 8 - 10 - 12 - 14 - 16	595

PENNEN, SPIEËN EN BUSSEN
PINS, KEYS AND BUSHINGS
GOUPILLES, CLAVETTES ET DOUILLES
PASADORES, CHAVETAS Y COJINETES
SPLINTE, STIFTE UNS BUCHSEN

ARTICLE	TYPE NR	COMPOSITION	TOTAL PCS
 DIN 94 COTTER PINS SPLITPENNEN STEEL	9 T 16	1x25 - 1,6x32 - 2x40 2.5x40 - 3.2x40 - 3.2x50 4x32 - 4x50 - 5x50	600
 DIN 94 COTTER PINS SPLITPENNEN STEEL	N 10	1x32 - 1,6x32 - 1,6x50 - 2x32 2x40 - 2x50 - 2.5x40 - 2.5x50 3.2x40 - 3.2x50 - 4x50 - 4x63 5x50 - 5x63 - 6.3x63 - 8x63	1463
 DIN 94 COTTER PINS SPLITPENNEN Stainless steel A2	9 T 66	1x20 - 1,6x20 - 2x32 2.5x32 - 3.2x32 - 3.2x40 4x40 - 5x50 - 6.3x50	165
 DIN 1 TAPER PINS CONISCHE PENNEN	18 T 114	2x10 - 2x12 - 2x14 - 2x20 - 2x30 3x14 - 3x20 - 3x24 - 3x30 - 3x40 4x20 - 4x30 - 4x40 5x20 - 5x30 - 5x40 6x30 - 6x40	365
 DIN 1 TAPER PINS CONISCHE PENNEN	9 T 214 (9 T 114A)	3x50 4x50 - 4x60 5x50 - 5x60 6x50 - 6x60 - 6x70 6.5x60	150
 DIN 6325 PARALLEL PINS CIL. PENNEN Hardened/ground gehard/geslepen tol. M6	18 T 115	2x10 - 2x12 - 2x14 - 2x20 - 2x28 3x14 - 3x20 - 3x24 - 3x32 - 3x40 4x20 - 4x32 - 4x40 5x20 - 5x32 - 5x40 - 6x28 - 6x40	187
 DIN 7343 SPIRAL PINS SPIRAAL-SPANBUSSEN A RESSORT	18 T 113	1,5x8 - 1,5x12 - 2x10 - 2x16 3x12 - 3x14 - 3x16 - 3x20 - 3x24 - 3x30 4x16 - 4x20 - 4x24 - 4x30 - 4x40 5x20 - 5x40 - 6x40	415
 DIN 7343 SPIRAL PINS SPIRAAL-SPANBUSSEN A RESSORT 24	9 T 213 (9 T 113A)	4x50 - 5x50 - 5x60 6x50 - 6x60 - 6x70 8x50 - 8x60 - 8x70	140

BLINDKLINKNAGELS EN -MOEREN
BLIND RIVETS AND BLIND NUTS
RIVETS ET ECROUS AVEUGELES
REMACHES CIEGOS Y TUARCAS
BLINDNIETE UND MUTTERN

ARTICLE	TYPE NR	COMPOSITION	TOTAL PCS
 **Blindrivets** **Incl. handriveter** **Blindklinknagels** **incl. handtang** **Avec App.**	**N 30**	Handriveter: FH 10 Rivets - Aluminium, Round Head Ø 3x4,5 - 3x6,5 - 3x8 - 3x10 Ø 4x6 - 4x8 - 4x10 - 4x12 Washers: Ø 3 - 4	1301
 **Blindrivets** **Incl. handriveter** **Blindklinknagels** **incl. handtang** **Avec App.**	**N 31** ✓	Handriveter: FH 10 Rivets - Steel, Round Head Ø 3x4,5 - 3x6,5 - 3x8 - 3x10 Ø 4x6 - 4x8 - 4x10 - 4x12 Washers: Ø 3 - 4	1301
 **BLIND RIVET NUTS** **Incl. handriveter** **Blindklinkmoeren** **incl. handtang** **Avec App.**	**N 35**	Staal: 4 PO 20 - 5 PO 30 - 4 FO 30 - 5 FO 40 Alu: 5 PO 200 - 6 PO 300 - 4 FO 250 - 5 FO 200	327

Annex X

A Quantitative Assessment of Training Needs of the Sugar Industry

With a more recent supplement for the automotive
and agricultural machines needs

A proposal for the development of the training facilities at the National Sugar Training Centre, Sennar.

Part 1. A quantitative assessment of the training needs of the Sugar Industry of Sudan which are to be met by the NSTC, Sennar.

Part 2. A summary of the present training accommodation and an indication of the additional requirements.

Part 3. An outline proposal reached during preliminary discussions with the Consultant and Resident Architects to the Sugar Project Implementation Committee.

Part 1. A quantitative assessment of the trianing needs of the Sugar Industry of Sudan which are to be met by the NSTC, Sennar.

Introduction

This document is intended to provide a guide to assist in defining the types of training accommodation needed at the NSTC in order that a genuine impact may be made towards satisfying the training needs of the Sugar Industry of Sudan - both short-term and long-term.

The basis for this assessment has been taken from the data prepared by UNIDO following the initial missions to Sudan to prepare a project doucment for the Training Component of the Sudan Sugar Rehabilitation Project and from which the present Project Document for Project SF/SUD/36/003 was derived.

The time lapse between the collection of the data and the present time is of little consequence to this assessment since it is realistic to assume that whilst ever a period of time the numbers of persons in permanent employment within the Sugar Industry may fluctuate, the general proportions in Occupational Areas and Fields of Work will remain far more constant.

The iufluence of any variation will simply result in changing the time required to reach the initial objective, i.e. providing basic training throughout the industry.

Since it is essential to base any proposed structural additions to the Training Centre upon facts and figures, it is also then of equal importance to provide the training facilities within them to meet the specific needs. - Some progress has already been made in attempting to collect data for a qualitative assesment of the trianing needs but the information available at this time is still incomplete.

1.0 The following figures indicate the numbers in permanent employment and for whom training programmes of personal skills improvement must be made available at NSTC. The large number of seasonal employees may be offered a short period of training on-the-job and in this respect it will be the responsibility of NSTC to provide training for the necessary Instructors.

2.0 The training needs of Middle and Top Level Management will be addressed separately since the faicilities provided may not be suitable, therefore, whilst this aspect of training will also be the responsibility of NSTC, it would be more appropriate to conduct the training programmes elsewhere.

3.0 Occupational Areas, Fields of Work and numbers of Employees to be trained.

3.1

Mechanical Technicians	No.
Mechanical Harvesters	5
Vehicles	4
Agricultural Implements	33
Crawlers	4
	46
Welding and Fabrication	4
Advanced Workshop Practice	42
Draughtsmen	8
	54
Total	100

3.2

Mechanical Artisans/Craftsmen	No.
Wheeled Tractors	186
Vehicles	99
Agricultural Implements	91
	376
Workshop Practice	218
Factory Maintenance	72
Factory Worshop	118
Total	784

3.3

Electrical/Instrumentation Tech^{ns}	No.
Electicans	48
Telephone	4
Instrument	4
Total	56

3.4

Electrical/Instrument Artisans	No.
Electicans	104
Instruments	20
Power House	60
Total	184

3.5

Building and Construction Trades	No.
Various Fields of Work	160
Total	160

3.6

Vehicle Operation	No.
Light Vehicles	145
Loader Operators	141
Wheeled Tractors	612
Crawler Tractors	98
Graders/Heavy Vehicles	40
Trucks	84
Total	1120

3.7

Plant Operation/Quality Control	No.
Laboratory	96
Plant Operation	156
Total	252

3.8

Business Admin. and Management	No.
Administration Personnel	668
Supervisors - Admin.	88
Supervisors - Plant	234
Total	990

3.9

Agriculture	No.
Various Occupational Areas Fields of Workd and Categories	600
Total	600

NOTE: A request to follow-up an earlier contact with Guneid Sugar Cane Research Station and establish a "Training Interface" covering common interests for co-operation and future development, dated 17 Nov. 88, has not produced any response to date, i.e. 17 Dec. 88.

4.0 A training Strategy

4.1 In order to attempt to make an impact on the training needs "across the board", it would be of considerable advantage to establish 3 categories, grades or levels of competence (training)

4.2 For Vocational Trades Skills Areas - i.e. Artisan level of employment these can be readily identified as:

4.2.1. Basic artisan skills

4.2.2 Intermediate level of skills

4.2.3 Advanced skills level

4.3 All personnel within each occupational area will be required to participate in and successfully complete a basic programme of training modules.

4.4. At least 60% of the participatns can then be selected for further training to Intermediate Level.

4.5 Then, at least 60% of those successful at the Intermediate Level training modules may be selected for further training to Advanced Level or Technician.

4.6 Further selection can then be made according to ability, skill, aptitude and attitude for:

4.6.1 Continuing as a Highly Skilled Craftsman or

4.6.2 Further training in Supervisory Skills or

4.6.3 Further training to be an Instructor or

4.6.4 Eventually further training in Management Skills.

4.7 Figure 1 shows a Progressive Training Structure for Artisan/Craftsman Training based upon the Modular Concept

4.8 Figure 2 shows a similar Progressive Training Structure for Technicians

4.7 For various Fields of Work: Artisans/Craftsmen.

All Staff:

	Basic Artisan Skills Training	
	Intermediate Skills Training	
	Advanced Skills Training	
Technician Training	Supervisory Training	Instructor Training
Supervisory Training	Management Training	In Plant / At STC
Management Training		Training Officer
		Management of Voc.Trg.Progr.

4.8. For various Fields of Work: Technicians.

All Staff:

Basic Training

Intermediate Training

Advanced Training

Supervisory Training

Management Training

Instructor Training

In Plant

At STC

Training Officer

Management of Voc.Trg.Progr

4.9 Again in the case of Administrative appointments, it is desirable to establish 3 levels of training requirement in order that a progressive training programme can be established and related to identifiable levels of attainment or competence necessary for professional advancement.

5.0 Training commitment necessary by the NSTC based upon a progressive training structure

5.1

Mechanical Artisans/Craftsmen	No.
Vehicle - Basic Artisan Skills	376
- Intermediate Skills	227
- Advanced Skills	136
Total	730
x	12 weeks = 8760 T/w
Factory - Basic Artisan Skills	408
- Intermediate Skills	245
- Advanced Skills	148
Total	801
x	12 weeks = 9612 T/w

5.2

Mechanical Technicians	No.
Vehicle - Basic - 46 + 136/4	80
- Intermediate	48
- Advanced	29
Total	157
x	12 weeks = 1884 T/w
Factory - Basic - 54 + 148/4	91
- Intermediate	55
- Advanced	33
Total	179
x	12 weeks = 2148 T/w

5.3

Electrical/Instrument Artisan	No.
Basic Artisan	184
Intermediate	110
Advanced	66
Total	360
x	12 weeks = 4320 T/w

5.4

Electrical/Instrument Technician	No.
Basic - 56 + 66	73
Intermediate	44
Advanced	26
Total	143
x	12 weeks = 1716 T/w

5.5

Building and Construction	No.
Basic Artisan	160
Intermediate	96
Advanced	58
Total	314
x	12 weeks = 3768 T/w

5.6

Plant Operation/Quality Control		No.
Operatives - Basic Artisan		156
- Intermediate		94
- Advanced		56
Total		306
	x	12 weeks = 3672 T/w
Control Technicians 96 + 56		
- Basic		110
- Intermediate		66
- Advanced		40
Total		216
	x	12 weeks = 2592 T/w

5.7

Business Admin. and Management		No.
Staff Training - Level 1		668
- Level 2		400
- Level 3		240
Total		1308
	x	8 weeks = 10464 T/w
Supervisors - 322 + 240		382
	x	4 weeks = 1528 T/w

5.8

Agricultural Operatives		No.
Various - Basic Artisans		600
- Intermediate		360
- Advanced		216
Total		1176
	x	8 weeks = 9408 T/w

5.9

The total number of Trainee/Weeks indicated above amounts to 59,872 rounded for convenience in future calculations to 60.000 Trainee/Weeks.

5.10.1 To assume the extraordinarily ambitious utilisation of the training facilities for 48 working weeks each year, the above figure may then be resolved to a base of 1250 trainees.

5.10.2 In order to meet this initial requirement only and standing still rather than countering the increasing demand for training AND supposing all the necessary facilities, accommodation and Instructors were available immediately, the actual training commitment is shown below in tabular form.

5.10.3 Table 1 showing daily attendance necessary for 48 weeks each year against time required to meet initial objective (and not allowing for a slow start and build up to capability).

Years		Trainees
3 yrs	with a daily attendance of	417
4 yrs		312
5 yrs		250
6 yrs		208
7 yrs		179
8 yrs	*	* 156

* The present Trainee Accommodation capacity after considerable maintenance and repair.

5.10.3 AN ALTERNATIVE VIEWPOINT - With maximum utilisation of the TRAINING FACILITIES now available - i.e. a maximum of 40 Trainees IT WILL REQUIRE 32 YEARS TO MEET THE ORIGINALLY IDENTIFIED OBJECTIVE.

5.11 The above figures do not include Vehicle Operation/Driver Training since the great majority of the instruction will not be considered in an enclosed space. However, the requirement for a suitable number of Instructors is evident at the Training Centre and at various working locations (on-the-job) since a training commitment of 1110 drivers x 2 weeks, i.e. 2236 Trainee/Weeks is anticipated.

5.12 As previously indicated - para.2.0 - the training needs of Middle and Top Level Management will be met by arranging appropriate training programmes outside NSTC.

6.0 Conclusion

6.1 It is beyond question that the present training facilities and accommodation at the National Sugar Training Centre, Sennar are totally inadequate to make even the slightest impact on the needs of the Industry and therefore high priority must be given to the provision of considerable extension to the existing premises.

6.2 The initial approach must be the complete rehabilitiation of the existing training facilities (and this can only be pratially accomplished within the Budget for Phase I.

6.3 The development of facilities must be pahsed to impact the most demanding areas first, i.e. the most critical requirement being Basic Artisan Skills Development in all Occupational Areas and Fields of Work.

6.4 The attempt to provide sufficient training facilities and residential accommodation will need to be accompanied by a serious recruitment programme to attract suitably qualified and experienced Instructors to participate in further training programmes in readiness for the completion and commissioning of new buildings and training equipment.

Part 2. A summary of the present training accommodation and an indication of the additional requirements

Introduction

A. The major cost in the rehabilitation of the existing accommodation will be encountered in the replacement of many electrical fixtures, fittings and appliances.

All the workshop areas require complete re-wiring in order to raise the safety standards to an acceptable level which would also include the complete replacement of the distribution panels and the installation of overhead bus bars.

B. The reference to short-term requirements indicates that the accommodation is planned to deal with initial training only. The figures quoted are for "first time" training only and do not take into account the proposed Progressive Training Structure.

C. A further item for consideration once the initial training programmes are in operation will be the possible introduction of a ONE YEAR OFF-THE-JOB APPRENTICESHIP TRAINING SCHEME which would be a major influence on the long-term objective of progressively raising the levels of competence of Craftsmen and Technicians in certain key occupations.

Sugar Training Centre, Sennar

1.0 Existing Accommodation

1.1

Office and Storerooms	Dimensions (m)	Area m^2
General Office	8.50 x 8.0	68.0
Directors Office	4.5x4.5 + 3x3	29.25
Training Office	4x6 + 3x3	30.0
General Store	8.5 x 8.0	68.0
Parts Store	4.5 x 7.0	31.5
Sub Store	2.5 x 6.0	15.0
	Total	244.75

1.2

Mechanical Workshops		
	Dimensions (m)	Area m^2
Machine Shop	8.5 x 25.0	212.5
Fabrication Shop	8.5 x 12.5	106.25
Working Shop	8.5 x 6.5	55.25
	Total	374.0

1.3

Vehicle Workshops		
	Dimensions (m)	Area m^2
Garage	8.5 x 11.0	93.5
Auto Electrics	8.5 x 6.0	51.0
Classroom	5.0 x 5.0	26.0
Workroom	3.5 x 5.0	17.5
Store	8.5 x 8.0	68.0
	Total	255.0

1.4

Instrumentation		
	Dimensions (m)	Area m^2
Laboratory	6.0 x 3.0	18.0

1.5

Classrooms		
	Dimensions (m)	Area m^2
No.1	8.5 x 9.0	76.5
No.2	8.5 x 10.0	85.0
No.3	8.5 x 9.0	76.5
No.4	8.5 x 10.0	85.0
	Total	323.0

TOTAL AREA = 1214.75 SQ.M. (Excluding kitchen and toilets)

Sugar Training Centre, Sennar.

Proposed additional accommodation.

2.0 Mechanical - Short-term requirement for:

8 Instructors

60 Technicians

400 Artisans

2.0

Workshop/Room	Dimensions (m)	Area m^2
Basic Fitting Shop	10.0 x 7.5	75.0
Advanced Fitting Shop	10.0 x 7.5	75.0
Advanced Machine Shop	10.0 x 20.0	200.0
Plumbing/Pipe Fitting	10.0 x 10.0	100.0
General Maintenance	10.0 x 15.0	150.0
Tool and Metal Store	5.0 x 5.0	25.0
Tool and Parts Store	5.0 x 5.0	26.0
Classroom	10.0 x 7.5	75.0
Classroom	10.0 x 7.5	75.0
	Total	800.0

3.0 Electrical/Instrumentation - Short-term requirement for:

5 Instructors

60 Technicians

180 Artisans

3.1

Workshop/Room	Dimensions (m)	Area m^2
Domestic Installation	10.0 x 10.0	10C.0
Industrial Installation	10.0 x 10.0	100.0
Electrical M/c Maintce	10.0 x 10.0	100.0
Instruments and Control	10.0 x 10.0	100.0
Parts and Tool Store	5.0 x 5.0	25.0
Instrument Store	5.0 x 5.0	25.0
Classroom	10.0 x 7.5	75.0
	Total	525.0

4.0 Vehicles - Short-term requirement for:

8 Instructors

50 Technicians

370 Artisans

1120 Drivers

4.1

Workshop/Room	Dimensions (m)	Area m^2
Engines	10.0 x 10.0	100.0
Transmission	10.0 x 10.0	100.0
Chassis	10.0 x 10.0	100.0
Electrics	10.0 x 7.5	75.0
Diesel	6.0 x 6.0	36.0
Hydraulics	6.0 x 6.0	36.0
Heavy Plant	10.0 x 15.5	150.0
Fitting Shop	10.0 x 7.5	75.0
Classroom	10.0 x 7.5	75.0
	Total	742.0

4.2

Covered Area	Dimensions (m)	Area m^2
Tractors	12.5 x 10.0	125.0
Harvesters	12.5 x 15.0	187.5
Heavy Plant	12.5 x 15.0	187.5
Trucks and Trailers	10.0 x 20.0	200.0
Light Vehicles	10.0 x 20.0	200.0
	Total	900.0

5.0 Building and Construction - Short-term requirement for:

1 Instructor

160 Artisans

5.1

	Dimensions (m)	Area m^2
Carpentry Shop	10.0 x 10.0	100.0

6.0 Chemistry - Short-term requirement for:

2 Instructors

96 Lab + 156 Plant

6.1

Room	Dimensions (m)	Area m^2
Laboratory	15.0 x 25.0	375.0
Lecture Room	10.0 x 7.5	75.0
Pilot Plant	10.0 x 20.0	200.0
	Total	650.0

7.0 Business Administration and Management - Short-term:

3 Instructors

90 Supervisors (Admin)

240 Supervisors (Plant)

670 Admin. Staff

7.1

Room	Dimensions (m)	Area m^2
Board Room	10.0 x 10.0	100.0
Classroom	10.0 x 10.0	100.0
Classroom	10.0 x 7.5	75.0
Classroom	10.0 x 7.5	75.0
Store	10.0 x 5.0	50.0
	Total	500.0

8.0 Training Department - To be located in existing accommodation

3 Instructors/Lecturers

8.1

Room	Dimensions (m)	Area m^2
Classroom	8.5 x 9.0	76.5
Classroom	8.5 x 10.0	85.0
Trg. Mat. Dev^t and A.V. Prep.	8.5 x 9.0	76.5
Reprographics Room	8.5 x 8.0	68.0
Materials Store	6.0 x 3.0	18.0
	Total	324.0

9.0 Agricultural Department - A request for inforr ˙¬n relating to Policy Decisions concerned with the establishi... this Department and its location has not yet been dealt with.

10.0 Additional Accommodation

Library 13.0 x 15.5

Lecture Theatre 13.0 x 15.5

Administration Section - as orginally proposed on drawings for new extension, i.e. - Reception, 9 offices and store 9.0 x 12.0

Total additional area approximately 5660 sq.m.

Part 3. An outline proposal reached during preliminary discussions with the Consultant and Resident Architects to the Sugar Project Implementation Committee

Introduction

Discussions took place on 11 December 1988 between:

Mr. Mohamed Ali M.O. Fadlabi - Director NSTC

Mr. J. Bye, UNIDO - CTA

Mr. J.O. Bergland - Elect/Instruments Expert

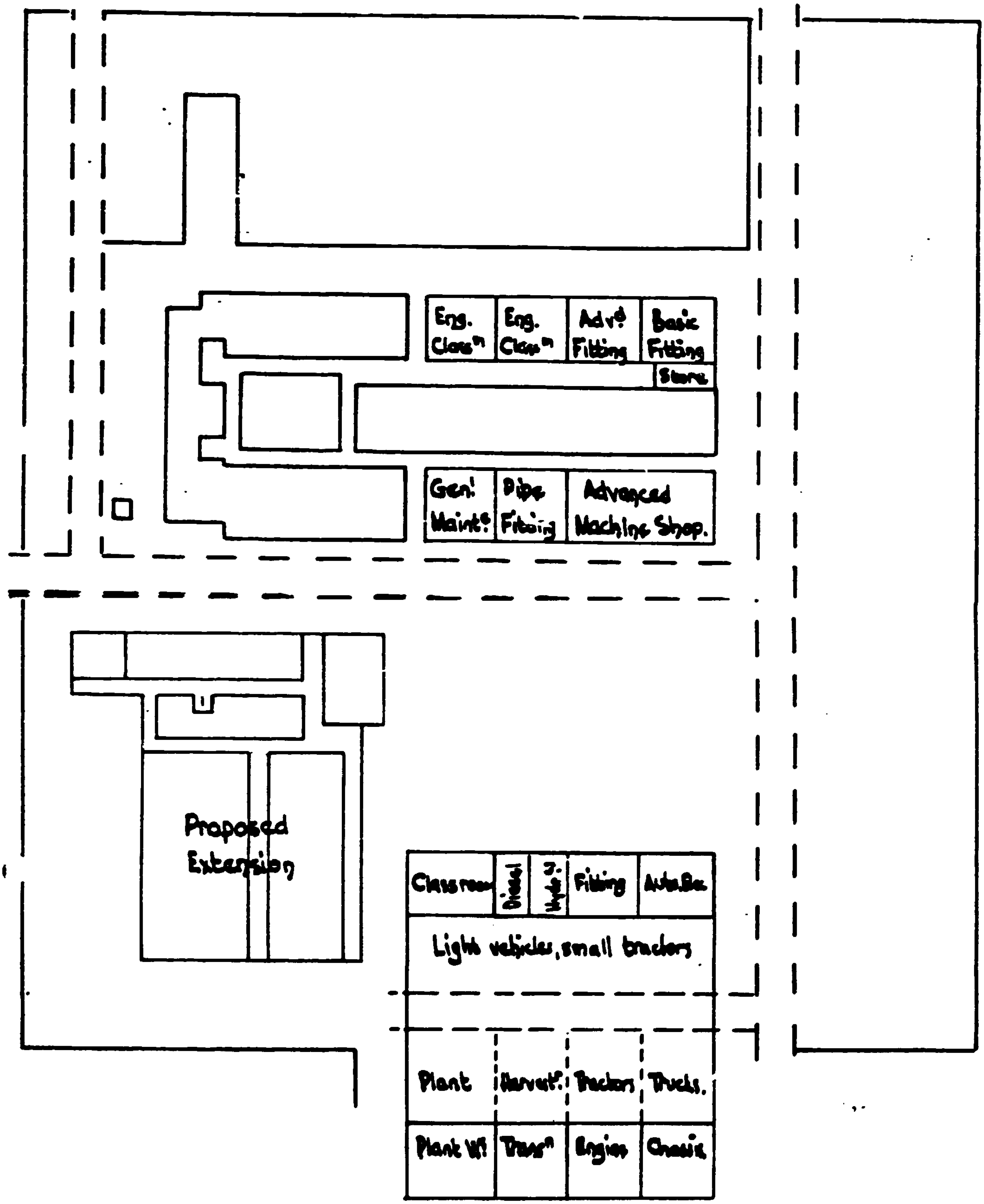
Mr. E. Pauli - Vehicles/Ag. Egypt Expert.

The discussions concentrated upon how best to try and provide sufficient accommodation to satisfy the training needs of the Sugar Industry.

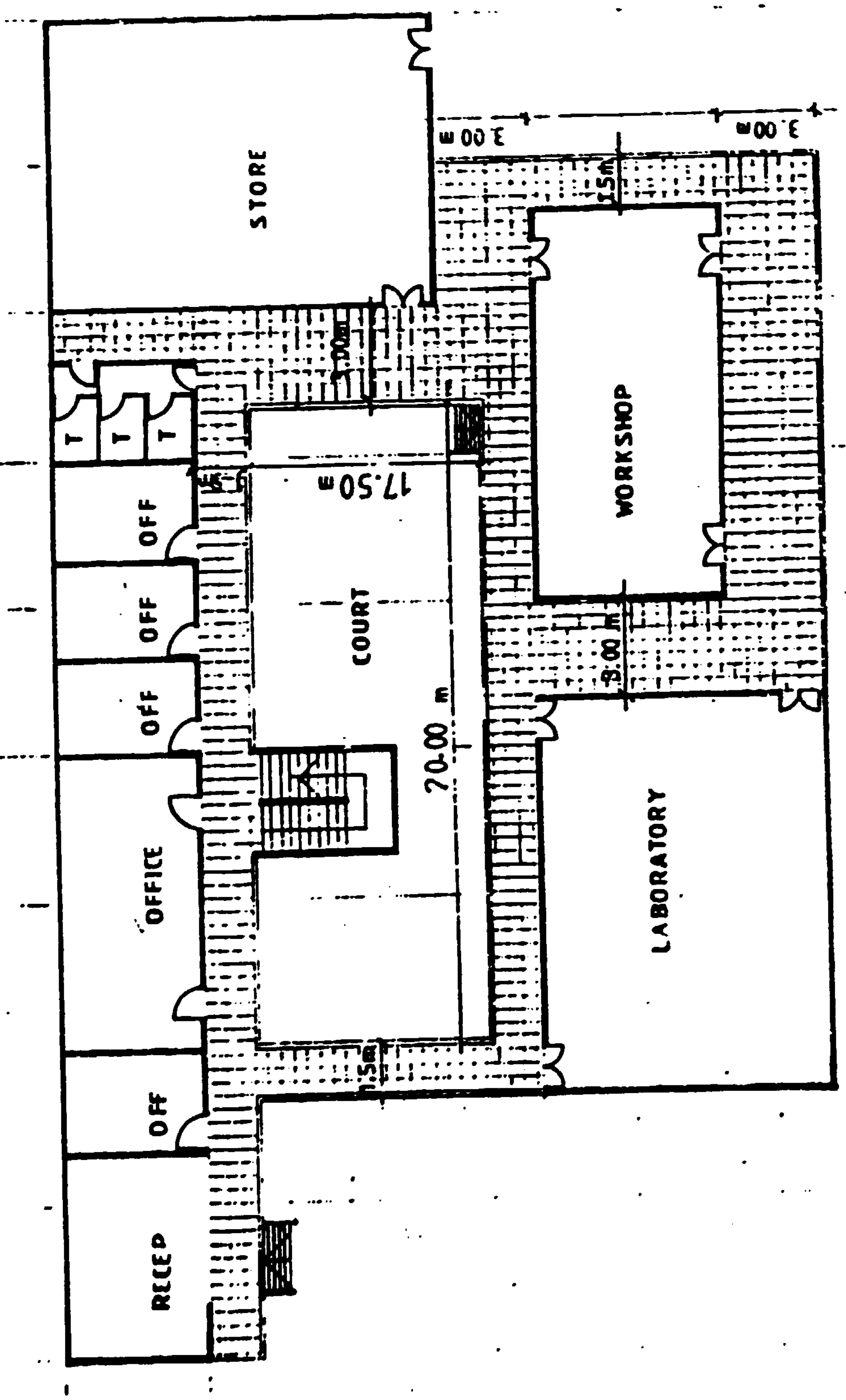
It was resolved that the CTA would prepare the rationale upon which to propose modifications to the recently prepared drawings and extensions to the training accommodation which up to this time had not even been considered.

Sugar Training Centre, Sennar

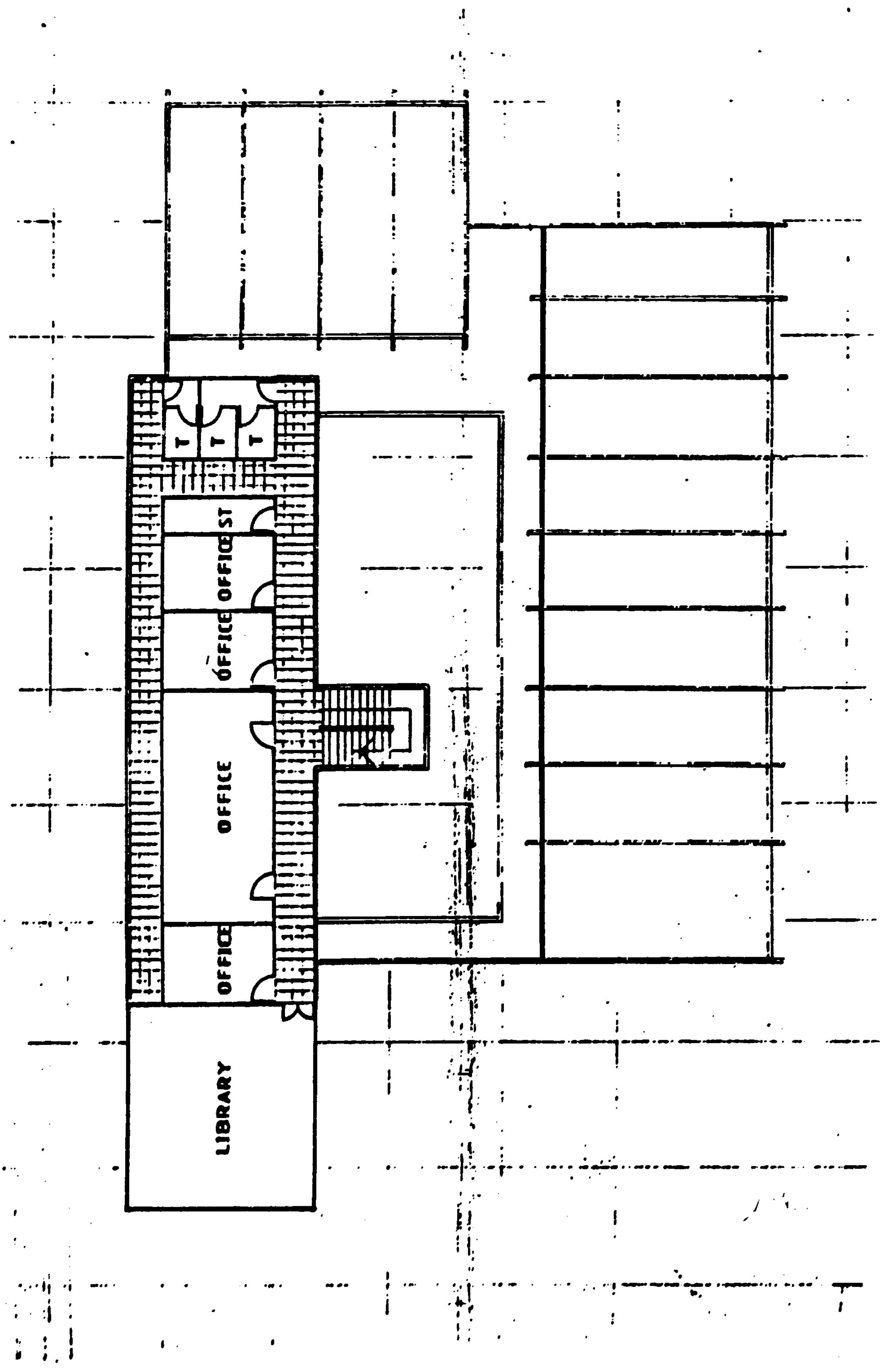
Possible layout for requested accommodation

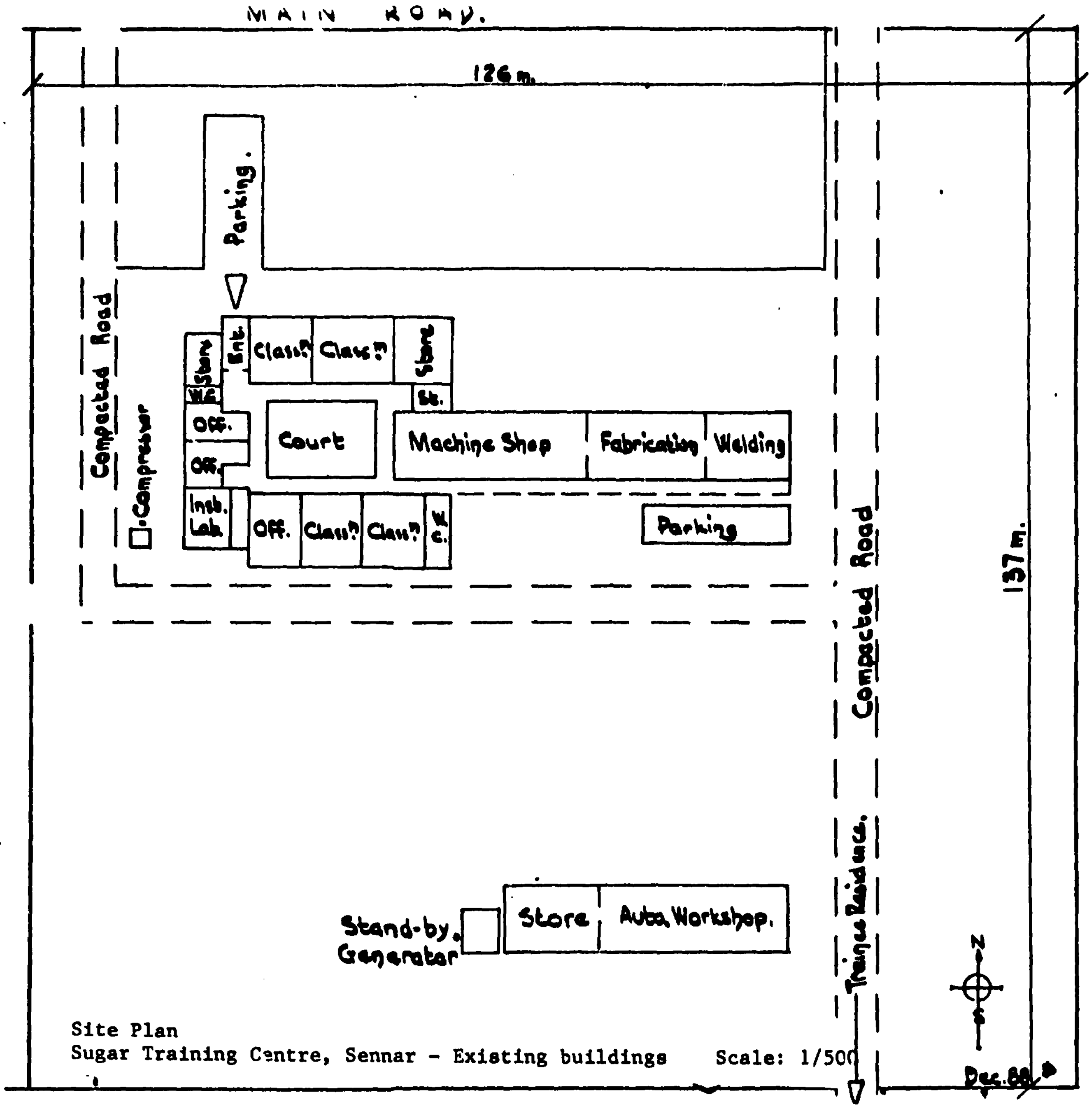


Original proposal for an extension to the accommodation at the NSTC - Ground Floor Plan



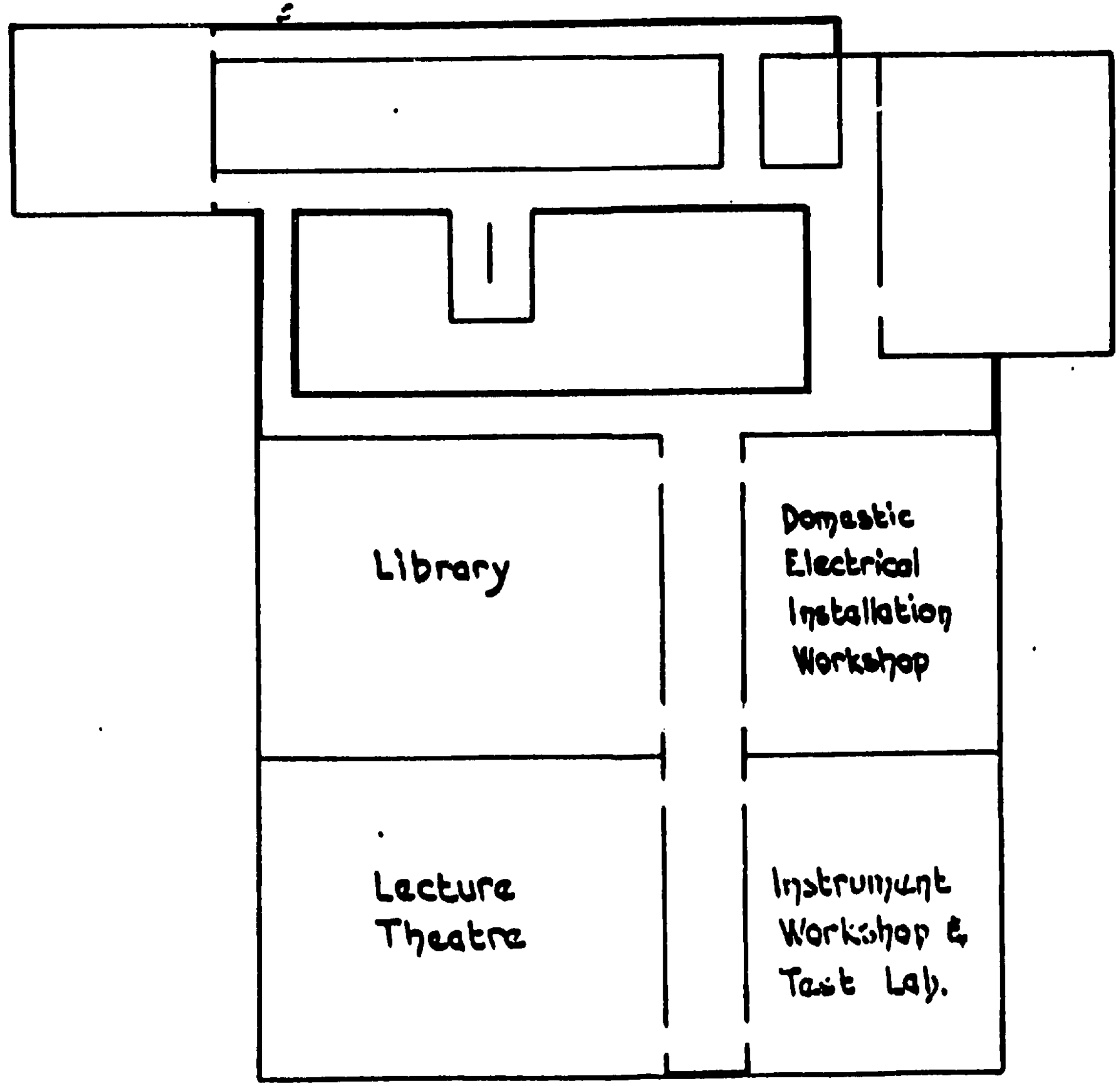
Original proposal for an extension to the accommodation at the NSTC - First Floor Plan





Site Plan
Sugar Training Centre, Sennar - Existing buildings   Scale: 1/500

Sugar Training Centre, Sennar.
Proposed extension with suggested modifications to original design - First Floor.



Scale 1:200.
Dec. 82 [initials]

Supplement to Annex X

QUANTITATIVE ANALYSIS OF PERSONNEL TRAINING NEEDS RELATED TO THE AUTOMOTIVE AND AGRICULTURAL MACHINES OPERATION AND MAINTENANCE.

1. Separate data collection resulted in figures very close to the ones reached in the quantitative analysis of the CTA. (within 5%)

2. For standardization reasons we will use the figures of the CTA' s quantitative analysis.

3. It is estimated that 30% of the total number of electricians is involved in the Automotive and Agricultural Machines section.

4. It is estimated that 30% of the total supervisors is involved with Automotive and Agricultural Machines and need upgrading in machine knowledge and use.

5. It is estimated that 10% of the managers needs some upgrading in Automotive and Agricultural Machines skills and especially to deepen the knowledge of potential of the machines and their correct usage, to better understand the Automotive and Agricultural Machines related problems, and how to avoid them.

6. 20% of personnel from the various occupational areas of Agriculture need some knowledge of the Automotive and Agriculture Machines as they work closely with them.

7. A 20% turnover of trained personnel is assumed. This figure is probably on the conservative side when considering losses to the private sector and to other countries. A figure of 30% rotation of seasonal operators is an average figure for the four mills.

8. For the sake of calculations and planning, it is estimated that a maximum of 250 trainees can be handled per day in the N.S.T.C. (5.10.3 in the CTA' s report). This means that a five year period will be needed to cover the present requirements of the industry if no personnel is lost. (I)

9. With personnel losses as indicated in 7 above turnover corrected figures are shown in II.

10. Basic training time requirements are shown in III.

11. It must be noted that the figures do not show conversion courses, refresher courses, or courses for the introduction of new machines. These will have to be organized according to needs, when these arise. No plans appear to exist at the time of writing to enable such a plan to be drafted.

I. Basic Analysis

Quantitative assessment reference numbers

A. Maintenance and supervision of maintenance.

5.1.	Mechanical artisans/craftsmen	730
5.2	Mechanical technicians	157
5.3	30% of electrical artisans	108
5.4	30% of electrical technicians	43
5.7	15% of supervisors	58
		1.096

B. Operators and supervisors of operators.

3.6	Vehicle operators	1.120
5.7	15% of supervisors	580
3.9	20% of agriculture	120
		1.298

C. Management

5.7	10% of management	131

II. Applying the turnover percentages to the above one has:

A. Maintenance and supervisors of maintenance

About 40% of 5.1 Mechanical artisans/craftsment are seasonal so the yearly figure should be divided in:

5.1	fixed	438 + (20% x 5 yrs)	=	876
	seasonal	292 + 30% = 380 x 5 yrs	=	1.900
5.2	mechanical technicians	157 + (20% x 5 yrs)	=	314
5.3	electrical artisans	108 + (20% x 5 yrs)	=	216
5.4	electrical technicians	43 + (20% X 5 yrs)	=	86
5.7	supervisors	54 + (20% x 5 yrs)	=	108
				3.500

B. Operators and supervisors of operators

- It is assumed 50% of the seasonal operators will return the next thereby decreasing the training needs.

- 80% of the operators are seasonal.

3.6	vehicle operators	fixed (20%) 224 + (20% x 5 yrs)224		=	448
		seasonal: 1st yr. 896 + 30%	= 1.165		
		2-5th yr. = 448+(30% of 896)269 = 717 x 4 yrs.	= 2.868		
					4.033
5.7	supervisors	58 + (20% x 5 yrs)58		=	116
3.9	agriculture	120 + (20% x 5yrs)120		=	240
					4.837

C. Management

5.7	Management	131 x (20% x 5yrs)	=	262

III. Basic training time requirements

A. Maintenance and supervisors of maintenance.
In this case it is felt that the minimal requirements are of 12 weeks.

3.500 men x 12 weeks = 42.000 m/w

B. Operators and supervisors of operators.
This area has widely varying needs in training, ranging from 4 weeks to several months.
For calculation purposes an average of 9 weeks is used.

4.837 men x 9 weeks = 43.533 m/w

C. Management.
Brief practical courses covering a wide range of machines will be needed with an average of 8 weeks.
NOTE: This is not management training but TECHNICAL TRAINING FOR MANAGEMENT.

262 men x 8 weeks = 2.096 m/w

Total time for courses = 87.629 man/weeks

Considering teachers'/trainers' time availability, the time necessary for preparation is 5%, follow up on the job is 6%, leave is 6%, holidays 4% and other time of low productivity (Ramadan) is 8% (Total 29%).
It cannot be expected to run any one course for any more than 68% of the time = 35 weeks, leaving 4% = 2 weeks margin for contingency.

A teacher in practical training sessions should not supervise more than 8 trainees at a time.

If a trainer/teacher can only teach 35 weeks/year, then to train all personnel in a period of 5 years it will require a number of teachers=

$$= \frac{87.629 \text{ (total man weeks)}}{8\text{(trainees/teacher)} \times 35\text{(teacher/weeks/yr)} \times 5\text{(yrs for completion)}} =$$

= 62.6 teachers full time for 5 yrs. (3.756 man/months)

The subjects to cover are in many different specialities (electrical, diesel, engines, hydraulics, frames/chassis, etc.) on many different machines, there must be a teacher for each speciality. (Courses will frequently be running simultaneously)
Teachers covering several specialities can be used but only as back up, or second teachers.
In some areas, where the work load is greater, more than one teacher will have to be appointed permanently for a speciality.
As quite a few of the training courses will be run at the mills, by part time instructors, it is felt that regular short visits by N.S.T.C. instructors will be necessary to ensure the correct implementation of the programme, up to the required standards.

Annex XI

Proposed courses and related activities

Two year plan

A. Course needs (with sample programme)
B. Trainers needs (with build up programme)
C. Integrated training programme chart

A. Course needs

All aspects of all machines involved have to be covered as there is an obvious lack of knowledge across the board. These aspects are listed below under major headings. It must be noted that each heading usually constitutes a full time job for a technician, and that therefore having technicians covering more than one heading could well result in loss of quality and insufficient time to cover all needs in those areas.
The only exception is the first heading in the list, "fitting", which can constitute a job to itself but is also a basis and need in many other jobs.

For maintenance and repair of the machines the following are the main headings:

1. Fitting
2. Engines
3. Transmissions
4. Chassis (suspension, steering, frame)
5. Fuel systems (Diesel - Petrol)
6. Electrical
7. Hydraulics
8. Tracks and accessories

These headings are of a generic nature. It is clear that it will be very difficult for any one to specialize in all the components under his heading. As an example consider the engines of the machine park.
One could reasonably cover all the engines in one category of machines at one mill.
E.g. Light Vehicle Engines in Sennar

Toyota	- Hylux 4 cylinder petrol 2000 cc
	Corolla 4 cylinder petrol 1300 cc
	Corona 4 cylinder petrol
	Hiace 4 cylinder diesel
	Land Cruiser 4 cylinder diesel
	Land Cruiser 6 cylinder diesel
	Land Cruiser 6 cylinder petrol
Nissan	- Cedric V6 cylinder petrol
	Urven 4 cylinder petrol

Of the above several have substantial changes within the same category. To cover the full range of the light vehicles engines in Sennar, one will have to run first a basic programme to ensure good basic understanding and then more programmes to specialize.

A similar situation exists for all headings in all mills and also for drivers/operators, although on a slightly smaller scale and simpler composition.

A sample training programme for Auto Electricians of 18 weeks with subjects and basic skills follows.
It must be noted that a full range of outlines of training programmes is being developed by the training officer of MATTS in Assalaya. Several discussions on this were held with the UNIDO team. These MATTS proposal programmes are considered quite good and are easily implemented using the proposed modular system as introduced by the UNIDO team.
The bulk of the proposed programmes was presented to the CTA by the MATT's team at the time of the writers departure upon end of contract and could therefore not be analysed in detail.

Assalaya Sugar Company

Basic Training Programme for Auto Electricans in the Agricultural Workshops

Duration 18 weeks Off the Job Training

1week
Safety

General Industrial Safety Practice - Safety Practice as applied to electrical equipment and electrical on vehicles.

3 Weeks
Electrical Theory

Understanding basic electrical theory. - Nature of electricity - Basic electrical circuits - Ohms Law - Conductors - Practice in reading a voltmeter.ammeter.multimeter. and avometer - Magnetism Electromagnetism - Electromagnetic induction - Generated voltage - Self Induction - Understanding Electrical Symbols and circuit diagrams.

1 Week
Automotive Batteries

How a Battery Works - Construction - Principle of current flow - chemical reaction - The battery and charging circuit - Types of batteries - Testing batteries - Charging batteries - Capacity rating - Factors affecting battery life - Safety when servicing and installing batteries

2 Weeks
DC Current Charging Circuits.

Basic Concepts of charging circuits - DC generator - Stripping and Assembly - Tests for Armature and Field Windings - Brush Testing - Generator Relays -Voltage Regulator - Current Regulator - Combined operation of all three regulators.

2 Weeks
AC Charging Circuits

Basic Principles and operation - Principles of Semi conductors - Diodes - Half and Full Wave Rectification - Three Phase Rectification Y stator and delta stator - Construction and Parts of Generator - Stripping and Testing - Trouble Shooting.

2 Weeks
Starting Circuits

General Theory Of Starter Circuits - How A starter Motor Works - Construction - Component Parts - Stripping and Testing - Types of Motor - Types of Bendix Drive - Types Of Circuit - Switches and solenoids.

2 Weeks
Ignition Circuits

Understanding how the system works - Component Parts and function - Primary Low Voltage Circuit - Primary and Secondary Coil - Distributor - High Voltage Distribution - Points - Timing of points - Spark Plugs - Reading and understanding circuit diagrams - Diagnostic - Testing.

2 Weeks
Lighting and Ancillary Circuits.

Understanding Circuit Diagrams - Electrical Symbols - Lights - Switches - Gauges - Circuit Breakers - Fuses - Relays - Electric Motors - Testing and Setting Procedures.

3 Weeks
Trouble Shooting

Diagnostic Testing - Batteries - Generators - Ignition Systems - Starters - Lighting Circuits and Ancillary Systems - Working Through a Range of Vehicles with Simulated Faults.

Notes

1.Safe Working Practice to be stressed at all times.

2.Each Trainee to be issued with a log book to record notes .lecture and trade talks given during the period of training.

3 Monthly phase tests of ability in practical and theoretical knowledge to be given to assess progress. ability and aptitude

Subject	Basic Skills
Safety 1 Week	a)General Industrial Safety in a Vehicle Workshop - Manual Lifting - Lifting with a Crane or Hoist - Fire Prevention - Safety when working with Tools - Electrical Safety as applied to working on Electrical Equipment on Vehicles and Plant in the Agricultural Workshop.

Basic Electrical Theory
2 Weeks

a)Nature of Electricity - Atoms - Electrons - Protons - Elements - Good Conductors - Insulators - Negative Charges - Current Flow of Electrons.

b)Introduction to Current - Amperes - Voltage Potential Force - Resistance - Ohms.

c)Basic Electrical Circuits - Series - Parallel-Parallel Series Circuits

d)Ohms Law - Formulas for Amperes - Volts - Ohms - Calculations involving Voltage,Current and Resistance in 3 Types of Basic Circuits.

e)Conductors - Resistance of Flow of Current - Length of Wire - Cross Sectional Area - Temp - Simple Calculations.

f)Practice and use of - Volt Meter - Ammeter - Multimeter - Avometer.

g)Magnetism - Magnetic Fields - North and South Poles - Theory of Magnetism - Permanent Magnet

h)Electromagnetism - Magnetic Lines of Force in a straight Conductor - Right Hand Rule - Lines of Force in relation to current Flow.

i)How Electromagnets Work - Effect of Magnetic Forces Through Several Loops - Concentration of Field Strength using an Iron Core - Factors controlling Magnetic Force in a Coil.

j)Electromagnetic Induction - How Voltage is Induced - Factors governing Induced Voltage - Magnetic Field Strength - Lines of Force Cutting Across a Conductor - Number of Conductors.

k)Generated Voltage - Basic Principles of DC Current - Single Loop Rotating Through a NS Field - Principles of Alternating Current - Rotating Magnetic Field Cutting Through a Stationary Conductor.

i)Self Induction - Self Induced Voltage - Induced Voltage in a Coil - Primary and Secondary Windings - Self Induction in a Circuit with the Current Increasing and Decreasing - Use of Self Induction in the Ingnition Coil.

m)Identifying and recognition of Standard Electrical Symbols - Understanding and Reading Vehicle Circuit Diagrams.

Automotive Batteries
1 Week

a)Function of a Battery - Supply Current - Stabilised Voltage System - Supply Current When Demand Exceeds Supply.

b)Construction of a Battery - Positive Plates - Negative Plates - Plate Groups - Connectors - Separated Elements - Plate Straps - Negative and Positive Posts - Vent Caps - Case - Cells in Series.

c)How a Battery Works - Current Flow From Dissimilar Plates - Electrolyte Solution - Specific Gravity of Electrolyte - Discharge of a Battery - Chemical Changes During Discharge - Charging - Chemical Changes During Battery Charging.

d)The Battery and Charging Circuit - Supplying Current - Discharging - The Generator - Reverse Current Charging.

e)Types of Battery - Wet Charged - Dry Charged - Activating a Dry Charged Battery - Wet Charged Battery - Storage of Both Types - Sulphated Batteries - Checking the Electrolyte Levels - Maintenance of Batteries.

f)Testing Batteries - Visual Inspection - Specific Gravity Tests - Light Load Tests High Rate Discharge.

g)Charging a Battery - Fast Charging - Slow or Trickle Charging - Advantages of Both Methods.

h)Capacity Rating of Batteries - Reserve Capacity - Factors involving Battery Selection - Terms covering Battery Ratings.

i)Factors Affecting Battery Life - Electrolyte Levels - Overcharging - Undercharging - Cycling - Other Factors including Cleanliness and Clamping.

j)Safety Rules When Servicing And Maintaining Batteries - Acid Spills - Explosive Gas Given Of When Charging - Rules When Using Booster Cables - Polarisation Of Generator - Battery Disconnection When Working on a Vehicle.

DC Current Charging Circuits
2 Weeks

a)Basic Concepts of Charging Circuits -.DC Generation - AC Generation - Operation of a Charging Circuit - During Starting - Peak Operation - Normal Operation.

b)DC Generator - Basic Concept and Principles - Rotating Wire Loop - Stationary Magnetic Field - Component Parts - Armature - Commentator - Brushes - Pole Shoes - Field Coils - Housing - Bearings - Fan - Connectors.

c)Stripping and Assembly - Testing Generator Output - Use of a Voltmeter - Ammeter - Types of Failure - Short Circuits - Open Circuits - Grounded Circuits - High Resistance.

d)Armature Tests - Open Armature Circuits - Shorted Armature Coils - Dirty or Worn Commutators - Skimming a Commutator - Undercutting Mica on a Commutator - Use of a Test Lamp - Use of an Avometer.

e)Field Circuit Testing - Testing for Open Circuits - Grounded Field Circuit - Shorted Field Circuit - Use of a Test Lamp - Use of a Volt Meter.

f)Brush Testing - Brush Holders - Spring Tension - Replacing Bushes - Testing Brush Holders - Polarity of Generator - Reasons For Correct Polarity - Damage Resulting from Incorrect Polarity - Method of Polarizing a Generator.

g)Generator Relays - Principles and Theory involving Cut Out Regulator - Series Windings - Shunt Windings - Points - Armature Cut OutRelay Circuits.

h)Voltage Regulator - Principles of Voltage Regulator - Single Winding Type - Accelerated Winding Type.

i)Current Regulator - Principles of Current Regulation - Series Winding - Shunt Winding.

j)Combined Operation of all Three Regulators - Current Voltage Regulators - Understanding Circuit Diagrams - Theory and Operation of Unit - Tests and Adjustment on

DC Regulator - Visual and with a Voltmeter Ammeter Ohmeter - Preliminary Checks - Airgaps - Voltage Setting Tests - Fixed Resistance Tests - Variable Resistance Tests - Current Regulation Tests - Trouble Shooting Charts.

AC Current Regulation
2 Weeks

a)Basic Principles and Operation of AC Generators - Stationary Wire Loop - £Rotating Magnetic Field - How Voltage Is Induced - Pattern of Generated Voltage - Voltage Curve Frequency and Cycles per Second - Delta Connected Stator - Y Connected Stator.

b)Semi Conductors - Silicon Crystal - Covalant Bonding - N Type Material - P Type Material - Principles And Theory of Semi Conductors - Electron Movement with P Material - With N Material - Diodes - Operational Forward Bias - Reverse Bias - Leakage of Current - Half Wave Rectification - Full Wave Rectification - Three Phase Rectification Y Stator - Three Phase Rectification Delta Stator - Reading And Understanding Circuit Diagrams.

c)Construction and Parts of an Alternator - Rotor Assembly -Drive end Frame - Fan - Pulley - Stator - Rectifier Diodes Positive - Rectifier Diodes Negative - Isolation Diodes - Brushes - Bearings - Types of Alternator - Stripping and Testing - Assembling an Alternator - Trouble Shooting - Failing to Charge - Low or Unsteady Charging - Excessive Charging Rate - Noisy Alternator.

d)Testing Diodes - Ohmeter - Test Lamp - Testing Stator Assembly with Ohmeter - Testing Rotor with Voltmeter Ohmeter or Avometer.

e)Alternator Regulation - Absence of Current Regulation - Voltage Regulation Only - Basic Theory - Operation - Reading Understanding Circuits Diagrams - Resistors - Diodes - Transistors - Themisters - - Operation in Circuits - Test Procedures - Checking Current Voltage Resistances. .

Starting Circuits
2 Weeks

a)General Principles and Theory of Starter Circuits - Battery - Ignition switch - Solenoid - Starter Motor - Pinion -Cranking the Engine.

b)Understanding how a Starter Motor Works - Poles and Field Windings - Live Loop Through a Magnetic Field - Armature - Commutator - Brushes - Types of Brushes - Type of Starter Motor - Series Wound Field Circuits - 4 Pole 2 Coil Wound Motor - 6 Pole Six Pole Wound Motor

c)Switches used in Starter Motor Systems - Solenoid Switches - Component Parts - Shift Lever - Plungers - Solenoid Pull in Windings -Contact Disc - Overrun Clutch - Pinion - Principles of Solenoid Circuit - With Solenoid Energising - Motor Engaged - Key Switch Released.

d)Types of Starter Motor Drive - Inertia Drives - Bendix Drives

e)Stripping Testing and Assembling Starter Motors - Preliminary Tests - No Load Test - Interpreting No Load Tests - Testing Armature for Concentricity - Open Circuit - Ground Test - Short Circuit - Skimming An Armature - Testing Field Windings - Grounded Circuit - Short Circuit - Replacement of Field Windings - Brush Maintenance - Bearing Maintenance - Pinion Replacement.

f)Types of Starter Circuits - Split Load Circuits - Series Parallel Circuits - Component Parts - Wiring Diagrams - Testing and Diagnosing on Starter Circuits - Trouble Shooting Charts

g)Testing Manual Switches - Testing Solenoid Switches - Hold in Winding Test - Pull in Winding Test

---

Ignition Circuits
2 Weeks

a)Introduction to component Parts and Basic Principles Ignition Coil - Condenser - Distributor - Spark Plugs - High Tension Leads - Battery

b)Understanding the Circuit - Primary Low voltage Circuit - Ignition Switch - Primary Coil Winding - Distributor Points - Spark Plugs - Condenser - Secondary Coil Windings - Distributor Rotor - Distributor Cap - Operation Prior to Points Opening and Closing

c)Distributor - Component Parts - Cap - Rotor - Condenser - Cam - Contact Points - Advance Mechanism - Drive Shaft - Principle of Operation - With Points Closed - With Points open - Centrifugal Advance Mechanism - Vacuum Advance System - Stripping Testing and Assembling a Distributor - Replacement and Setting Points - Timing The Distributor to Engine Timing.- The Effects of a Miss Timed Engine.

e)Spark Plugs - Construction and Basic &unction - Long and Short Reach - Hot and Cold Plugs - Setting the electrode Gap - Condition of Plugs on - Normal Operation - Carbon Fouling - Oil Fouling - Failures of Plugs - Cleaning Of Spark Plugs.

f)Reading and Understanding Ignition Circuit Diagrams - Test Procedures and Test Points in the Ignition System - Diagnostic Testing.

General Lighting
and Ancillary Circuits
2 Weeks

a)Understanding Circuit Diagrams - Electrical Symbols - Layout of Typical Vehicle Lighting Circuits - Light Switches - Oil Pressure Gauges - Indicator Lamps - Head Lights - Fuse Boards - Flasher Warning Lights - Procedures for Checking and Testing Wiring Open Circuits - Grounded Circuits - Short Circuits

b)Testing Gauges - Ammeters - Voltmeters - Hourmeters - Horns - Buzzers.

c)Relays - Basic Principles and Application - Cut Out Relays - Horn Relays - Testing and Setting Procedures

d)Servicing Switches - Electric Motors - Transformers - Glow Plugs.

Trouble Shooting
3 Weeks

a)Diagnostic Testing and Effecting Repairs of Vehicle Electrical Systems - Knowing the System - Asking the Operator - Inspecting the System - Operating the Machine - Listing Possible Causes - Reaching a Conclusion - Testing Conclusions - Working Through a Range of Vehicles with Simulated Faults in - Starter Circuits - Lighting Circuits - Charging Circuits - Ignition Circuits - Lighting Circuits - Charging Circuits - Batteries.

B. Trainer needs

1. As it is unrealistic to start all training activities at the same time, it is felt that priority objectives have to be selected and initial efforts concentrated.

   As all technical documentation is in English, it is felt that the first priority should be that all NSTC instructors should understand English properly. This step No. 1 can be achieved by intensive crash courses run in Sudan with a duration of approx. 2 - 3 months. (See CTA's report)

2. Training methodology is the next step. This will ensure that the trainers know how to analyse the needs, prepare themselves and the facilities so as to ensure the necessary learning by the trainees. This phase is to include practice in the production of audio visual aids. This step No. 2 should take about 3 months to complete.

3. Once this step is completed, it must be ensured that trainers are fully conversant with the technical aspects and repair of the machines they have to teach, their details and maintenance procedures to follow, whilst working on them. Some of this training can be done at the machine's agents premises to start with or by courses at NSTC, run be specialists of the machines with all the relevant documentation, tools and equipment. The duration of this step No. 3 can vary from 3 weeks to 2 1/2 months. In some cases it might be better to consider external fellowships for both methodology and machine training this will have to be considered previous performance of the candidate, potential, post. This of course has also to be related to the industries capacity to retain well trained personnel. An effort is certainly needed with regard to this last point by the industry.

4. This step is to be followed by a step in NSTC where the instructors set up the new faciliteis with all they need for training, the trainees and in the process practice themselves, so as to know thoroughly the machines and related training materials,facilities, etc. Some visits to the Mills W/S at this stage will be useful.

   This fourth step can vary considerably from the first time a course is run, which could take months to a change in a course which could take a few days.

5. Only when the above 4 steps are completed satisfactorily, can the trainer start training personnel from the mills.

6. From the time a new trainer is recruited, the time necessary to ensure he is well equiped to run training courses will probably be from a minimum of 5 months to a more likely 7 or 8 months.

C. Integrated training programme charts and explanatory notes.

1. Indicative Course duration for drivers, operators and supervisors

These are the general knowledge courses for understanding of the machines in general and their related operation and safety aspects. A brief supplementary specific course of 2 or 3 days will then give the final training to the trainee on a machine in particular.

Course Instructor	Category	Level	Duration in weeks	
01	L.V.	B	3	Drivers
02	HGV	B	3	Drivers
03	Tr	B	2 1/2	Drivers
04	HGV I	1	4	Drivers
05	Tr I	1	2	Operators
05	Tr A	A	I + 2	Operators
06	Pl I	1	2	Operators
06	Pl A	A	I + 2	Operators
41	L.V.	1	2	Supervisors
41	HGV	1	2	Supervisors
41	Tr	1	1	Supervisors
41	Pl	1	1	Supervisors

A combination of the proposed MATT's training programmes and the ILO MES elements (list of elements below) and similar material produces locally according to needs will be the basis of the programme.

INTERNATIONAL LABOUR OFFICE
CH-1211 GENEVE 22

MES

MODULES OF EMPLOYABLE SKILL

CATALOGUE OF LEARNING ELEMENTS AND RELATED MATERIALS

1986

NOTE

Persons interested in further information concerning the M.E.S. concept of Vocational Training are kindly requested to write to ILO Publications, International Labour Office, CH-1211 Geneva 22, Switzerland, for free copies of the brochure:

M.E.S.
An Approach to
Vocational Training

Prepared by the
Vocational Training Branch, ILO Geneva
First Published March 1981
Fifth Edition, April 1986

INTRODUCTION

For some time there has existed the need for a vocational training system with sufficient flexibility to cope with the changing and varied needs of employers for trained personnel. The ILO's worldwide experience in the planning and execution of vocational training programmes has led to the development of a universal and flexible concept of vocational training called "Modules of Employable Skill" (M.E.S.). In order to implement programmes under this concept, it has been necessary to develop an appropriate form of learning material having the necessary flexibility to enable individualised training programmes to be compiled. This form of learning material is known as the "Learning Element", and a bank of these is under development covering a number of occupational areas. Development work is taking place in collaboration with a number of industries and institutions.

Learning elements are self-contained instructional booklets, each covering a specific learning objective. The amount of learning that each element covers is small, significant and precisely matched to the learning objective. Each element starts with the learning objective, addressed to the trainee, a list of tools, equipment and aids required, together with a list of other learning elements related to it. The instructional pages contain short, concise texts and are highly illustrated. Allowance is made for sufficient practice to master the skill concerned, and the element ends with a progress check precisely matched to the learning objective. Learning elements of this type are also suited to learner-based as well as instructor-based training in training institutions or in-plant programmes. The illustrations used in learning elements are in the form of line drawings to allow for easy reproduction using simple duplicating equipment commonly available. The text is presented in such a way that translations into other languages can easily be eccommodated.

Because learning elements are designed to provide training with the flexibility inherent in the M.E.S. system, they can equally well be used for the implementation of any other type of vocational training methodology. The presentation of the learning elements lends itself to easy adaptation into other media (sound/slide, video, etc.), thus extending their application for other purposes, such as the training of illiterates.

Learning elements are being developed initially in the English language and provision is being made for their translation into other languages, for example French, Spanish and Arabic.

Learning elements dealing with general skills such as measuring, marking out and the identification of hand tools are used, in many cases, by more than one occupational area for which they were originally developed. When selecting learning elements you are therefore advised to refer also to other occupational areas. For example, when selecting learning elements for automotive or mechanical engineering you would require the learning element "Identifying Screwdrivers and Their Uses" which is listed under Electrical/Electronic Engineering for which it was originally developed.

The possible use of particular learning elements for other occupational areas as much as could be foreseen, is indicated in this catalogue by letters which are placed behind the title of a learning element.

- The letter "A" means that this learning element can be used for the occupational area of Automotive Engineering;
- The letter "B" for Building Construction;
- The letter "E" for Electrical/Electronic Engineering;
- The letter "M" for Mechanical Engineering; and
- The letter "P" for Plumbing and Pipe Fitting.

Please note that on page 26 of the catalogue are listed learning materials foreseen for the training of instructional staff in all aspects of the implementation of the MES approach to training, which when followed give the maximum benefits.

For the purchase of the learning elements or related materials listed in this catalogue, please refer to the prices and sales conditions quoted on pages 28 and 29. When ordering, either use the order form shown in the catalogue or list the learning elements or other materials you wish to obtain by quoting occupational area, category, ISBN number and the title on a separate sheet of paper. Should you wish to purchase a complete set of learning elements from one particular occupational area, you only have to quote the name of that occupational area.

When ordering learning elements, please indicate if it is your intention to reproduce, translate and/or modify them for commercial or non-commercial use, to enable us to provide you with the appropriate agreement.

The code box on the front cover of each element and at the head of each page is for the moment left blank. However, it is intended that a comprehensive coding system, which will facilitate the compilation of training programmes, will be introduced in the near future. The code numbers will then be inserted in the boxes provided.

The ILO welcomes any comments on the content and structure of the learning elements and any suggestions for their improvement. Industries and Institutes interested in co-operating with the ILO in the joint preparation of learning elements should contact the Vocational Training Branch of the ILO. The ILO will also provide interested parties with advice on the planning and implementation of M.E.S. based training programmes.

AUTOMOTIVE ENGINEERING

ISBN No.

General

92-2-104089-5	Passenger Car - Main Assemblies
92-2-104090-9	Classifying Motor Vehicles
92-2-104091-7	Installing Low Pressure Flexible Hoses
92-2-104092-5	Spanners, Wrenches - Kinds and Sizes (B.E.M.P.)
92-2-104093-3	Using Spanners/Wrenches (E.M.P.)
92-2-104887-X	Using Dial Indicator for External and Internal Measurement(M)
92-2-104094-1	Using Torque Wrench (M)
92-2-104095-X	Removing Low Pressure Flexible Hoses
92-2-104096-8	Low Pressure Flexible Hose in the Motor Vehicle
92-2-104097-6	Engine - Main Parts and Function
92-2-104098-4	Operation of 4-Stroke Petrol Engine
92-2-104099-2	Passenger Car - Opening/Closing Bonnet
92-2-104100X	Identifying Mobile Lifting Devices and Support Stands and Their Uses
92-2-104101-8	Lifting Up Cars Using Mobile Jacks
92-2-104102-6	Identifying Car Lifts and Their Uses

Cylinder Head

92-2-104137-9	Cylinder Head - Petrol Engine
92-2-104138-7	Engine Compression Ratio and Pressure
92-2-104139-5	Valve Operating Mechanism
92-2-104140-9	Valve Timing
92-2-104141-7	Checking Valve Timing
92-2-104142-5	Removing/Installing Valve Covers
92-2-104143-3	Adjusting Valve Clearance
92-2-104144-1	Checking Compression Pressure in the Petrol Engine
92-2-104068-2	Checking Compression Pressure in Diesel Engines
92-2-104145-X	Tightening Cylinder Head Bolts/Nuts
92-2-104850-0	Removing Cylinder Head - Petrol/Diesel Engine

Air Filters

92-2-104044-5	Air Filters - Kinds and Purpose
92-2-104045-3	Removing Car Air Filters
92-2-104046-1	Installing Car Air Filters
92-2-104047-X	Oil Bath Filters
92-2-104048-8	Dry Air Filters
92-2-104049-6	Dry Air Filters - Servicing
92-2-104050-X	Oil Bath Air Filters - Servicing

ISBN No.

Fuel System

92-2-104064-X	Fuel Tank
92-2-104066-6	Identifying Cylinder Head: Diesel Engine
92-2-104067-4	Cleaning/Replacing Diesel Fuel Filter
92-2-104069-0	Bleeding the Diesel Engine Fuel System (Line Pump)
92-2-104070-0	Bleeding the Diesel Engine Fuel System (Distributor Pump)
92-2-104071-2	Removing/Installing Fuel Injectors in Diesel Engines
92-2-104073-9	Fuel Feed Pump - Mechanical Diaphragm Type
92-2-104888-8	Fuel Feed Pump - Plunger Type
92-2-104074-7	Using Venturi Principle for Fuel Carburation
92-2-104077-1	Servicing Fuel Feed Pump - Mechanical Diaphragm Type
92-2-104079-8	Function of the Variable Choke Carburettor - Stromberg
92-2-104080-1	Function of the Constant Depression Carburettor - SU Type
92-2-104081-X	Fuel Sedimenter
92-2-104886-1	Checking Exhaust Emission for HC and CO Content
92-2-104056-9	Identifying Environmental Pollution Caused by Motor Vehicl
92-2-104057-7	Combustion of Petrol in the Engine
92-2-104058-5	Function of the Fixed Choke Carburettor
92-2-104059-3	Identifying the Function of the Diesel Fuel Filter
92-2-104060-7	Removing/Installing Fuel Feed Pump - Mechanical Diaphragm Type
92-2-104062-3	Cleaning the Fuel Tank and Fuel Lines

Ignition System

92-2-104001-1	Ignition System
92-2-104002-X	Spark Plugs
92-2-104003-8	Applying Electro Magnetism Theory to the Ignition System
92-2-104004-6	Ballasted Ignition System
92-2-104005-4	Coil & Condenser
92-2-104006-2	Distributor, Contact Breaker, Dwell Angle
92-2-104007-0	Distributor Cap, Rotor and High Tension Cables
92-2-104008-9	Distributor-Vacuum Advance Mechanism
92-2-104009-7	Distributor-Mechanical Advance Mechanism
92-2-104010-0	Replacing and Selecting Spark Plugs
92-2-104011-9	Cleaning and Gapping Spark Plugs
92-2-104012-7	Analysing Spark Plug Face
92-2-104013-5	Testing Spark Plug with Plug Tester
92-2-104014-3	Removing and Installing Spark Plug
92-2-104015-1	Removing, Cleaning and Installing High Tension Cables, Distributor Cap and Rotor
92-2-104016-X	Checking Coil Polarity
92-2-104017-8	Ignition Timing Using Control Lamp
92-2-104018-6	Ignition Timing Using Stroboscope Lamp
92-2-104019-4	Checking the Ignition System with the Oscilloscope
92-2-104020-8	Simple Method of Locating Faults in the Ignition System
92-2-104021-6	Servicing Contact Breaker Points
92-2-104022-4	Checking High Tension Circuit
92-2-104023-2	Setting Points Gap with a Dwell Angle Tester
92-2-104024-0	Checking Ignition Coil
92-2-104025-9	Checking and Replacing Condenser
92-2-104026-7	Replacing Contact Breaker of the Ignition System
92-2-104027-5	Checking Contact Breaker Arm Tension

ISBN No.	
	Car Electric
92-2-104051-8	Removing Alternator
92-2-104052-6	Dismantling Alternator
92-2-104053-4	Examining Alternator Rotor
92-2-104054-2	Examining Alternator Stator
92-2-104055-0	Examining Alternator Rectifier Assembly
92-2-104848-9	Removing the Starter Motor
92-2-104849-7	Installing the Starter Motor
	Battery
92-2-104082-8	Lead Acid Battery
92-2-104083-6	Cell Action (Lead Acid Type Battery)
92-2-104084-4	Servicing the Battery (Lead Acid Type)
92-2-104085-2	Putting New Battery into Service
92-2-104086-0	Charging Batteries
92-2-104087-9	Fast Charging of Battery
92-2-104088-7	Removing/Installing Car Battery
	Cooling System
92-2-104028-3	Cooling System
92-2-104029-1	Closed Cooling System
92-2-104030-5	Pressurised Cooling System
92-2-104031-3	Radiator
92-2-104032-1	Water Pump
92-2-104033-X	Cooling Fan
92-2-104034-8	Thermostat, Design and Function
92-2-104035-6	Removing/Installing Thermostat
92-2-104036-4	Thermostat Checking
92-2-104037-2	Removing/Installing Radiator
92-2-104038-0	Draining and Re-filling Cooling System
92-2-104039-9	Cleaning Radiator and Flushing Cooling System
92-2-104040-2	Checking Cooling System for Tightness
92-2-104041-0	Checking and Topping Up Coolant Level
92-2-104042-9	Preparation of Coolant
92-2-104043-7	Rectifying Engine Overheating
92-2-104847-0	Removing the Water Pump
92-2-104824-1	V-Belt Construction - Adjusting and Replacing
	Engine Lubrication System and Lubricants
92-2-104103-4	Friction
92-2-104104-2	Hydrodynamic Friction
92-2-104105-0	Oil Pressure Warning Devices
92-2-104106-9	Chassis Lubrication
92-2-104107-7	Checking Oil Pressure
92-2-104108-5	Engine Oils
92-2-104109-3	Engine Oils - SAE Viscosity Classification
92-2-104110-7	Engine Oils - API Classification
92-2-104111-5	Transmission Oil
92-2-104112-3	Lubricating Greases
92-2-104113-1	Replacing/Cleaning Oil Filters
92-2-104114-X	Engine Lubrication System
92-2-104115-8	Changing/Topping Up Engine Oil
92-2-104116-6	Oil Filters
92-2-104117-4	Changing/Topping Up Transmission Oil

ISBN No.	
	Clutch System
92-2-104871-3	Single/Dual Disc Clutch
92-2-104872-1	Removing Clutch Pressure Plate and Disc
92-2-104873-X	Removing the Flywheel
92-2-104874-8	Installing the Flywheel
92-2-104875-6	Checking the Clutch Disc
92-2-104876-4	Re-lining the Clutch Disc
92-2-104877-2	Checking the Flywheel
92-2-104878-0	Balancing the Flywheel
92-2-104879-9	Removing the Ring Gear
92-2-104880-2	Installing the Ring Gear
92-2-104881-0	Installing the Clutch
92-2-104882-9	Checking and Adjusting Clutch Free Travel
92-2-104883-7	Checking the Fluid Level in the Hydraulically Operated Clutch System
92-2-104884-5	Bleeding the Hydraulically Operated Clutch System
	Power Train
92-2-104868-3	Repairing Cross and Roller Universal Joint (Circlip Type)
92-2-104869-1	Checking Propeller Shaft/Universal Joint
92-2-104859-4	Differential
	Brake System
92-2-104118-2	Removing and Fitting Wheels
92-2-104120-4	Disc Brakes - Replacing Brake Pads on Fixed Caliper Types
92-2-104121-2	Disc Brakes - Replacing Brake Pads on Sliding Caliper of Single Piston Type
92-2-104122-0	Adjusting Parking Brakes
92-2-104123-9	Identifying Drum Brakes and Their Function
92-2-104124-7	Identifying Function of Disc Brakes
92-2-104125-5	Identifying Parking Brakes
92-2-104126-3	Topping Up Brake Fluid
92-2-104127-1	Brake Fluid
92-2-104128-X	Removing/Installing Brake Drums
92-2-104129-8	Adjusting Drum Brakes
92-2-104130-1	Adjusting Wheel Bearings
92-2-104131-X	Changing Brake Fluid in the Hydraulic Brake System
92-2-104132-8	Bleeding Hydraulic Brake System
92-2-104133-6	Inspecting/Cleaning Brake Shoes
92-2-104134-4	Identifying Disc Brakes of Fixed Caliper Type
92-2-104135-2	Identifying Disc Brakes with Sliding Caliper Assembly
92-2-104136-0	Brake System Layout
	Tyres
92-2-104146-8	Identifying Tyre Types and Their Construction
92-2-104147-6	Identifying Tyres - Tube and Tubeless
92-2-104148-4	Why Wheel Balancing is Essential
92-2-104149-2	Checking Static Wheel Balance
92-2-104150-6	Dynamic Wheel Balancing
92-2-104151-4	Identifying Tyre Tread for Various Purposes
92-2-104152-2	Inspecting Tyres
92-2-104153-0	Aquaplaning
92-2-104154-9	Identifying Tyre Size, Maximum Tyre Load and Speed Index Letter
92-2-104823-3	Checking Tyre Inflation Pressure
92-2-104822-5	Tyre Life
92-2-104860-8	Removing/Fitting Car Tyres
92-2-104166	Repairing Tubes

ISBN No.

Motor Vehicle Driver Training

92-2-104155-7	Motor Vehicle Driver Training - Vehicle Knowledge
92-2-104156-5	Washing Vehicle Body by Hand
92-2-104157-3	Cleaning the Underneath of the Motor Vehicle
92-2-104158-1	Waxing Vehicle Body Paint
92-2-104159-X	Polishing Vehicle Body Paint
92-2-104160-3	Cleaning Car Interior
92-2-104161-1	Cleaning Engine Compartment
92-2-104162-X	Loading Goods On Vehicle
92-2-104163-8	How to Avoid Brake Failure
92-2-104164-6	Economical Driving
92-2-104165-4	Parking a Vehicle
92-2-104167-0	Replacing Bulbs
92-2-104168-9	Replacing Vehicle Fuses
92-2-104169-7	Towing a Vehicle
92-2-104170-0	Braking Distance
92-2-104171-9	Gearbox, Clutch and Their Operation
92-2-104172-7	Anchoring a Load
92-2-104829-2	Starting the Engine
92-2-104851-9	Running in the Motor Vehicle
92-2-104853-5	Stopping the Engine
92-2-104858-6	Motor Vehicle Daily Inspection

2. A & AM Section - Recruitment & Training Chart (see following page)

Notes:

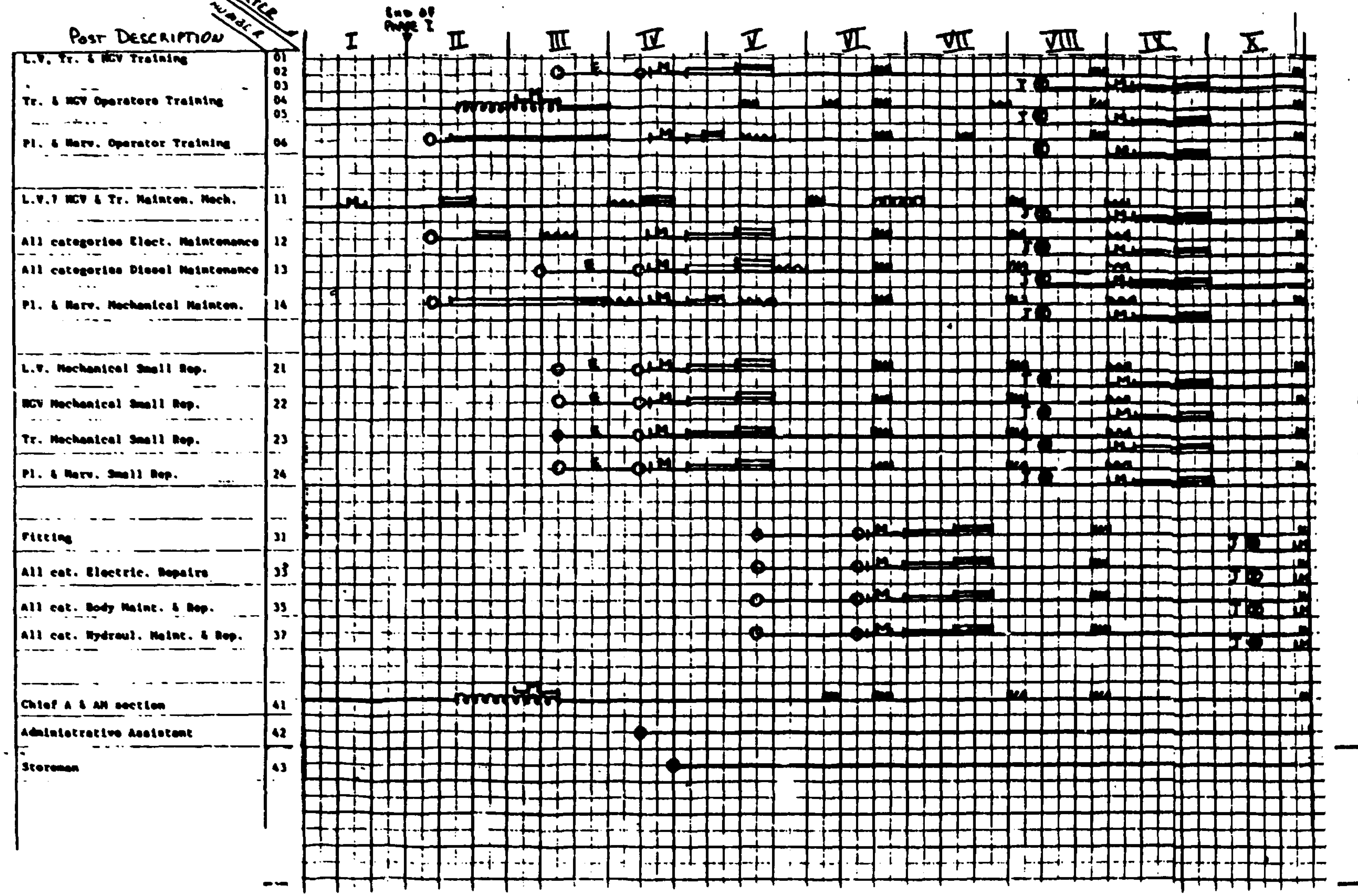
a. The first big drive of instructor recruitment should not take place before the chief of the A & AMS is nominated and has returned from fellowship.

b. From this plan it can be seen that no training of mill personnel can start on any scale before the end of the instructor training and practice period (Mid VIth quarter).

c. After 2 successful courses run at NSTC, part time instructors can start being brought to participate in Methodology and Technical Upgrading Courses of duration variable from 1 + 1 week to 3 + 3 weeks depending on complexity of field prior to returning to their respective mills.
This is likely to take place towards the end of the VIIth quarter, beginning VIII quarter.

d. At the same time as "c" above, beginning VIIIth quarter, more instructors (junior) can be recruited. These can participate with the part time instructors during their training. Further training of the junior NSTC instructors will take place later (6 months), after some practice and validation of their suitability to continue.

2 — AlAM Section – Recruitment & Training Chart



2. Recruitment and Training Chart

KEY TO ABBREVIATIONS

L.V.	= Light Vehicles (Cars - Pick up - Minib
HGV	= Heavy Goods Vehicles (Trucks - Busses)
Tr	= Tractors (with tyres)
Pl	= Plant (CAT - Graders - Ditchers etc.)
Harv.	= Harvesters
B	= Basic
I	= Intermediate
A	= Advanced
E	= English Language training
	= Recruitment
	= Work
	= Training in Sudan
	= Training abroad
	= Training material preparation
	= Practice
	= Visits to mills
M	= Methodology for instructors

NOTE :

1. If English language standard is insufficient candidates have to bring it up to standard first.
2. Junior instructors marked ⊗ recruit to reach the wanted capacity of MSTC
3. It is not expected the new buildings will be ready and usable before mid VII quarter, therefore some instruct recruitment has to be delayed.

AUTO AND AGRI SECTION

INSTRUCTOR RECRUITMENT ALLOCATION AND TRAINING

Post No	Field	Date in	Training Programme	Date 80% operational
01 - 03	L.V., Trucks & Tractor Driver Training	Aug/Sept. 89	Recruit a tractor or truck driver with good standard of education - Needs English - Course in Methodology - Course by Massey F. & John Deere in Sudan - Developing & preparation training materials	April 90
04 - 05	Tractors & HGV Operator Training	Oct. 88	Awad - Introduction to Modular Trg - Nov. 88 - Sennar - Training methodology for instructors - June July 89 - EU - Tractor driving operation & maintenance - Aug. Sept. 89 - UK (M.F.) - Developing and preparing training material - 2 mth	Jan. 90
06	Plant Operation	A.S.A.P.	Recruit a technical college leaver ASAP - Put him as operator assistant for one month on each type of operation - (Ditching - plow - harrow etc.) - 6 mth. - Operator course with SUTRAC - on the job - 1 month - Self study course harvesters - Sennar - 1 month - Training Methodology for Instructors - Sennar - 1 1/2 month - Developing & preparing training material - 2 1/2 mth.	Feb. 90

Post No	Field	Date in	Training Programme	Date 80% operationa
11	L.V.; HGV & Tr. Mechanical Maintenance	Oct. 88	El Tayeb - Introduction to Modular Training Nov. 88 - Training Methodology Feb. 89 Subject to confirmation by Mr. Clanton & Bye. - Self study with available documents in Sennar - Short courses at agents in Sudan - Further training subject to performance	April 89 ?
12	All categories	A.S.A.P.	Technical Institute - Electrician preferably auto electrician A* B* C* E*	Feb/March
13	All categories Diesel maint.	Aug/Sept. 89	Technician with Diesel experience A* B* C* D* One month at Sutrac in diesel departement	April 90
14	Plant & Harvesters Mechanical Maintenance	A.S.A.P	Young technician - maybe from Massaad A* D* Three months at Sutrac in Maintenance Department.	April 90

* Key to letters on Sheet 5

Post No	Field	Date in	Training Programme	Date 80% operational
21	L.V. Mechanical Small Repairs	Aug. 89	Young technician from Auto background A* B* C* D* E*	April 90
22	HGV Mechanical Small Repairs	Aug. 89	Young technician from Auto background A* B* C* D* E*	April 90
23	Tr. Mechanical Small Repairs	Aug. 89	Young technician from Auto background A* B* C* D* E*	April 90
24	Pl & Harv. Mech. Small Repairs	Aug. 89	Recruit someone with already some experience in repair of this type of machine, maybe from the W/S A* B* C* E* Courses at Sutrac, Komatsu 7 the other agents	June 90

* Key to letters on Sheet 5

Sheet 4
Others

Post No	Field	Date in	Training Programme	Date 80% operational
31	Fitting			
33	Electrical		Specifications of these people should be defined	
35	Body Repair	Feb. 90	by the expert in Phase II.	
37	Hydraulics			
41	Chief A&AM section	Ad Interim since Aug. 88	Mechanical Engineer - Intro to Modular training Nov. 88 - Fellowship abroad on Training Methodology for Vocational Trade Instructors - Course on MF Tractors & others - M.F. England - Management of Vocational Training Centers.	July 89
42	Admin. Assist.	End 89	Administrative background - typing - English	
43	Storeman	End 89	Stores training - English	

Sheet 5
Key

A. Training Methodology for Vocational Trade Instructors
Approx. 6 weeks course in Sennar — 1 1/2 mth

B. Preparation or adaptation of training material for future courses. Including going through all training materials and manuals in Sennar, NSTC relevant to instructor's field — 2 mths

C. Practice, organizing all that is needed for the course and going through it alone first and then with 3 trainees.

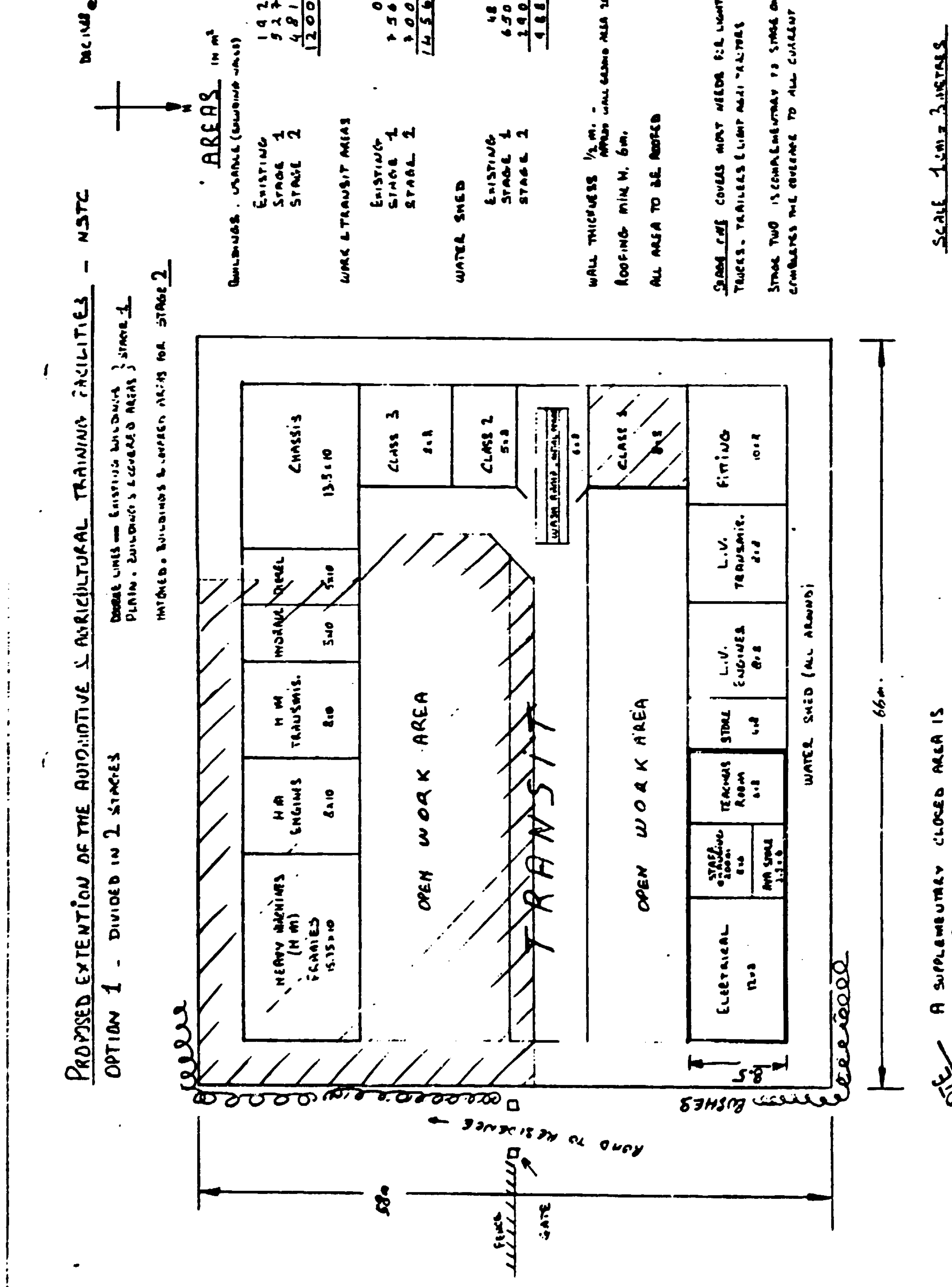
D. Short courses at the available representatives of the machines in question in Sudan - 1 week each

E. English language training if standard insufficient.

Annex XII

Workshop Plan

An Idea in Two Versions

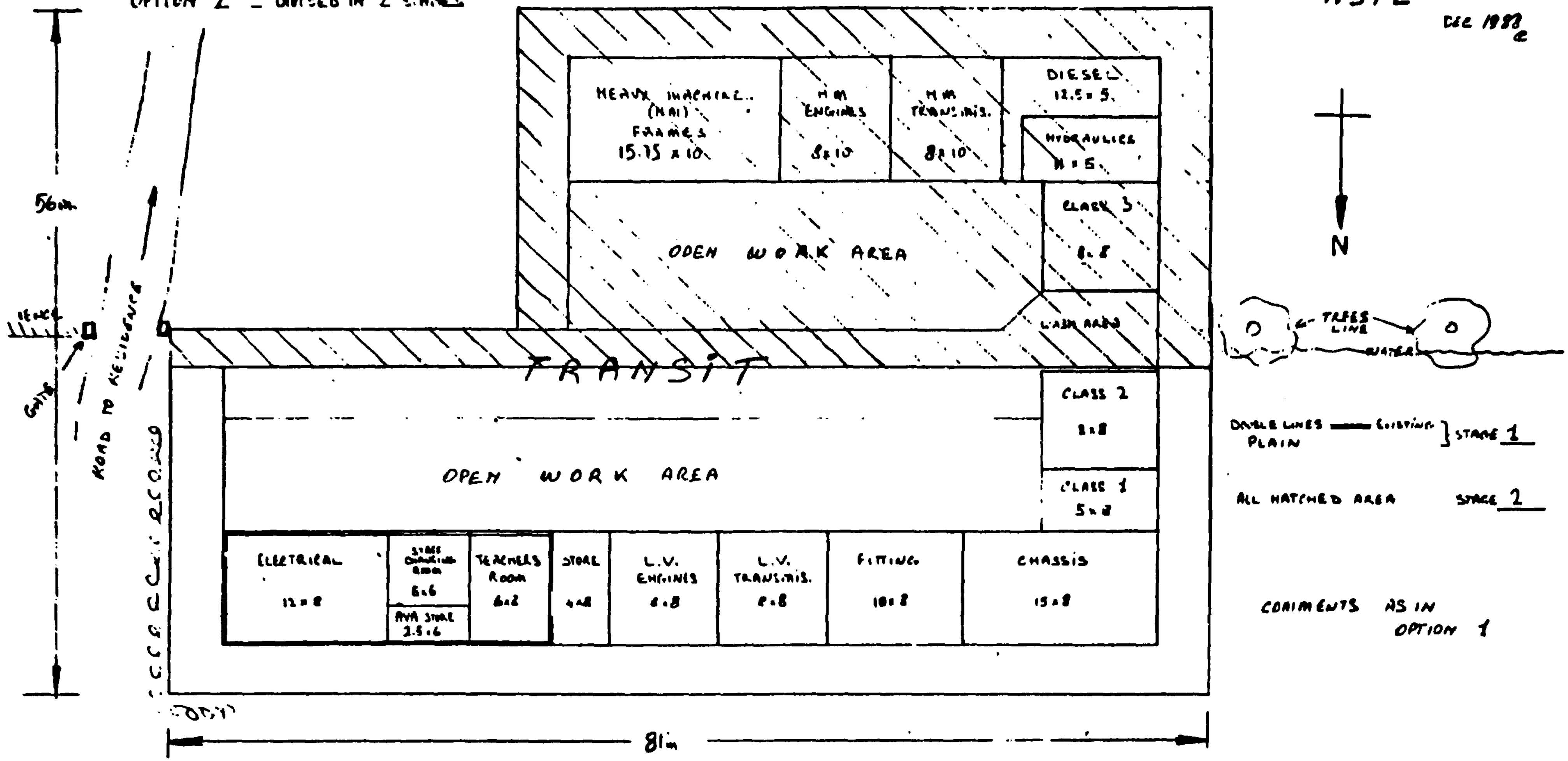


PROPOSED EXTENTION OF THE AUTOMOTIVE & AGRICULTURAL EQUIPMENT TRAINING FACILITIES

NSTC

DEC 1982

OPTION 2 – DIVIDED IN 2 STAGES



NOTE: A SUPPLEMENTARY CLOSED AREA OF 2 x (6x9) IS NEEDED FOR THE BODY WORK SHOP

SCALE 1cm = 3 METRES

Annex XIII

List of automotive vehicles and agricultural machines in the four mills.

In spite of only one sugar mill (Assalaya) having completed and returned the questionnaires sent out, a general picture has been completed by collecting more information personally, during visits to the mills and the suppliers. This took longer than planned and it is not guaranteed that every machine is listed.

Having excluded single machines and machines about to be phased out, the picture is still dauntingly large. Counting machine types which are substantially similar, as being one, the figure reached is still of 70 basically quite different machines.

From a training point of view one could further reduce the number to about 50, but this still leaves a very large volume of work to be handled.

For each machine type one has to cover all the system including manuals, spares, special tools. Instructors have to be fully trained before they can teach.

Machines marked with an asterisk (*) are suggested as priority machines to concentrate upon during the initial period of phase II.
The suggested total is of 14 machines.

Category A. Light tyred agricultural tractors

Make	Model	12 Types (4*)
1. Massey Fergusson	290 *	
	390 *	
	265	
2. John Deere	2030	
	4240 *	
	4250 *	
3. Ford	6000	
4. I.M.T. (Yugoslavia)	5100	
	577	
5. ISIKI	9000	
6. CASE	1070	
7. International	1255	

Category B. Trailers

7 Types

1. Blumhart	cane - mobile w/s - general purpose
2. Macke	seed cane
3. Yassin	water tanker - seed cane
4. Massey Fergusson	seed cane
5. Bonger	seed cane
6. Tong	seed cane
7. Gueid	seed cane

Category C. Heavy Plant

20 different types (6*0

1. Caterpillar	
Track laying tractors	D8L - D8K(*) - D7F - D7G - D6C - D6D(*) - D5B - D4E
Graders	12G(*) - 112F - 120G
Wheeled loader	920
Other	- Grabloader D4D - Road roller Cat Hatz CB-22X
2. J.C.B.	
Wheeled loader	
3. CAMECO	
Grab loader	SP 1800 - SP 2200 (*) 235B - 405B - 115B
4. TOFT	
Harvester	7000 (*)
5. MULLER	
Tractor	
6. Various cranes	Grove - Coles - Jones
7. KLAAS	
Harvesters	(*)

Many assorted implements and other single machines.

At the time of writing news arrived that 2 new CASE track laying front loaders were delivered to New Halfa and that some new KOMATSU machines will be shortly delivered to Sennar. (Details not available)

Category D. Trucks

		13 Types (2*)
Bedford	1 Type (*)	
Morris	2	
Austin	2	
Nissan	2 Type (*)	
Daf	1	
Mitsubishi	2	
Steyr	1	
Praga	1	
Isutzu	1	

Category E. Light vehicles

		18 Types 2(*)
Nissan	Minibus Petrol and diesel - pick up - Cedric - Patrol	
Toyota	Land Cruiser Petrol and diesel (*) - Corona - Corolla - Hy Lux (*) - Hiace - - Cresida	
Peugeot	504	
Mitsubishi	- Galant - Pick up - Minibus	
Mercedes	200	
Suzuki	210	

Annex XIV

Briefing in Vienna - 14-17th November 1988

Besides the routine meetings with the administrative officers, meetings of technical relevance were held with:

- Mr. W. Kamel and his assistant Mr. G. Anestis of the department of industrial operations. During these meetings the 9 week Tentative Work Plan was re-written into a 14 week Tentative Work Plan. Also discussions took place on communication problems with the project and on implementation suggestions from Headquarters.

- Mr. Karamanouglou, from the training department filled in the background history of the project since its conception with great competence.

- Mrs. Lorenzo, Chief of the training departement, gave a brief rundown on the possible backing available from her department.

- A meeting with all the above plus Mrs. Jette-Jensen summarized the general situation and pointed outs ome of the objectives of the DDG's, Mr. Wiesebach, proposed visit to Khartoum.

Annex XV

COUNTRY - SUDAN

PROJECT - SI. D/86/003

SECTION - AUTOMOTIVE AND AGRICULTURAL MACHINES

LIST OF TOOLS AND EQUIPMENT FOR PHASE II

Unfinished Caterpillar Special Tools List

ELECTRICAL SUPPLY - Volts Single 230/Three phase frequency 50 Hz.

Progressive N° Line	ILO EPG N°	Description	Quant.	Observations
1	9S3265	Retaining Compound	6	
2	7M7456	Bearing Mount	3	
3	5P3413	Pipe Sealant	6	
4	9S3263	Thread Lock	10	
5	2P2506	Thread Lubricant	4	
6	2S3230	Bearing Lubricant	5	
7	5P0960	Molybdenum Grease	10	
8	5P3975	Rubber Lubricant	4	
9	5P3931	Anti Seize Compound	5	
	6V2055	High Vacuum Grease	3	
11	3S6252	RTV Silicone Adhesive	5	STD
12	5P3321	Fast Cure Epoxy Mixercups	10	
13	2P2333	Manifold Sealer	2	
14	5H2471	Cement	15	
15	7M7260	Liquid Gasket	15	
16	6V3025	Battery cable repair kit	1	
17	8K4644	Fuse 1 Amp.	30	
18	9G3782	Fuse 3 Amp.	50	
19	2S6024	Fuse 5 Amp.	100	
20	3K8781	Fuse 7.5 Amp.	50	

Project - SF/SUD/86/003
Section - Auto and Agri Machines
Volts 230 - 280 - 50 Hz.

Proges. no. Line	ILO I.P.G. No	Description	Quantity	Observations
21	3K8782	Fuse 10 Amp.	100	
22	8M8948	Fuse 15 Amp.	100	
23	8M0456	Fuse 20 Amp.	50	
24	8M8947	Fuse 30 Amp.	30	
25	5L5069	In line fuse holders	50	
26	5P7277	Voltage tester	2	
[illegible]	1P1790	Spark plug firing indicator	2	
28	3P2044	Cooling system conditioner	100	
29	6V4511	Cooling system cleaner	20	
30	8T0450	Thread Measurement Kit	1	
31	9S3135	Seal Kit (O.R.)	5	x T-3
32	5P8433	Seal Kit (Rectangular Seal)	5	x T-5 & 6
33	6V4900	Hydr. Hose Assembly press	1	
34	6V4974	Stand for 33 above	1	
35	6F7032	Bolts	4	
36	1D4717	Nuts	12	
37	0S0509	Bolts	14	
38	6V4860	XT-5 Tool group	1	
39	6V6015	Hose cutting machine	1	
40	6V6016	16" Abrasive Cutting wheel	2	spare
41	6V4890	Hydraulic pump	1	230V-50C
42	6V4988	Chain wrench	2	
43	6V7939	Tape maker	2	
44	2P8250	Filter strap wrench	2	
45	5P7255	Flare nut wrench	4	13/32 + 15/32
46	5P7255	Flare nut wrench	4	17/32 + 19/32
47	5P725	Flare nut wrench	4	25/32 + 29/32

Project - SF/SUD/86/003
Section - Auto and Agri Machines
Volts 230 - 280 - 50 Hz.

Progres. No. Line	ILO E.P.G.nc	Description	Quantity	Observations
48	9S9100	Sling assembly	1	
49	6V7905	Filter cutter tool	1	
50	5P4811	Cutting wheel	2	
51	8N2694	Aircleaner service indica'	2	
52	1W0613	Aircleaner service indicator	2	
53	5S1212	Aircleaner service indicator	2	
	7S0637	Aircleaner service indicator	2	
55	8T0470	Thermo group Termister	1	Eng T
56	5P7361	Pump pressurizing	1	
57	5P1763	Socket (for rod plug)	1	
58	9S8096	Sleeve Seal installer	1	
59	6V6035	Hardness tester	1	
60	5F8665	Cyl. liner pulling tool	1	
61	1P2391	Adapter for 60 above		
62	1P5580	Brush group	3	
63	4H0446	Driver (D324)	1	
64	7S8859	Driver (3304 - 3306)	1	
65	5P1727	Bushings (D342)	1	
66	7S8858	Bushings (3304 - 33060	1	
67	7F4292	Compressor Group	1	
68	6V4805	Tool group - valve seat extractor	1	
69	2A5118	Wrench (Cyl. head retain nut)	1	
70	1P2305	Electrical Terminal Assort.	3	
71	2L8058	Ring Terminal	5	
72	2L8066	Ring Terminal	5	
73	2L8067	Ring Terminal	5	
74	2L8069	Ring Terminal	3	

Project - SF/SUD/86/003
Section - Auto and Agri Machines

Volts 230 - 280 - 50 Hz.

Progre No. Line	ILO E.P.G. no	Description	Quantity	Observations
75	2L8071	Ring Terminal	3	
76	2L8075	Ring Terminal	6	
77	2L8076	Ring Terminal	6	
78	5P4571	Blade terminal	10	
79	2S1043	Butt splice	5	
80	4S1988	Blade Terminal	5	
	8S4626	Butt splices	3	
82	6V3000	Sure Seal Electr. Connect. Kit	2	
83	8T0900	Ammeter AC/DC - clamp on	1	
84	6V7070	Multi meter digital	1	
85	6V6014	Cables	1	
86	9S1743	Wrench (inf. lines)	3	
87	5P6229	Extractor (nozzle)	1	
88	6V6980	jPuller group (nozzle)	1	
89	8S0225	Wrench (precomb. chamber)	1	
90	5FS353	Wrench (precomb. chamber)	1	
91	8S2264	Puller Group	1	
92	8S8375	Sleeve	1	
93	1V5481	Gauge Group (pressure)	1	
94	1V5482	Adapter Group (pressure)	1	
95	6V4072	Wrench spanner	1	
96	6V4071	Wrench spanner	1	
97	6V4074	Wrench spanner	1	
98	6V4070	Wrench spanner	1	
99	6V9061	Pump	1	
100	9S8901	Cylinder	1	

Project - SF/SUD/86/003
Section - Auto and Agri Machines
Volts 230 - 280 - 50 Hz.

Progres. no. Line	ILO E.P.G. no	Description	Quantity	Observations
101	8S7172	Cylinder	1	
102	6V7333	Copper Seal	10	
103	6V7332	Copper Seal	10	
104	6V7331	Copper Seal	15	
105	6V7330	Copper Seal	15	
106	6V7329	Copper Seal	10	
107	6V7328	Copper Seal	5	
108	6V7377	Copper Seal	5	
109	5J1583	Metal backed seals	15	
110	6J3575	Metal backed seals	20	
111	6J3600	Metal backed seals	20	
112	6J3625	Metal backed seals	15	
113	6J3650	Metal backed seals	10	
114	6J3800	Metal backed seals	10	

REPORT ON ELECTRICAL AND INSTRUMENTATION ENGINEERING by Bernt Jan-Olof Bergland

16 January 1989

ACKNOWLEDGEMENTS

The expert would like to express his appreciation for the excellent co-operation and support as received from his counterpart Mr. Mudawi Elsadig Mudawi, Head of Electrical and Instrumentation Engineering Department at Sennar Sugar Training Center, SSTC.

The expert would like to express his appreciation for the excellent co-operation and support, for the open friendly attitude, for an excellent personally manner as received from the Director of the Sennar Sugar Training Center, Mr. El Fadlabi.

The expert would like to express his appreciation for the excellent co-operation and support,for the open friendly relationship between the expert and the Chairman of SPIC, Mr. Badr El Din Habbani and Mohammed Ahmed Hassan, Ex-General Manager, Guneid Sugar Factory and Deputy Chairman of SPIC.

The expert would like to express his appreciation for the excellent co-operation and support, for the open and friendly relationship between the expert and respective Heads of Departments and Instructors:
Mr. Mahgoub Widatalla, Mr. Amin Yousif Mohamed Alloub, Mr. Abdelwahid Mohammed Farak, Mr. Osman El Thair, Mr. Elsteb El Hassan El Shaer, Mr. Awad Mohamed Sitngag, Mr. Ibrahim Mohamed Abdo.

The expert would like to express his sincere appreciation to Mr. Jack Bye, Chief Techical Adviser of project SF/SUD/86/003, for the excellent co-operation, open and friendly attitude, support and co-operation as received during the mission.

<u>A joint programme in Sudan under Sudan Sugar Rehabilitation Project between SPIC and UNIDO</u>

<u>Project Title</u>	:	Training component of the Sudan Sugar Rehabilitation Project (Credit 1506 SU).
<u>Project Number</u>	:	SF/SUD/86/003.
<u>To</u>	:	Mr. Jack Bye Chief Technical Adviser UNIDO Project: SF/SUD/86/003 Sennar, Sudan.
<u>From</u>	:	Bernt Jan-Olof Berglund Electrical and Instrumentation Engineering Training Expert UNIDO Project: SF/SUD/86/003 Sennar, Sudan.
<u>Subject</u>	:	FINAL REPORT.
<u>Post Title</u>	:	11-51, Electrical and Instrumentation Engineering Training Expert.
<u>Reporting Period</u>	:	14th November, 1988 TO 13th January, 1989.

INTRODUCTION

The Government of Sudan represented by the Sugar Project Implementation Committee (SPIC) in the Ministry of Industry requested assistance within the objectives of the project document in the field of planning and executing the training programmes to the Sennar Training Centre (SSTC).

United Nations Industrial Development Organization (UNIDO) in Vienna appointed on the 14th of November 1988 the Expert for the Post No. 11-51 to be attached to the international team within SPIC for a period of two months.

The Expert commenced his duties on the arrival to Sudan on the 18th of November 1988.

2. Terms of reference — JOB DESCRIPTION SF/SUD/86/003/11-51-Rev.2

Post Title	:	Electrical & Instrumentation Engineering Training Expert
Duration	:	Two months in phase (1)
Date Required	:	As soon as possible
Duty Station	:	Sugar Training Centre (STC), Sennar, Sudan with travel to other Sugar Estates.
Responsible to:	:	UNIDO Chief Technical Adviser

2.1 Duties

(a) To assist in planning and executing the training programmes to be run by the Electrical and Instrumentation Engineering Department of the Sennar Sugar Training Centre.

(b) To coordinate with the work of the other (international experts and counterparts), design and review, in accordance with the needs, an approach strategy methods and techniques for developing the various programmes within his specialized field.

(c) To train the counterparts that need training within his field.

(d) To undertake such other work as may be required by UNIDO/CTA in the initial design and development of the electrical and instrument engineering department of the STC.

(e) Prepare progress reports and a final technical report at the end of the assignment(s).

3. BACKGROUND INFORMATION

The former public Sector of the Sugar Industry in Sudan consists of factories and sugar cane estates with a joint rated output of 374,000 tons per annum.

The industry is currently being developed under a World Bank Rehabilitation Scheme.

UNIDO has the responsibility for assisting with the development of needed training facilities on behalf of the Sudan Government to support the Rehabilitation Programme.

The Sugar Training Centre (STC) has recently been incorporated to be responsible for the development of a comprehensive training service for the Sudan Sugar industry.

It is a strategy formulating body responsible to the Sugar Project Implementation Committee (SPIC) representing the Government of Sudan and the Sugar Industry. Management of the Centre is the responsibility of the Sudanese National Director who reports to SPIC.

A detailed assessment and analysis of training needs has been made by UNIDO. International funding for the project has been agreed to as part of the overall Sudan Sugar Rehabilitation Programme.

Funding is under the control of the World Bank and includes substantial contributions from other sources such as the Arab Fund.

As the climatic and natural conditions are favorable for extending its Sugar Industry, the Sudan is aiming at becoming selfsufficient for internal consumption of sugar.

Later it intends to become an exporter of sugar, particularly to the oilproducing Arab countries. Therefore in its Development Plan priority has been given to the development of this sector. The essential characteristics of the STC programme will be:

3.1 (a) A training of trainers programme for:

- training officers
- technical trainers/instructors (full-time)
- instructors (part-time)

3.2 A programme for engineers, senior technicians and supervisory personnel.

3.3 Practical training programme for vocational personnel and operators.

4. TENTATIVE WORKPLAN

4.1 Briefing in Vienna

During the 3 1/2 days spent in UNIDO Headquarters in Vienna (14-17 November inclusive) a tentative workplan was prepared (Annex I). This workplan proved to be a satisfactory guide for the activities undertaken at the Sugar Training Centre, Sennar. All items planned were addressed during the mission.

4.2 The Expert was briefed by the following members of UNIDO, Headquarters staff:

Ms. Petroff	
Ms. G. Kimberger	Project Personnel Recruitment
Ms. T. Svoboda	Technical Co-operation Personnel Administration
Ms. H. Zeilmayer	Adminstrative Assistans
Mr. G. Anestis	Substantive Officer Department of Industrial Operations
Mr. W. Kamel	Chief, Integrated Industrial Projects
Mr. A. Karamonoglou	Industrial Development Officer
Ms. I. Lorenzo	Chief, Industrial Training
Ms. J. Jensen	
Ms. Kummar	

The briefing was well planned and carried out in a highly professional manner.

5. TRAVEL TO DUTY STATION

5.1 The Expert left Vienna for Khartoum on 17th November 1988 as scheduled and arrived at 03.30 hrs on the 18th November 1988 at the end of an uneventful journey.

It appears that Mr. Ismail Mohammed, UNDP Programme Officer assigned to the Project was waiting at the Airport but failed to identify himself resulting in the Expert travelling to the arranged Hotel by taxi.

5.2 The Expert was picked up at the Hotel on the morning of the 18th November to attend briefing discussions at the UNDP Office in Khartoum. Items discussed included financial arrangements, various necessary permits and visas etc.

5.3 On the 19th November the Expert visited the headquarters of the Sugar Project Implementation Commmittee (SPIC) to begin the process for obtaining a Government Travel Permit.
The visit also included a brief introduction to the Chairman of SPIC Mr. Badr El Din Habbani who offered a few words of welcome before directing the Expert to meet his Deputy Mr. Mohammed Ahmed Hassan who provided a very comprehensive description of the Project, the activities of SPIC and the Sudanese Sugar Industry.

5.4 The Travel Permit was obtained on 20th November when the Director of the Sugar Training Centre, Sennar Mr. Mohammed Ali Mohammed Osman (Fadlabi) arrived at the hotel to transport the Expert to Sennar by car. The journey is approximately 350 km and took about 3 1/2 hours.

6. THE NATIONAL SUGAR TRAINING CENTRE, SENNAR

6.1 On the 21st Nov. the Expert was taken on a brief tour of the Training Centre to assist in providing an overall appreciation of the tasks ahead.

6.2 The Expert was then introduced to the Training Staff and Administrative Staff of the Centre.

6.3 The Expert was then invited to "Sit-in" on a teaching session presented by the CTA Mr. J. Bye. The session was part of a Staff Development Training Programme titled: The introduction to a Modular System of Training to be Developed at the National Sugar Training Centre, Sennar.

The Programme Plan is enclosed as (Annex III).

6.4 The Expert was then required to continue the supervision of the Programme since the CTA had to leave later in the day to prepare for the high level UNIDO Mission to Khartoum led by Mr. H. Wiesebach, Deputy Director General.

6.5 The expert continued to run the programme along with the Transport and Agricultural Machniery Expert Mr. E. Pauli until the CTA returned on the 28th Nov. as the programme was closing.

6.6 The programme was concluded with a review session on 30th Nov. and Diplomas were presented on 1st December 1988.

7. THE STAFF DEVELOPMENT PROGRAMME

7.1 It was possible to follow the original plan and timetable with only a very slight variation in timing.

7.2 The overall continuity of the programme was maintained.

7.3 The presentation of work (lesson plans comprising a Modular Unit following an analysis) was of a high standard throughout particulary considering that it was prepared and presented in English.

7.4 The final evaluation and validation of the Modular Training Material produced is still being carried out at the training Centre and a formal programme Report will be prepared by the CTA when all the activities have been completed.

8. THE INSTRUMENT WORKSHOP

8.1 Comments about workshop, space and facilities:-

8.1.1 The workshop has got all windows painted to decrease the involvement of sun-shine into the workshop itself.

8.1.2 The result is a space with too much light reduction which can not be compensated with the existing flourescent tubes in the roof.

The distance from the floor to the flourescent tubes in the roof is ca.10 meters and the rate of luxdeduction is high.

8.1.3 The space of the existing workshop is too narrow.CTA suggested Mr. Mohammed Ali Mohammed Osman (El Fadlabi) to involve workers to push a hole in the wall to the next room, to be able to increase the space, until the new Building programme is ready for use.

8.1.4 The workshop contains one steel cabinet and locally produced wood cabinets, some of them with drawers and connections for compressed air supply.

8.1.5 Studying places (benches) for (8) trainees is available.

The overall dimensions of the workshop are only (4 x 8 meters).

8.2 Comments about Equipment in workshop:

8.2.1 USEFULLNESS: The equipment does still have a very good function and is usefull in comming education programmes wihtin SSTC.

8.2.2 SHORTAGES: Different kinds of Tools.
A whole range of tools and equipment such as pliers, wire, stripping tools, soldering equipment, instrument spanners and screwdrivers small filer and many special tools for specific instruments.

8.2.3 Necessary immediate additions: Combined testequipment for:

- in and output of different pressure ranges.
- in and output of different current ranges.

9. A TRAINING PROGRAMME IN BASIC MAINTENANCE OF INSTRUMENTS

9.1 A training programme was conducted from 10th Dec. 1988 to 8th January 1989. The programme plan prepared by the Head of Electrical and Instrumental Development is attached as (Annex IV).

9.2.1 The participants showed a great deal of interest and self motivation which resulted in excellent all round results.

9.2.2 Because of some slight difficulties in the understanding of English some of the teaching and instructing was carried out in Arabic.

9.2.3 The group consisted of (3) Engineers
(1) Technician and
(3) Laboures
Two other participants left the programme in mid-stream.

9.3.1 Certain initial problems with availability of suitable equipment were encountered. In particular it was difficult to obtain a Reference Pressure Gauge to establish calibration procedures.

9.3.2 Special batteries were missing (and are not available in the local market) for the Thermo Compensator and Avo Meters.

9.3.3 There are no solding facilities in the workshop which is a major deficiency in an instrumentation teaching workshop.

9.4 Outputs from the Training Programme:

Having completed the work schedule all the trainees were able to calibrate.

9.4.1 Vacuum gauges.

9.4.2 Pressure gauges.

9.4.3 Temperature gauges.

9.4.4 Different types of transmitters.

9.4.5 Different types of pneumatic controllers.

9.4.6 Ph-measuring equipment.

9.4.7 Electronic temperature recorders.

9.4.8 Pneumatic controllers by stripping a unit, replacing defective parts and re- assembling.

9.4.9 Magnetic flow meters.

9.4.10 Pneumatic valves.

9.5 Two weeks of the training activity took place in the Sennar Sugar Mill instrument workshop.

10. VISITS TO SUGAR MILLS (SENNAR, GUNAID, ASSALYA)

10.1 In all cases the Expert was able to observe control systems with broken measuring and/or indicating devices.The most severely damaged or often completely destroyed devices being electronic recorders.Needless to say, a most unsatisfactory, dangerous and un-economic method production processing of any kind.

10.2 Many expensive items of control equipment had the apperance of being vandalised.

10.3 The instrument workshop in each Sugar Mill were devoid of test and calibration equipment, most items on display being broken gauges.

11. VISIT TO KENANA TRAINING CENTRE

11.1 Awell appointed but unused show-piece intended to impress visitors but not train the Sugar Mill personell.There was very little evidence of any activities concerned with training.

12. FUTURE DEVELOPMENTS

12.1 Equipment in the workshop

Pressure Gauges	12 Pcs.
Vacuum Gauges	2 Pcs.
(Reference Gauges (Spirax Sarco)	1 Pc.
Pneumatic Controllers	2 Pcs.
Pneumatic Transmitter	1 Pc.
Temperature Transmitter	1 Pc.
Pressure Transmitter	1 Pc.
Differential Pressure Transmitter	1 Pc.
Computing Relay	1 Pc.
Flow Integrator	1 Pc.
Honeywell Temperature Recorder	1 Pc.
Ultrasonic Oscillator	1 Pc.
Resistance Bulb	1 Pc.
Pressure Regulators	5 Pcs.
Electrod Assembly	1 Pc.
Square Rooth Extractor	1 Pc.
Temperature Gauges	4 Pcs.
Foxboro Valve	1 Pc.
Ded Weight Tester (Incl. Equipment)	1 Pc.
Ph-Measuring Equipment	1 Pc.
Thermo Compensator	1Pc.

12.2 Additional equipment, tools etc. required to cover the envisaged training programmes is included as (Annex V).

12.3 Fellowship Training Programmes are recommended as (Annex VI).

13. ANTICIPATED IMPACT OF TRAINING

13.1 The training need is most evident for both the Instrument Technicians and the Process Workers.(It is worth noting that the damage to the instrument panels is the result of abuse by Process Workers.)

13.2 The most important impact of appropriate training would be a more cost effective operation of the plant together with making a significant contribution to the safety of the operators and the plant.

13.3 A further factor would be to induce respect for the instruments during application and use, maintenance and storage.

13.4 To accomplish the task of putting all the production plant at the four National Sugar Mills back under control would require an investment in the region of 250,000 US-dollars to cover the purchase of new instruments, spares and replacement stand-by units together with suitable training for the Technicians involved.

Such a cost is unavailable but is also absolutely essential.

14. TECHNICAL INSPECTION I

14.1 The space, equipment and instrumentation needs for the instrument workshop in the Sennar Sugar Mill.

14.2 Increase the space in the workshop to an acceptable size at least 10 x 10 m^2.

14.3 Equipment and instrumentation needs: (Basic needs)
2 Pcs. Adjustable desk lamps, with magnifying glass.
4 Pcs Worklights (Placelights).
The expert discovered an operable oscilloscope without oscilloscope measuring probes.
4 set of Reversible oscilloscope measuring probes, 1:1 (10:1)
2 set of High voltage measuring probes, 100:1, 2 kv
6 set of screwdrivers.
6set of crossdrivers.
6 set of spanners, hexagon socket, (mm).
6 set of spanners, hexagon socket, (inch).
6 set of bloch spanners.
6 set of pliers.
4 Pcs. Instrument Jaw vices.
20 Pcs. Sparepart Jaws, aluminium.
20 Pcs. Sparepart Jaws, nylon.
6 Pcs. Digital multimeters (Fluke 85).
30 Pcs. Rechargeable batteries Hp II.Batteries SLF 22.
2 set of Rechargeable cells and charger.
1 Pc. Thermocompensator with a built in manual temperature compensating unit. Manufacture Norma Vienna Austria.
4 Pcs. Steel cabinets.
1 Pc. Precision test unit for Pressure Gauges.
6 Pcs. Reference Pressure Gauges in different pressure ranges.
1 Pc. Test panel Pneumatic Transmitters and Controllers (max 6 bar).
2 Pcs. Movable Pressure Compressor (Electrical supply).

TECHNICAL INSPECTION II

15 The space, equipment and instrumentation needs for the instrument workshop in the Assalaya Sugar Mill.

15.1 Increase the space in the workshop to an acceptable size, at least 10 x 10 m^2.

15.2 Equipment and instrumentation needs: (Basic needs)
2 pcs. Adjustable desk lamps with magnifying glass.
4 pcs. Worklights (place lights).
6 set of screwdrivers.
6 set of crossdrivers.
6 set of spanners, hexagon socket (mm).
6 set of spanners, hexagon socket (inch).
6 set of block spanners.
6 set of pliers.
4 pcs. Instrument jaw vices.

20 pcs. sparepart jaws, aluminium.
20 pcs. sparepart jaws, nylon.
6 pcs. digital multimeters (Fluke 85).
30 pcs. sparepart batteries SLF 22. Rechargeable batteries type HpII.
2 set of rechargeable cells and charges.
1 pcs. Thermocompensator with a built in manual temperature compensation unit. Manufacture Norma, Vienna, Austria.
1 pcs. Precision test unit for pressure gauges.
6 pcs. Reference pressure gauges in different pressure ranges.
1 pcs. Test pannel for pneumatic transmitters and controllers (max 6 bar).
4 pcs. Steel cabinets.
2 pcs. Movable pressure compressors (Electrical supply).
2 pcs. Movable test unit for current and pressure in and output in different measuring ranges. Type Tc-4. Manufacture: Global Automation Services Limited, Basildon, Essex, England.

TECHNICAL INSPECTION III

16. The space, equipment and instrumentation needs for the instrument workshop in *EL Guneid Sugar Mill.*

16.1 Increase the space in the workshop to an accetable size, at least 10x10 m^2.

16.2 Equipment and instrumentation needed: (Basic needs)
2 pcs. Adjustable desk lamps with magnifying glass.
4 pcs. Worklights (place-lights).
6 set of screw drivers.
6 set of cross drivers.
6 set of spanners, hexagon socket (mm).
6 set of spanners, hexagon socket (inch).
6 set of block spanners.
6 set of pliers.
4 pcs. Instrument jaw vices.
20 pcs. sparepart jaws, aluminium.
20 pcs. sparepart jaws, nylon.
6 pcs. Digital multimeters (Fluke 85)
30 pcs. Sparepart batteries SLF 22, rechargeable batteries type HpII.
2 set of rechargeable cells and chargers.
1 pcs. Thermocompensator with a built in manual temperature compensation unit. Manufacture Norma, Vienna, Austria.
4 pcs. Steel cabinets.
1 pcs. Precision test unit for pressure gauges.
6 pcs. Reference pressure gauges in different pressure ranges.
1 pcs. Test pannel for pneumatic transmitters and controllers (max 6 bar).
2 pcs. Movable pressure compressor. (Electrical supply).
2 pcs. Movable test unit for current and pressure in and output in different measuring ranges. Type Tc-4. Manufacture Global Automation Services Limited, Basildon, Essex, England.
1 pcs. Test oven for thermocuples.
1 pcs. Valmet Air Tester, Type: A8. Manufacture Valmet, Finland.
Measuring ranges:
0-1,0 kp/cm.
0-1,5 kp/cm.
0-6,0 kp/cm.
0-10 kp/cm.

TECHNICAL INSPECTION IV

17. The space, equipment and instrumentation needs for the instrument workshop in *New Halfa Sugar Mill.*

17.1 Increase the space in the workshop to an acceptable size, at least 10 x 10 m^2.

17.2 Equipment and instrumentation needed: (Basic needs)

2 pcs.	Adjustable desk lamps with magnifying glass.
4 pcs.	Worklights (place-lights).
6 set	of screw drivers.
6 set	of cross drivers.
6 set	of spanners, hexagon socket (mm).
6 set	of spanners, hexagon socket (inch).
6 set	of block spanners.
6 set	of pliers.
4 pcs.	Instrument jaw vices.
20 pcs.	sparepart jaws, aluminium.
20 pcs.	sparepart jaws, nylon.
6 pcs.	Digital multimeters (Fluke 85)
30 pcs.	Sparepart batteries SLF 22, rechargeable batteries type HpII.
2 set	of rechargeable cells and chargers.
1 pcs.	Thermocompensator with a built in manual temperature compensation unit. Manufacture Norma, Vienna, Austria.
4 pcs.	Steel cabinets.
1 pcs.	Precision test unit for pressure gauges.
6 pcs.	Reference pressure gauges in different pressure ranges.
1 pcs.	Test pannel for pneumatic transmitters and controllers (max 6 bar).
2 pcs.	Movable pressure compressor. (Electrical supply).
2 pcs.	Movable test unit for current and pressure in and output in different measuring ranges. Type Tc-4. Manufacture Global Automation Services Limited, Basildon, Essex, England.
1 pcs.	Test oven for thermocuples.
1 pcs.	Valmet Air Tester, Type: A8. Manufacture Valmet, Finland. Measuring ranges: 0-1,0 kp/cm. 0-1,5 kp/cm. 0-6,0 kp/cm. 0-10 kp/cm.

TECHNICAL INSPECTION V

18 The Training center in the Sennar Sugar Mill.
Physical facilities.

18.1 Additional equipment, tools etc, required to cover 30% of the envisaged training programmes for Phase II is included as (annex V).

18.2 The Expert carried out a technical inspection to three Sugar Mills instrument workshops.

18.3 On the 2nd of December to Assalaya Sugar Mill.
18.3.1 On the 3rd of December to Kenana Sugar Mill.
18.3.2 On the 4th of December to Sennar Sugar Mill; and
18.3.3 On the 5th of December to El Guneid Sugar Mill.

19. The expert has got a comprehensive information about the New Halfa Sugar Mill from personnel working there.

20. **Conclusions**

20.1 All four Governments Sugar Mills indicate the same symptoms. During the years the sugar mills has existed, all equipment and instrumentation has slowly been broken down and got destroyed due to lack of experience - how to handle and maintenance the equipment, lack of resourses to buy new equipment depending of lack of foreign currency.

20.2 The quality of the equipment and instrumentation in the instrument workshops is in the same technical level. El Guneid and New Halfa Sugar Mills is equipped with electronic instruments from Siemens in Germany. The pneumatic instrumentation is manufactured by Valmet in Finland.
Assalaya and Sennar Sugar Mills is equipped with pneumatic instrumentation and test equipment from England.

21 SPIC has involved instrument technicians from England in Assalaya and Senar Sugar Mills. (MATS team).

21.1 In Sennar Sugar Mill the Instrument technician has got a 18 month contract. The technician has brought new testequipment and instrumentation back to the workshop when the technician visited England.

21.2 New equipment delivered:

21.2.1 Microprocessorcontroled recorder (Chessel) 1 pcs.

21.2.2 Test unit for current and pressure (Tc-4) 1 pcs.

21.2.3 Multimeter (Beckman) 1 pcs.

22. <u>The new very important test equipment gives the instrument workshop in the Sennar mill a stronger side in comparison with the other instrument workshops in Assalaya, El Guneid and New Halfa</u>.

23. New equipment and instrumentation has been purchased for the instrument workshop in Sennar Sugar Training Centre <u>mainly physical facilities needed for Phase II</u> (to cover 30% ot the training programmes for Phase II.)

23.1	Digital multimeter.	(Fluke 23)	2 pcs.
	Bench multimeter	(Fluke 37)	1 pcs.
	Oscilloscope 50 MHz.		1 pcs.
	Function generator.		1 pcs.
	Megger tester.		1 pcs.
	TWT hand held meter.		1 pcs.
	2 bar gague calibrator.	(DP1700)	1 pcs.
	7 bar gague calibrator.	(DP1600)	1 pcs.
	15 bar calibrator.	(DP1203)	1 pcs.
	Two pen recorder.	(Chesell 301)	1 pcs.
	100 KΩ simulator.	(P1)	1 pcs.
	Decade resistance box.		1 pcs.
	100 UF capacitance box.		1 pcs.
	Transducer Simulator.	(1077)	1 pcs.
	Laboratory power supply.	(761-1)	1 pcs.
	Laboratory power supply.	(704)	1 pcs.
	Multimeter.	(AV08)	1 pcs.
	Electronic wattmeter.	(EW604)	1 pcs.
	Transistor tester.		1 pcs.
	Digital voltage tester.		1 pcs.
	Precision Pneumatic Calibrator.	(FA235)	1 pcs.

24. <u>Comparative assessment of needs among Sugar Factories of Public Sector in terms of equipment.</u>

25. <u>Conclusions</u>

25.1 The needs of equipment is with very small differences the same among Sugar Factories of Public Sector. Factual comparison between the English build factories and the German build ones indicale: The German factories is cleaner and better functioning.

26. TECHNICAL REQUIEREMENTS. I

26.1 A quantitative and qualitative comparison between Sennar Sugar Training Centre (SSTC) and the locally instrument workshops in Sennar, Assalaya, El Guneid and New Halfa indicate: <u>Sennar Sugar Training Centre is quantitative and qualitative best equipped from all instrument workshops</u>.

27. **Conclusions.**

27.1 The reason is simple. Sennar Sugar Training Centre is Pilotcentre for all Goverments Sugar Mills maintenance training programme.

28. Maintenance training is not a one-for-all activity. Changing technology demands rapid development of skills and affects all levels from management to workers. To be able to meet constantly changing technology, the technical standard of the equipment must be very high in Sennar Sugar Training Centre (SSTC).

29. **Views for the future.**

29.1 An upgrading of the technological stand of the equipment in Sennar Sugar Training Centre is from time to time a necessary measure because of the constantly changing technology.

30. TECHNICAL REQUIREMENTS II.

30.1 Weather all necessary shop facilities for Phase II is available by July 1989?

31. **Conclusions**

31.1 The last 14 days before the Expert left Sennar Sugar Training Centre, a discussion was held together with CTA, Mr. Jac Bye, The Expert and the Experts counterpart Mr. Mudawi Elsadig Mudawi about order of required equipment for Phase II. About 43000 USD. was available for purchase of equipment during Phase I.

31.2 As far as the Expert know, CTA was ready to send the order form to Rs-Export Centre, P.O.Box 99, Corby Northans, 9 RS England, for measure the 28th of December 1988.

31.3 The Expert was involved in the purchase order control of needed equipment. The Expert has changed some of the posts in the order form and has purchased high quality equipment, which is much more useful for the Sennar Sugar Training Centre. since constantly changing technology demands long lived and high technology equipment which from technological aspects is still up-to-date even after 5 years of time.

32. TECHNICAL REQUIREMENTS III

32.1 Weather all necessary shop faciclities for Phase II is available by July 1989?

33. **Conclusions.**

33.1 Highest priority must be given by UNIDO to order remaining required equipment for Phase II, including complete equipment for:
33.1.1 A Domestic Electrical Engineering Workshop.
33.1.2 A Industrial Electrical Engineering Workshop.
33.1.3 A Electrical Engineering Motor Laboratory.
33.1.4 An Instrument Engineering Workshop.

34. To order all equipment needed for four workshops and to write different comprehensive Curriculums for all four workshops is a separatley UNIDO-mission. The Expert estimate the time it will take to complete the mission to between one and a half to two months depending on the back-up situation from firms and factories or an open time for the mission.

35. Weather all necessary shop facilities for Phase II is available by July 1989 is a question of priority. Is money available from the World Bank by June 1989 for purchase of equipment needed for Phase II? Is UNIDO ready to involve Experts in developing curricula and order the remaining equipment needed by May-June 1989?

36. TECHNICAL REQUIREMENTS IV

36.1 Could the existing equipment be sufficient for Phase II?

37. **Conclusions**

37.1 The existing equipment in the instrumentworkshop in the Sennar Sugar Training Centre is sufficient for Phase II. It is the same equipment and instrumentation The Assalaya and Sennar Sugar Mills make use of in the production.

38. **What are the needs for Phase II?**

38.1 The needs for phase II is a complete education for:
38.1.1 A Domestic Electrical Engineering workshop.
38.1.2 An Industrial Electrical Engineering workshop.
38.1.3 An Electrical Engineering motor laboratory.
38.1.4 An Instrument Engineering workshop.

39. It is impossible to specify all equipment needed during Phase II for four complete workshops by the Expert. The time the Expert has got to finish the final report in the Experts home was limited. The Expert refer to page 27, point 34, about the estimate time to complete the mission.

39.1 The Expert can as an example give an overall picture of the equipment neede for a Domestic Electrical Engineering workshop.
A description of the equipment is included as Annex VI.

40. TECHNICAL REQUIREMENTS V

Installation Training

41. **Installation Kits**

41.1 Each kit is complete with cables, clips, screws, joint boxes, plugs and the necessary electrical accessories ready to install. Installation instruction and circuit diagrams are prepared in pedagogical sequence thus ensuring easy installation and correct functioning. These training kits are designed to be installed on assembly boards which are placed in special frames. The boards can be removed from the frames and stored in a rack built for this purpose.
Assembly Frame MV1605
Assembly Board MV1606
Storage Rack MV1607

42. **PVC Conduit Installation MV 1600.**

42.1 Installation practice using PVC conduit in concealed conditions is complimented with different wiring circuits including intermediate switching and socket circuits.

43. **Surface wiring MV 1601.**

43.1 Practice in clipping, bending and setting of surface mounted cables. Circuit connection from a fuseboard to 3phase outlets controlled by different types of control, are also included in this module.

44. TECHNICAL REQUIREMENTS VI.

Installation training

45. **Single Phase Motor MV 1602**

45.1 A single Phase Motor is connected to the mains supply via a direct-on-line starter, fuseboard and kWh meter. PVC surface cable is used throughout exept for the connection between the motor and the terminal box where flexible conduit with single PVC cable is used.

46. **Three Phase Motor MV 1603.**

47. **Lighting Control MV 1604.**

48. **Installation Training Equipment MV 1608.**

49. **Cubicle for fault finding MV 1609.**
Fault Finding Trainer MV 1000.

50. **Installation Protection.**
50.1 Systematic MV 1610.

51. **Washing Machine Simulator MV 4211.**

52. **Tool Kits.**
52.1 Electrical Student MV 1613.
52.2 Electrical Workshop MV 1614.

53. TECHNICAL REQUIREMENTS VII.

53.1 The minimum needs of equipment Phase II.

54. **Conclusions**

54.1 The minimum needs of equipment and instrumentation for the start of Phase II by July 1989 has already been covered by purchase of needed equipment the 20th of December 1988. (Provided that the equipment has been purchased).

55. Who will receive and inspect outstanding consignments?

56. **Conclusions**

56.1 The Experts counterpart Mr. Mudawi Elsadig Mudawi responsible for Electrical and Instrumentation Engineering section.

57. What are the views for the future?

58. **Recommendations**

58.1 Correct information and ordering of spare parts is of fundamental importance.
A correct balance needs between fast moving parts required in quantity and slow moving parts needed only in small numbers needs to be established. A big number of electronic equipment refuse to function after a couple of months because of lack of special batteries impossible to find in developing countries.
To establish an education in purchase of correct spareparts is very important.

59. TRAINING

59.1 Involvement in the design of the new part of the training centre. An outline proposal reached during preliminary discussions with the Consultant and Resident Architects to the Sugar Project Implementation Committee (SPIC).

60. **Introduction**

60.1 Discussions took place on 11th December 1988 between
Mr. Mohamed Ali Mohamed Fadlabi, Director of SSTC
Mr. Jae Bye, UNIDO, CTA
Mr. J.O.Berglund, Electrical/Instrumental Expert
Mr. E.Pauli, Transport and Agriculturai Machinery Expert.

60.2 The discussions concentrated upon how best to try and provide sufficient accomodation to satisfy the training needs in the future of the Sugar Industry. It was reseolved that the CTA would prepare the rationale upon which to propose modifications to the recently prepared drawings and extensions to the training accomodation.
The original proposal for an extension to the accomodation at the SSTC for the instrument workshop was 14,5 x 5,5 (77 m^2).
The reviewed proposal accepted after discussions became 10 x 12 m (120 m^2) for each workshop (4 x 120 m^2).
Domestic Electrical Workshop.
Insdustrial Electrical Workshop.
Electrical Engineering Motor Laboratory.
Instrumentation Engineering Workshop.

61. Sennar Sugar Training Centre, proposed additional accomodation.

62. Electrical and instrumentation short term requirement for:
62.1 5 Instructors
62.2 60 Technicians
62.3 180 Artisans

63.

Workshop, Room	Dimensions (m)	Area (m^2)
Domestic Installation	10,0 x 12,0	120,0
Industrial Installation	10,0 x 12,0	120,0
Electrical Mot.Lab.comb.Maint.w.	10,0 x 12,0	120,0
Instrumentation Workshop	10,0 x 12,0	120,0
Parts and Tool Store	5,0 x 5,0	25,0
Instrument Store	5,0 x 5,0	25,0
Classroom	10,0 x 7,5	75,0
	Total:	605,0

64. **Introduction**

64.1 The reference to short-term requirements indicates that the accomodations is planned to deal with initial training only and do not take into account the proposed Progressive Training Structure.

65. A further item for consideration once the initial training programmes are in operation will be the possible introduction of a One Year Off The Job Apprenticeship Training Scheme which would be a major influence on the long term objective of progressively raising the levels of competence of Craftsmen and Technicians in certain key occupations.

66. A tabular approach showing the needs for maintenance personnel at the plant level including a comparative table among the four platns in an integrated manner.

67. **Introduction**

67.1 Since it is essential to base any proposed structual additions to the needs for maintenance personnel at the plant level including a comparative table among the four plants in an integrated manner upon facts and figures, some progress has already been made in attemting to collect data for the needs of mainetance personnel at the plant level including a comparative table among the four plants in an integrated manner, but the information available at this time is still incomplete.

68. **Conclusions**

68.1 The Expert visited 3 sugar mills in 4 days, approximately 2 hours was spent in the instrument workshop and in the mill itself discussing noicelevel from the production, instrument workshop space, follow-up of all broken equipment and instrumentation needs, education needs and finally local education needs. A nearly impossible task, 3 sugar mills in 4 days. The Expert should have needed at least 1 or 2 days in each sugar mill, totally 3 to 6 days instead of 2 hours in each mill, totally 6 hours in order to present a more systematic approach followed in documenting the findings to full UNIDO satisfaction.

68.2 The personnel in the instrument workshops in the different sugar mills consists of day-time and shoftworkers. During the short visits in each sugar mill, the Expert only met day-time workers. The Expert only met between 2 and 3 technicians in each instrument workshop, the rest of the team was involved in trouble shooting in different places in the Sugar Mill.

68.3 The time the Expert got to disposal was too short. A day-off was utilized for the transport and visit to the Assalaya Sugar Mill (Friday 2nd of Dec.1988). The Expert utilized day-off to check the equipment and the instrumentation in the Sennar Sugar Mill. The Expert should have needed a extension of one week in the Project to be able to visit New Halfa Sugar Mill.

69. The need for a series of different training programme whether at the sensitisation level or at the technical documentation level, organization of supply.

70. **Information**

70.1 The analysis of the technical level of the equipment and the mainetance jobs in the National Sugar Mills is fundamental for developing curricula and training materials to establish an education.

71. During the time the Expert and his counterpart trained the trainees in the Sennar Sugar Mills Instrument workshop the Expert, counterpart and trainees examined a new microprocessor controlled recorder from Chesell in England.
The recorder is modulary build-up and cointains double sided printed circuit boards with extremely advanced technology.

72. The Expert is interested in producing a picture of the equipment needed to be able to repair the recorder and the education needs to be able to understand the function of the recorder and the equipment needed for maintenance of the recorder. The education needs can change during a night in a factory by purchase of high technology.

73. **Equipment needs:**

73.1 In order to maintain a double side printed circuit board the technician need a Bench-Top Rework and Repair Center specially designed for production rework and touch-up use and depot-level mainetance of electronic assemblies. The Rework and Repair Center is a completely self-contained bench-top system and can be used for rework, repair and modification of any printed circuit board.
Test equipment needed: Oscilloscope, measuring probes, logic measuring probe, puls injector probe for TTL and CMOS integrated circuits, data books.

74. In order to understand the function and use of soldering equipment, test equipment and function of the microprocessor controlled temperature recorder in Sennar Sugar Instrument Workshop it is necessary to educate the instrument technicians. Qualified mainetance requires complex knowledge and multiple skills!

75. <u>Education needs</u>

75.1 Soft soldering technology.
Practice.
Electrical engineering technology.
Practice.
Electrical measuring technology.
Practice.
Electrical drawing technology.
Practice.
Installation training.
Electronic components.
Drawing technology.
Basic electronics.
Practice.
Advanced electronics with practise.
Digital technology.
Practice.
Industrial measuring technology.
Automatic control.
Basic computer technology.
Programmable controller technology.
Microcomputer technology.

76. <u>Conclusions</u>

76.1 Qualified maintenance training requires from the teaching team komplex knowledge and multiple skills within a wide field.

77. <u>Weather it is any Sugar mill with a stronger side of educated personnel in the instrument maintenance team.</u>

78. <u>Information</u>

78.1 During the time the Basic Process Instrument Trining Course was held in the Sennar Sugar Training Centre (SSTC) from 10th of December 1988 to 8th of January 1989 the Expert examinated all trainees about their theoretical and practical background.

79. <u>Conclusions</u>

79.1 Engineers working in the instrument mainetance team:

Sugar Mills	Number of Engineers	Background Education
New Halfa	3	(1) Electrical Engineering (2) Electronics
El Guneid	1	Electrical Engineering
Assalaya	1	Electrical Engineering
Sennar		

80. The number of Engineers working in the instrument team gives New Halfa a stronger side using Engineers in the maintenance training of high technology equipment.

81. <u>Needs of personnel for the Sugar Mills and the Training Center itself.</u>

81.1 It is difficult to draw 100% corresponding conclusions when we are dealing about manpower in factories and training centers with low payment within the Government in development countries.
If the employees are not satisfied with the existing economical situation, they will try to move abroad or to get a well payed job within their own country.

81.2

Sugar Mills	Number of Engineers	Background Education
New Halfa	3	Electrical Engineering Electronic "
El Guneid	1	Electrical Engineering
Assalaya	0	
Sennar	0	

81.3 New Halfa has got 3 Engineers in the instrument maintenance team.
Engineer A has got 1 year practice.
Engineer B has got 2 years practice.
Engineer C has got 2 yeras practice.

82. Conclusions

82.1 All of them are aware of the reality, they need at least 10 years practice to be able to get at well payed job in Saudi-Arabia, 50 times their own payment. They will stay and continue to work for New Halfa Sugar Mill. The Sugar Mill is also beautifully located.

82.2 The movement of manpower in the shift working team is very low, attractive job, shift addition payment gives benefits.
The movement of manpower in the day-time working team is also very low, attractive job. Each worker in the Governments Sugar Mills will get 25 kg sugar each month. Attractive gift since the sugar prices increased rapidely in the open market during December 1988.

82.3 El Guneid has got 1 Engineer in the instrument maintenance team.
Engineer A has got 3 years practice.

83. Conclusions

The same as for the New Halfa team. The Engineer, shift and day-time workers will continue to work for the El Guneid Sugar Factory. The movement of manpower in the instrument maintenance team is very low.

83.2 Assalaya and Sennar Sugar Mills don't have any Engineers in the instrument mainetance team.

84. Conclusions

84.1 The circumstances are the same as for New Halfa and El Guneid, the movement of manpower is low.

84.2 Assalaya is beatyfully located and it is not so far away to Kenana Sugar Mill. A big market is located in the surroundings, extremely important fir the well-being and manpower stability.

85. Needs of personnel for Sennar Sugar Training Centre, New Halfa, El Guneid, Assalaya and Sennar Sugar Mills.

85.1 The needs of personnel in Sennar Sugar Training Centre is in the first place to cover the needs of personnel for the new planned four workshops:
Domestic installation.
Industrial installation.
Electrical motor lab and maintenance workshop.
Instrument workshop.
Consideration must be taken by appointment of number of teachers in order to cover eventual movement of manpower to other estates or long sickness.

85.2 NEEDS OF INSTRUMENT TECHNICIANS WITHIN 3 YEARS OF TIME

	No:
SENNAR SUGAR TRAINING CENTRE (SSTC)	9
NEW HALFA	1-3
EL GUNEID	1-3
ASSALAYA	1-3
SENNAR	1-3
TOTAL MIN:	13
TOTAL MAX:	21

85.3 NEEDS OF INSTRUMENT ARTISANS WITHIN 3 YEARS OF TIME

	No:
SENNAR SUGAR TRAINING CENTRE (SSTC)	0
NEW HALFA	1-2
EL GUNEID	1-2
ASSALAYA	1-2
SENNAR	1-2
TOTAL MIN:	4
TOTAL MAX:	8

86. Personnel needed for phase II as teacher in Sennar Sugar Training Centre (SSTC).

87. Conclusions:

87.1 Involvement of increased technology in the education requires recruitment from an electrical or electronical university background and at least 5 years of advanced practice and multiple skills.

87.2 The Expert has involved 1 teacher for each workshop and 2 teachers with complex knowledge and multiple skills the Director in SSTC can utilize as allround teachers for all workshops: Domestic El. Industry El. Motor lab and maintenance workshop and Instrument workshop.

87.3 If multiple skilled engineers is impossible to find in Sudan, a combination of fellowship for training abroad and Trainingcenter-University Training Linkage is a necessary way in order to create required multiple skills for Sennar Training Centre.

87.4 If the Expert deduct the needs of technicians for the new planned 4 workshops the Expert has appreciated the needs of personnel in the trainingcenter itself to 3 technicians within a 3-years period of time.

88. Training needs covering common needs of all the sugar mills

88.1 There is a pronounced lack of electrical knowledge amongst the majority of the instrument technicians in all 4 sugar mills. The existing technicians should all undergo a thorough grounding in electrical theory applicable to equipment and instrumentation of at least 8 to 12 weeks.

88.2 Between 95 and 98% of the total number of instrument technicians have intially been drawn on recruitment from a mechanical background. When it comes to servicing and installation of instrumentation, electricians are called into fault finding and installation equipment leading to time delays and overlap of responsibilities.

88.3 The assessment of training needs at the training centre level and at each of the four plants.

88.4 The training needs is almost the same for the training centre and each one of the 4 sugar mills. The reason is the mechanical background of teachers and technicians.

PROPOSAL TO AN OVERALL CURRICULUM FOR PHASE II

89. **Target.**

89.1 After completed education in Electrical Engineering **all trainees will have got knowledge about:**

89.2 Fundamental principles and the relation between those fundamental principles and practical application within single phase and three phase alternative current.

89.3 Different types of measuring instruments and their application and assessment of measurement test reading.

89.4 Function and use of electrical motors.

89.5 Starting devices and remaining operating devices for electrical motors.

89.6 Relation between theoretical fundamental principles and practical applications.

89.7 Skills in use of different types of measuring instruments.

89.8 Read and construct electrical drawings.

89.9 Wiring and safety regulations for electrical constructions. (Safety all aspects)

89.10 Human safety.

89.11 Soft soldering technology.

90. Electrical Engineering, Direct Current (DC)

91. **Contents**

91.1 Komponent knowledge.
Magnetism and electromagnetism.
Induc tion and inductance.
Electrostatics and capacitance.
Capacitors.
Power and energy.
Efficiency.
Electrical drawing technology.
Electrical drawing symbols.
Electrical drawings.

91.2 **Alternating current (AC).**

Way and pointer diagram.
Alternating current and voltage.
Phase difference (phase shift).
Lag and lead of phases.
Reactance and impedance.
Active, reactive and apparent power.
Energy.
The transformer.
The three phase system.

91.3 **El machinery.** (El motors).

DC and AC machinery.
Synchronous machinery.
Squirrel cage and slipring motors (short circuit motors).
Speed control of short circuited non synchronous motors.
Start device for single-phase motors.

94. **Measuring instruments.**

94.1 Symbols for electrical measuring instruments.
Different measuring instrument systems.
Series resistance, shunts, power transformers.
Universal instruments, multimeters, measuring bridges, insulation tester, recorders, powertester, clip-on amperemeter.

94.2 Measuring Pratice. Electrical Engineering.

95. **Contents:**

95.1 Measuring voltage, current and resistance using different types of circuits.
Measuring reactance for calculation of impendace and phase angular measuring.
Measuring AC-power.
Measuring resistance, impedance and capacitance using universal measuring bridge.
Measuring frequence, time and voltage using oscilloscope.
Measuring insulation using insulation tester.
Measuring rotation speed.
Measuring temperature.
Basic electrical training, ground and hanging cables.
Installation training external and internal cable-lying.
Power systems and metering equipment.

96. **Basic Electronics**

96.1 Basic components knowledge, function.
How to handle electronics components.

97. **Target**

97.1 After completed education in Electronics Engineering all trainees shall have got knowledge about:

97.2 Introduction to electronics.
What a power supply is.
Half-Wave rectifiers.
The full wave rectifier circuit.
Filter circuits, micro circuits.
Characteristics of diodes, optocomponents.
Transistors, semiconductors, diodes.
Transistor construction, operating amplifiers.
How a transistor operates. switching components.

97.3 Connection, mounting test and trouble shooting in electronic equipment (circuits).

97.4 Read and understand electronic drawings.

97.5 Function of electronic circuitry.

97.6 Electronics measuring technology their application and assessment of measurement test reading.

98. **Previous knowledge**

98.1 Fundamental knowledge in Electrical Engineering.

98.2 Good knowledge about the function and how to handle electronics components.

98.3 How to handle different types of measuring instruments.

98.4 Electronics components and electronics circuit properties.

99. **Practice**
Soft soldering practice.

99.1 Measuring semiconductors using different measuring instruments.
Measuring frequency, output voltage and output power.

99.2 Measuring frequence and shape of a curve using oscilloscope and frequence counter.

100. **Target**

100.1 After completed education in Pneumatics all trainees shall have got knowledge about:

100.2 Building up control system using pneumatic components.

100.3 Ability to read and understand pneumatic drawings for pneumatic construction.

100.4 Function of pneumatic equipment.

100.5 Methodical troubleshooting on pneumatic equipment.

100.6 Maintenance of pneumatic equipment.

101. Pneumatic Engineering.

102. **Contents**

102.1 Physics.
Structual member.
Applied mechanics engineering.

102.2 Sealing devices.
Pneumatic pipes.
Pumps.
Pneumatic connectors.
Compressors.

102.3 Various types of cylinders.
Choise of cylinder diameter and cylinder stroke.
Liquidstabilized cylinder movement.
Different types of valves.

102.4 Applications using pneumatic and el-pneumatic systems.
Cylinder and speed control.
Electropneumatic components.

103. **Practice**

103.1 Connection of pneumatic flexible tubes and pipes.
Assembling of connectors.

103.2 Supervision of compressor plant and oil pumping unit, pressure regulator and oil mist lubricating device.

103.3 Assembling and exchange of cylinders and valves.
(Strip and assembling of cylinders and valves).

103.4 Cylinder velocity control.

103.5 Truobleshooting in pneumatic circuits using pneumatic diagram.

103.6 Exercises on el-pneumatic systems.

103.7 Exchange of packings and spareparts in pneumatic components.

104. **Target**

104.1 After completed education in Industrial Measuring Practice all trainees shall have got knowledge about:

104.2 How to manufacture and assemble minor instrument panels with requisite electrical and pneumatic instruments.

104.3 Control and adjustment of electrical and pneumatic instruments.

104.4 Read and understand processdiagram for control and monitoring. (Symbols for measuring systems).

104.5 Basic principles for measuring conductivity, flow, level, pressure, vacuum, Ph, temperature.

105. **Practice**

105.1 Instrument panel work.

105.2 Manufacturing of minor plastic or steel sheet instrument panels with requsit electrical and pneumatic instrument.

105.3 Assembling of terminal block and wiring channels.

105.4 Wiring installation between terminal block and instrumentation.

105.5 Installation of plastic and metall pipes.

105.6 Control of electrical and pneumatic instruments.

105.7 Control and adjustment of pressure gagues, pressure transmitters, magnetic flow meters (magnetic flow transmitters), pneumatic recorders, measuring test converters, electronic recorders.

106. **Contents**

106.1 Temperature measuring establishment with resistive transmitter and thermocouples.

106.2 Temperature dependence of thennocouples resistive transmitters (resistance thermometers Pt-100, Ni-100).

106.3 Measuring pressure, level, flow, ph,using industrial measuring instruments.

106.4 Measuring pressure using U-tubes, pressure gauges, vacuum gauges, transmitters.

106.5 Measuring level using bubble-pipe in combination with differential pressure transmittes in open tank.

106.6 Measuring flow using magnetic flow meters and differential pressure transmitters.

106.7 Measuring temperature using thermocouples and thermocompensator, moving coil and electronics instruments.

106.8 To transmit electro-pneumatic measuring value to international standard signals.

106.9 Assembling of flow measuring flange in a ringchamber.

106.10 Mainetance jobs, control and adjustment of zeropoint and linearity.

106.11 Control of instrument reproducity and alteration of measuring range.

107. Automatic Control Technology

108. <u>Target</u>

108.1 <u>After completed education in Automatic Control Technology all trainees shall have got knowledge about:</u>

108.2 Installation of automatic control equipment.

108.3 Mainetance of automatic control equipment.

108.4 Methodical troubleshooting on automatic control equipment.

109. <u>Practice</u>

109.1 Inspection and adjustment of pneumatic valves and controllers.

109.2 Assembling of controllers and valves.
To study the characteristics and limits of the manual control.
To study the advantage of automatic control compared with maual and time control.

109.3 To adjust zero and span of the transmitter so that the output varies between 3-15 psi.

109.4 To study the step responce from a P-controller and measure P-gain.

109.5 To study the step responce from a PI-controller and measure the integral time.

109.6 To study the step responce from a PD-controller and measure the derivative (rate) time.

109.7 To study the step responce from a PID-controller.

109.8 <u>P-control</u>
To study how the size of the load change is affected by the stationary offset.
To study how the proportional gain affects the amplitude of the stationary offset and the dynamics of the controlling.

109.9 <u>PI-control</u>
To study how the integral action affects the offset and the slope of the curve.
To study the difference between an oscillation due to high P-gain and an oscillation due to high integral (reset) action.

109.10 PD and PID-control.
PD-control, to study how the Derivetive action is damping the oscillations due to high P-gain when controlling two capacity process.
PID-control, to study the effect of the D-action when PID controlling a two capacity process. To study the difference between oscillations due to high P-gain high Integral action and high Derivative action.

110.I The needs for indivdual training courses to be held in respective workshops of the sugar mills.

110.1 The Expert has got a proposal from Assalaya Sugar Company about a skill upgrading course for factory instrument technicians stage 1. (Annex VII)

110.2 Consideration must be taken to indivdual training needs from the Governments four sugar mills.

110.3 El Guneid was the first build up Sugar Mill in Sudan bought from Germany. The instrumentation is of German (Siemens) and Finnish (Valvet) manifacture.

110.4 From technological aspect it is a difference between German and English instrumentation. Therefore it is necessary to educate and train the trainees on respectively equipment used in the German and English build factories.

110.5 When it is time to replace broken down equipment in the sugar mills, the equipment needs doesn't follow any jointly pattern any longer.

110.6 For example in Sennar Sugar Mill, an instrument technician involved in the Mats team brought a microprocessor controlled recorder (Chessel) back to the instrument workshop when he visited England.

110.7 The analysis of the technological level of the equipment and the maintenance jobs is fundamental for developing curricula and training materials to establish an education in equipment and instrumentation maintenance.

111. Conclusions

111.1 The consequenses of new technology is very interesting to follow-up.
If Sennar Sugar Mill only has got 1 recorder with extremely advanced technology a comparisation at economical basis must be done between the investment and maintenance cost of the recorder and the investment in teacher capacity, further education (training) and the total cost of the equipment needed to be able to maintenance the recorder.

111.2 From economical aspect it is necessary to find a suitable model for all 4 sugar mills to be able to reduce the cost of maintenance and reduce the number of different types of spareparts needed for the instrumentation.

111.3 A lot of equipment is useful for all 4 sugar mills, for example test equipment for the instrument workshop, we can buy the same type of test equipment for all workshops including the Sennar Sugar Training Centre. The same circumstances are valid for a lot of equipment and instrumentation.

112 Advantages

112.1 Increased flexibility between the Sugar Mills, borrow sparepart and equipment from each other.

112.2 All technicians in the 4 Sugar Mills is familiar with the same type of testequipment.

112.3 Reduces the number of spareparts needed (economical advantages).

113. II The need for individual training courses to be held in respective workshops in the Sugar Mills.

113.1 During the visit to Sennar, Assalaya and El Guneid Sugar Mills the Expert discovered a lot of damaged spareparts, equipment and instrumentation.
The Expert was from the beginning very interested to find out a system to eleminate the un-economic situation for the Sugar Project Implentation Committee (SPIC) and the Government in Sudan.

113.2 When the basic Process Instrument Training Course was held in Sennar Sugar Training Centre (SSTC) from 10th of December 1988 to 8tf of January 1989, the Expert examinated all trainees about their theoretical and practical background.

113.3 The reason for the examination was to pick ut the most convenient engineers and technicians from the training course and invite them into a discussion togehter with the Expert and the Expert counterpart Mr Mudawi Elsadig Mudawi, Head of Electrical and Instrumentation Engineering Department, about the Experts idea to introduce a in plant training system in each Sugar Mill. (Annex VI).

114. Task:

114.1 To educate newcomer (artisans) in the instrument workshop about the function, maintenance and how to store the equipment and instrumentation.

114.2 To educate the existing artisans and technicians in the instrument workshops about the function, maintenance and how to store the equipment and instrumentation.

114.3 To educate the storage personnel about how to take care of and store the spareparts equipment and instrumetnation in the poropre way in the storage.

114.4 To educate the personnel about safety all aspects!

114.5 To educate the personnel about how to use tools the proper way (The correct tool for the right screw).

115. RECOMMENDED FOR FELLOWSHIP.

To make it possible for UNIDO:s Education Policy to survive and exist in the sugar mills, the Expert was interested to involve fellowship for training of the selected technicians, one from each plant, to increase their respective knowledge from the German and English build up factories and instrumentation.

115.1	NAME:	ABDALLAH MOHAMMED ALI
	GRADUATION:	Diploma in Electrical Engineering. 3 years Course Khartoum Polytechnic, College of Engineering Studies.
	POSITION:	Engineer, El Guneid Sugar Company.
	EL GUNEID:	German Built factory.
	EDUCATION:	3 month fellowship for training by Siemens Munich. Germany.
115.2	NAME:	AMIN YOUSIF MOHAMMED ALLOUB
	GRADUATION:	Diploma in Electronics Engineering. 3 years Course. Khartoum Polytechnic, College of Engineering Studies.
	POSITION:	Instrument Technician, New Halfa Sugar Company.
	NEW HALFA:	German built factory.
	EDUCATION:	3 month fellowship for training by Siemens Munich. Germany.

115.3 RECOMMENDED FOR FELLOWSHIP

NAME:	MOHAMMED ABDALLAH ELGORASHI
GRADUATION:	Secondary School
POSITION:	Instrument Technician, Sennar Sugar Company
SENNAR:	English built factory.
EDUCATION.	3 month fellowship for training by Foxbora, London, England.

115.4

NAME:	MOHAMMED ELNOUR ABDALLAH
GRADUATION:	Secondary School.
POSITION:	Instrument Technician, Assalay Sugar Company
ASSALAYA:	English built factory
EDUCATION:	3 month fellowship for training by Foxboro, London, England.

115.5

NAME:	MUDAWI ELSADIG MUDAWI
GRADUATION:	
POSITION:	Head of Instrumentation & Electrical Engineering Department Sugar Training Centre Sennar.
EDUCATION:	3 month fellowship for training by Siemens Munich, Germany.

115.6

NAME:	MOHAMED AHMED MOHAMED
GRADUATION:	Senior Technical School Certificate. Khartoum Polytechnical Institute. Two years in electrical department.
EXPERIENCE:	Teacher in the technical school for 9 years from 1966 to 1975. Electrical Instructor with Aramco (Saudi Arabia) for two years from 1975 to 1977.
EDUCATION:	3 month fellowship for training by Siemens in Electrical Department Munich Germany.

SUGGESTED POST FROM THE MANAGEMENT OF THE TRAINING CENTRE IN SENNAR:
Electrical and Electrical Installation. Phase II.

115.7

NAME:	MAHGOUB WIDA AHMED.
GRADUATION:	Medani Vocational Training Centre. 3 years Course.
EXPERIENCE:	1 month in Paris, France - Berliett. 1 month in Milano, Italy - Borsani. (Cooling systems). 5 years in Gizera Tannery. 1 year General Maintenance in Libya. 2 years in Riyadh City, Telecom. work.
EDUCATION:	3 month fellowship for training by Siemens in Electrical Department, Munich, Germany.

SUGGESTED POST FROM THE MANAGEMENT OF THE TRAINING CENTRE:
Electrical and Electrical Installation. Phase II.

116. From pedagogical aspect it was also necessary to recommend the selected technicians from the 4 sugar mills and the suggested technicians from the training centre a 9 weeks Methodological Training Course in ILO:s Training Centre in Turin, Italy, relating to their future tasks as in plant training specialists and teachers in the Training Centre.

116.1 The expert discussed the actual proposal about fellowship for training for the trainees and a 9 weeks Methodological Training Course in ILO Training Centre in Turin, Italy, together with the Chief of Industrial Training, Ms I. Lorenzo. Ms. I. Lorenzo agreed to the proposal.

116.2 Even if the Methodological Training Course in ILO Centre in Turin is one of the best, the Training Course don't deal with Practical Training in actual fields.

116.3 The last day before the Expert left Vienna for Sweden, the Expert visited the Industrial Development Officer Mr. Karamonoglou. The Expert discussed the in plant Training System and the philosophy around it. Mr. Karamonoglou suggested an integrated Vocational Education of Training of trainees in Training methods and Technology.

116.4 Technical Training in Mechanical Technology, Electrical technology, Instrumentation, Maintenance Engineering both Theory and Practice.

Education at Sheffield Polytechnic in cooperation with the industry in the surroundings.

117. <u>Industry University linkage including linkages with the Vocational Training Centre in Khartoum.</u>

117.1 After some years without further edcuation (training) it is very easy to loose 50% of the total amount of technical knowledge within the instrument technician team. Frequent recurrent of further education (training) is the best way to keep a high technological knowledge level of the personnel in the Sugar Mills in Sudan.

117.2 Industry - University linkage is one possibility to educate the trainees from the industry, <u>provided that the teaching staff hasn't left the University in order to take up teachings positions abroad and equipment and apparatus are in working order.</u>

117.3 If not, priority must be given to change the situation in the University!

117.4 Linkage with the Vocational Training Centre in Khartoum and the industry is an interesting way to educate the personnel at artisan and technician level. (Further education training).

117.5 A cooperation between the Vocational Training Centre in Khartoum and the Sennar Sugar Training Centre (SSTC) is a possibility.
Equipment and personnel are movable. Education could be held in Sennar Sugar Training Centre with Specialists from the Vocational Training Centre in Khartoum.

117.6 The review of the policies governing training in the field of maintenance and the strategic approach relating to methods and techniques for training including professional upgrading, training and retraining.

<u>Introduction</u>

117.7 It has been more and more important to acquire knowledge about the problems of the modern industry in order to be able to determine repair costs and specify the quality of repair work. No matter how good the equipment may be, sooner or later it will stop funcioning. This may not happen for years, but it is an inevitable consequensce of daily wear and tear. Equipment failure is not only irritating but costly! The services of a modern factory can easily be brought to a complete stop when the maintenance system is not correct developed.

117.8 <u>The Management of each established can-and-should-anticipate equipment breakdowns!</u>

117.9 It is therefore a necessity to establish a coordinated Maintenance System, consisting of specific supervisory routines, well trained personnel and adequate supplies of spare parts, tools and instruments. The system should be designed to prevent as well as correct equipment failures.

117.10 A well managed system often save time, trouble and money.

118. Training needs

118.1 A modem industrial establishment needs comparative little maintenance, because it has been designed for high reliability and good maintainability. On the other side, the complexity and demands on availability require a high quality of maintenance manpower and a production oriented maintenance control system.

118.2 During the delivery stages, training of operators and maintenance personnel should be started. In many cases, the manufacturer offers to receive the customer's personnel for training during the assembly of a machine in the maufacturer's plant, which surely is not the very best training opportunity. Too often the time in the manufacturer's workshop is poorly utilized, and a training as such is not all planned for efficiency. It is also in most cases not economically possible to send all personnel for training. Many managers then choose to sen one or two staff members for training and hope that these after return can be able to train other people.

118.3 Maintenance training programme has to be handled professionally, with established training programmes with a good pedagogical lay out and suitable material. Otherwise the effort and costs are spent in vain and, which is more important, **The personnel will not be fully competent to operate and maintain the equipment!**

118.4 The maintenance staff at all levels need a thorough and versatile basic training covering several craft fields, to make them competent to perform the work tasks quickly and efficiently. The most important group of personnel is the middle level maintenance technicians.

118.5 They have a thorough knowledge about mechanical, electrical, hydraulic, pneumatic, electrical and electronic equipment and special techniques in Maintenance, such as failure analysis, failure diagnosis, trouble shooting (logical faultfinding), special repair techniques, such as dismounting and mounting of high precision components.

118.6 Maintenance technicians also have to know administrative systems in order to understand and work with failure reports, work orders, recorded data, drawings, diagrams and technical descriptions of complicated equipment. Proposed training programme should be designed with all these, and few more, conditions duly considered.

119 Training objectives

119.1 It is important to give the Maintenance Workshop its own well reputed identity and to establish the quality of assessing staff. The main objective of such Training Programme is to adapt professional technical training to the needs of selected students from the industries.

119.2 An essential part of the Maintenance Training Programme is character formation, **training of young men in habits of thought and character to make them feel proud of their work and to develop a sence of team work and loyality to the country and the establishment.**

119.3 The Maintenance Training Workshop needs also to be adjusted to other factors influencing the efficiency of the training programme, such as instructors, training material and teaching methods.

119.4 The principal objectives for industrial training centre are:
To teach general subjects as a basis for their future activities, such as language, mathematics, statistics, ecnomics, chemistry and physics to such a level that they are able to perform job tasks normally found in the modem industrial sector, covering all kind of work within his own field.

119.5 To teach the participants the use of techniques and methods used in the industry such as planning methods, analysis methods, use of computerized maintenance systems and allied subjects, to such an extent that they can actively participate in design and development of administration and operation systems.

119.6 To train the participants in handling of tools and machine tools to such an extent that they can actively participate in design and development of administration and operation systems.

119.7 To teach maintenance philosophy and various manintenance systems to such a level that the participants understand the organization, administration and operation of the establishment and the maintenance function and its influence on the industry economy.

120. <u>Training principles</u>

120.1 The training programme shall contain a mixture of theoretical lectures, exercises in the classroom or laboratories at the training centre, individual problem solving exercises, group discussions of selected problems, workshop practises and On-The-Job training in actual factories!

120.2 The training scheme takes the students gradually trough each subject from simple to more complicated modules or levels, from theory to practical applications. Tests and evaluations take place during the theoretical as well as practical studies to control the learning process. Students progress should be reported to the Authorities who are issued with log book for each student. Certificate will be issued when a trainee successfully completed a training programme.

121. <u>The Training Programme</u>

121.1 An international modern training programme must be based on industry, incorporation theory and practical training in the appropriate proportions. The mixture depends on the occupation. Measured against a background of modern machinery, production methods, better education systems and the accelerating rate of change in these fields it is obvious that the training programmes for technicians and craftsmen must be flexible and realistic in reflecting the conditions of the special industrial sector.

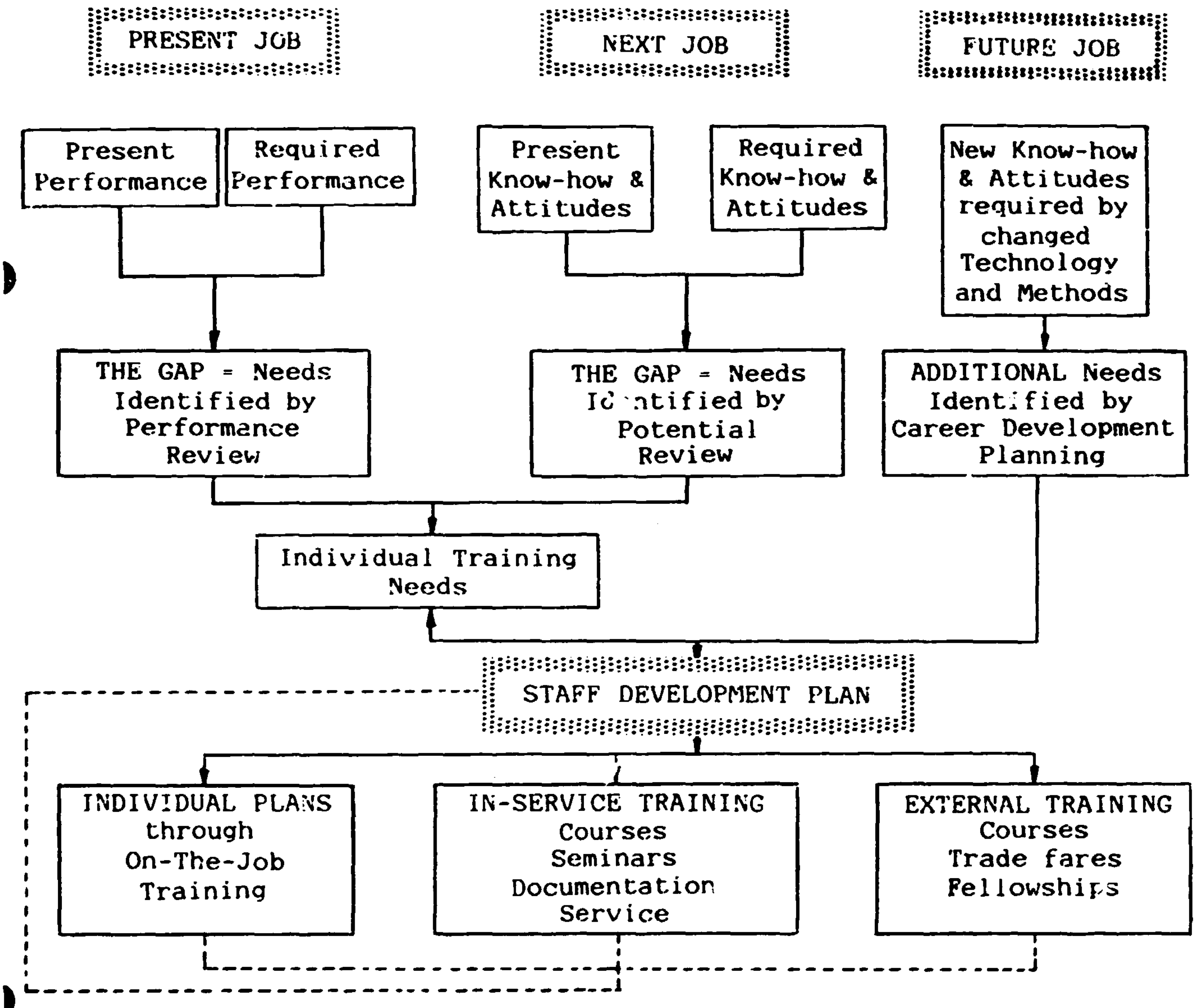
121.2 The training programmes are based on 75% practical technology and 25% academic subjects and related technical theory.

121.3 The purpose of On-The-Job training is to provide an opportunity for trainees, to gain relevant work experience within the maintenance unit within the company. Each company is required to ensure that the training provided comprices both the skills and operations relating to the trade.

122. <u>Staff Development Programme</u>

122.1 Properly trained staff is usually a bottleneck in the industrial expansion, especially during the introduction of new skills. The training of key personnel will be successful only through a well functioning Staff Development Programme. An inplant training programme, built upon individual Career Development Plans, should be the best way to upgrade the staff within the maintenance sector.

123. THE IN-SERVICE, UP-GRADING AND PROMOTION PROCESS.



124. The integration of the training courses in the global approach described in the project document.

124.1 The CTA, the STE and other UNIDO training experts in selected fields to be determined by the end of Phase 1, in conjunction with their counterparts at the SSTC, the Training Departments of the Sugar Estates and in consultation with the MATS trainers and as may be appropriate with the Sudanese educational institutions and will:

124.2 Develop and prepare the curricula and training materials for induction and up-grading courses for difference categories and level of personnel to be conducted at SSTC and the sugar estates on the basis of in-depth assessment of training needs.

124.3 Normally [illegible] analysis of the technological level of the equipment and the maintenance jobs fundamental for developing curricula and training materials to establish an integrated education in equipment and instrumentation maintenance.

125. **Conclusions**

125.1 In the four Governments Sugar Mills in Sudan, the recruitment background has decided the integration o f the training courses. Between 95 and 98% of the total number of instrument technicians have mechanical background.
The result is lack of electrical knowledge amongst the majority of the technicians.

125.2 When it comes into servicing and installation of instrumentation electricians are called into fault finding and installation of equipment, leading to time delays and overlap of responsibilities.

126. **Consequences**

126.1 Production disturbances
Involvement of personnel from the electrical workshop the management could have used for other tasks.
Main consequence, loss of economy.

127. Training objectives

127.1 The first integrationof training courses is to educate 100% of the instrument technicians in electrical technology.
The electrical education is the base for future integrated training courses for instrument technicians from the four sugar mills.

128. Elaboration on the methodology as it was and the result following each step.

129. **Programme**

129.1 Starting-point for the Education in Sennar was the introduction to a Modular System to be used as a basis for developing the various Training Programmes and courses to be established at the National sugar Training Centre.

131. **Objective**

131.1 At the completion of the programme each participant will have prepared a Modular Unit based upon the principles and guidelines set out by the programme presenter. The individual Modular Units will be integrated into a compolete Learning Package prepared to International specifications, codes of practice and standard format as a group activity.

132. How the training programmes were designed and developed.

133. <u>Information</u>

133.1 A lot of influence decide if a education is going to be successfull or not, for example:

133.2 The technological stand of the equipment and instrumentation in the Training Centre.

133.3 Do the existing equipment in the Training Centre fit the equipment in the German and English build-up factories?

133.4 The existing condition of equipment and instrumentation in the Training Centre.

133.5 The existing knowledge and experience of the Teacher(s) and Expert(s) involved in the education.

133.6 The actual level of technology and English language knowledge within the trainees in the group, etc.

133.7 The Expert discussed the existing equipment and instrumentation with the Experts counterpart Mr. Mudawi Elsadig Mudawi and the Expert decided to testify all equipment and instrumentation in the instrument workshop before the training course start the 10th of December 1988.

133.8 The Expert examinated all trainees about their English language knowledge, theoretical and practical background before and during the time the Training Course was held in the Training Centre.

133.9 The Expert and the Experts counterpart Mr Mudawi Elsadig Muldawi used the Modulary System step by step to design and develop the education.

133.10 The training programmes were designed and developed based on the existing equipment and instrumentation in the Training Centre and in the Sennar Sugar Instrument Workshop towards the equipment and instrumentation in the German and English built-up factories and towards the building up of the training capacity and capability in The Sennar Sugar Training Centre (SSTC).

134. <u>How the training programmes were implemented.</u>

134.1 The Expert and the Experts counterpart Mr Muldawi Elsadig Muldawi used the Modulary System in combination with the existing equipment and instrumentation as base for the implementation of the training programme.

135. <u>Methodology</u>

135.1 In order to achieve the objective of the programme the following procedures was adopted:

135.2 25% of time engaged in academic subjects and related technical theory.

135.3 75% of time occupied by practical technology.

136. <u>Activities</u>

136.1 The last 14 days was spent in the Sennar Sugar Mill Instrument Workshop. The Expert and counterpart was interested to train the trainees on realistic equipment and instrumentation used in the production in the sugar mill. (Point 9.5)

PROJECT NO:SF/SUD/86/003

RECOMMENDATIONS

(a) It is recommended to continue with the Modular System of Training in Sennar Sugar Training Centre, SSTC, and in Governments four Sugar Mills, in order to achieve the Objective of future Training Programmes.

(b) Relating to the purchase of new equipment and instrumentation for Phase II it is recommended to use an air-filter system in the new workshops: Instrumentation, domestic and industrial electrics, motorlab and chemical laboratory in order to avoid dust problems.

(c) The Expert discovered high peak voltage from time to time in Sennar Sugar power supply system. It is recommended to buy a protective transformer in order to avoid break-down of electrical equipment and instrumentation in Sennar Sugar Training Centre.

(d) It is recommended to change the existing situation in trainees and instructors accomodation in the guest-house in Sennar Sugar Training Centre. No toilets and lavatories exists in the guest-rooms. In order to make the education in the training centre more attractive and increase the wellbeing of the trainees and instructors,it is a necessity to supply the guest-house with bathrooms containing lavatorys, showers with warm and cold water and toilets.

(e) It is recommended not to change the education programme for the engineers and technicians selected for in plant training in the sugar mills (one from each plant) recommended for fellowship. The Expert is interested to use technicians as resourcer for Sennar Sugar Training Centre (A Teacher Bank). Annex VI.

(f) With Modawi as a coordinator we could use the seven educated Technicians from the basic process Instrument Training Course in Sennar Training Centre(SSTC), as a Task Force to send them for example to the Assalaya Sugar Mill during the closing down period July, August and let them do all pressure gauges in the Mill at the same time. To be able to do this operative, we must borrow dead weights testers and pressure gauges from all other Mills, Sennar, El Guneid and New Halfa.
Purchase of more testequipment could involve more Instrument Technicians, to be able to do all pressure gauges faster.

(g) It is recommended to use extra filters for the compressed air in Sennar Sugar Mill to avoid introduction of dust into the air supply system.

(h) It is recommended to send all broken expensive testing equipment for pressure from Sennar Sugar Instrument Workshop for repair to England so that they can get utilized again. (3pcs. two turns precision pressure gagues test equipment from Wallace and Tiernan, England).

(i) It is recommended to increase the space in the Governments four Sugar Mills Instrument Workshops to an accetable size, at least 10 x 10 m^2.

(j) It is recommended to buy a lot of different types of tools and hopefully get read of the philosophy producing tools from hack-saw blades.

Suggested equipment for selection Phase II.

Festo Didactic Education Material - Pneumatic.

ANNEX (I)

DRAFT

Based on

JOB DESCRIPTION

SF/SUD/86/003/11-51/Rev.2

Electrical and Instrumentation Engineering Training Expert

Mr. B. O. BERGLUND

WORK PROGRAMME FOR ELECTRICAL & INSTRUMENTATION ENGINEERING TRAINING EXPERT

WEEK NO:	ACTIVITIES:
1	VIENNA: Briefing, UNIDO
2	KHARTOUM: Travellings Permit Paper benefits, Visits, UNIDO, UNDP, Embassy
3a	SENNAR: Visit of four sugar mills. Type of Instrumentations, Manufactures, Ages, Existing Conditions, Do the manufacture firms still exist ? Existing Spareparts, Service Manuals
3b	SENNAR: Assess of instrumentation training needs, Existing training Soft- and Hardware, Preparation of Programme outline, Existing software production equipment.
4a	SENNAR: Curriculum for Job-Specification and Training Programme.
4b	SENNAR: Phase II, Workplan with a) Inputs b) Activities c) Output

5b SENNAR: Rehabilitation of the training building
Rehabilitation of training material
New training material a) Equipment
b) Training Aids
c) Software

5c SENNAR: Detail Analysis of 1) Workshop
2) Users, Trainee - Specifications
Skill for Task Analysis

6 SENNAR: Detailed List of Equipment for Production, Test and Maintenance, Tools and Spareparts

SENNAR: Travel Arrangements - Sennar-Khartoum-Vienna

The above work programme can only be completed satisfactorily over a minimum period of 9 weeks.

ANNEX II

DRAFT

Based on

JOB DESCRIPTION

SF/SUD/86/003/11-51/Rev.2

ALTERNATIVE WORK PROGRAMME FOR 10 WEEKS

WEEK NO:	ACTIVITIES:
1	VIENNA: Briefing, UNIDO
2	KHARTOUM: Travellings Permit Paper benefits, Visits, UNIDO, UNDP, Embassy
3	SENNAR: Visit of four sugar mills. Type of Instrumentations, Manufactures, Ages, Existing Conditions, Do the manufacture firms still exist ? Existing Spareparts, Service Manuals
4	SENNAR: Assess of instrumentation training needs, Existing training Soft- and Hardware, Preparation of Programme outline, Existing software production equipment.
5	SENNAR: Curriculum for Job-Specification and Training Programme.
6a	SENNAR: Advice and assist in training activities and other selfrequired activities by SSTC (Sennar Sugar Training Center)
6b	SENNAR: Rehabilitation of the training building Rehabilitation of training material New training material a) Equipment b) Training Aids c) Software

6c SENNAR: Detail Analysis of 1) Workshop
2) Users, Trainee - Specifications
Skill for Task Analysis

7/8 SENNAR: Phase II, Workplan with a) Inputs
b) Activities
c) Output

9 SENNAR: Design with counterpart's architects proposed extensin to the existing training facilites.

10 SENNAR: Detailed List of Equipment for Production, Test and Maintenance, Tools and Spareparts

11 SENNAR: Travel Arrangements - Sennar-Khartoum-Vienna

ANNEX (III)

National Sugar Training Centre, Sennar.

Staff Development Training Programme.

PROGRAMME PLAN.

Title: **The Introduction to a Modular System of Training to be Developed at the National Sugar Training Centre, Sennar.**

Date: NOVEMBER 1988 J.Bye.UNIDO. C.T

UNIDO

PROGRAMME : The introduction to a Modular System of Training to be developed at the National Sugar Training Centre, Sennar.

DURATION : Twelve days- 15th to 28th Nov., 1988 (Inclusive).

A I M : To provide a uniform understanding of one specific model for a Modular Training System to be used as a basis for developing the various Training Programmes and courses to be established at the National Sugar Training Centre.

LOCATION : The National Sugar Training Centre, Sennar.

PARTICIPANTS : All Counterparts and Workshop Instructors of the Training Centre.

Plus : Nominated Training Officers from the four (4) Public Sector Sugar Mills.

Plus : Any visitors from Kenana Sugar Training Centre, (as participants or observors).

LANGUAGE : The language of the programme will be ENGLISH.

OBJECTIVE : At the completion of the programme each participant will have prepared a Modular Unit based upon the principles and guidelines set out by the programme presenter.
The individual Modular Units will be integrated into a complete Learning Package prepared to International specifications, codes of practice and standard format as a group activity.

UNIDO

Subject Structure.

No	%	Subject Fields.	Subjects.
1.	5	Introduction to the System Approach to Training:-	a. The development of a Modular System. b. Definitions and Terminology. c. The key characteristics of a Modular System.
2.	5	The Modular Concept :-	a. The philosophy of phased development of skills using Training Modules.
3.	10	Training Needs Assessment:-	a. Training Population Analysis. b. Preparing a Trainee Specification c. Job Specifications. d. Identification of Training Needs.
4.	50	Developing a Modular Training Package:-	a. Identifying a Modular Unit. b. Specifying the objective of a Modular Unit. c. Job analysis. d. Task analysis. e. Skills analysis. f. Identifying the steps of work within a Modular Unit. g. Analysing the steps of work. h. Identifying the Learning Elements within a Modular Unit. i. Writing the objectives for a Learning Element. j. Determining the contents of a Learning Element. k. Designing Assignments and Progress checks for Learning Elements. l. Preparing Performance Tests. m. Preparing Instructional Units for future development into Learning Elements.
5.	25	Implementing a Modular Training System:-	a. Preparing Instructor Guidance Material. b. Preparing Trainee Guidance Material. c. Managing the implementation of a Training Programme. d. Evaluating Trainee Progress and Performance. e. Validation of Training Material.

UNIDO

Subject Structure.

No.	%.	Subject Fields.	Subjects.
6.	5	Follow-up and Feedback:-	a. Evaluating Efficiency and Effectiveness of Training. b. Designing and Carrying out follow-up procedures after Training.

UNIDO

METHODOLOGY

In order to achieve the objective of the programme the following procedures will be adopted:-

25% of time engaged in Seminar-Lecture activities.

75% of time occupied by supervised project work.

i.e. Individual and Group Projects will be assigned and whilst the time allocation may vary through the duration of the programme, as necessary, the ultimate aim is to spent 30% of total time available on Group Activities and 45% on Individual Project Activities.

The pattern of time allocation will be:-

07.00 to 07.30 -	Seminar, discussion etc. to consolidate the previous days assignment activities.
07.30 to 09.00 -	Presentation of subject material.
10.00 to 14.00 and 17.00 to 19.00 -	Group and Individual Projects.

PROJECT ASSIGNMENTS

The Individual and Group Assignments will be selected and supervised as follws:-

The assignments will be concerned with the detailed development of Modular Units and Modular Unit Learning Packages.

The final sessions of the programme will be devoted to the presentation of the materials developed as a basis for assessment and evaluation.

INSTRUCTIONAL PRACTICE

The application of the training materials and presentation techniques developed during the programme will begin as soon as possible following completion. To this end the National Director for Training and the CTA have planned three Training Programmes to begin on the 3rd December, 1988. These are:-

1. Mechanical - A Practical Course on Skills Awareness for Graduate Engineers.

2. Auto. Mechanics - Basic Practical Course for Vehicle Maintenance Fitters.

3. Elect./Instruments - Basic Practical Course for Instrument Technicians.

Each programme will be limited to (16) participants (ideally 4 from each location) to allow for ease in Assessment of Trainee Performance and Validation of the Modular Units used.

REPORT

A joint report will be prepared by the National Director for Training and the CTA.

J. BYE, OCT. 88

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGA ZATION.   SI/SUD/80/003   TRAININ COMPONENT OF THE SUGAR REHABILITATION PI

NATIONAL SUGAR TRAINING CENTRE - SENNAR

ME   WEEK No (2)   FROM. 19th Nov.   TO 24th

SAT	SUN	MON	TUE	WED	THUR
Developing Modular Training Package. - Instructional Units BYE	Implementing Mod. Training System. -Instructor Material. BYE	Implementing Mod. Training System. - Trainee Guidnce. Material. BYE	Implementation and Follow-up. Evaluating Trained Performance and Training Efficien-cy. BYE	Designing Follow-up System. BYE	PRESENTATI
P R O J E C T B / P / B	P R O J E C T B / P / B	P R O J E C T B / P / B	P R O J E C T B / P / B	PRESENTATION	PRESENTAT
P R O J E C T B / P / B	P R O J E C T B / P / B	P R O J E C T B / P / B	P R O J E C T B / P / B	PRESENTATION	CLOSING REV
P R O J E C T B / P / B	P R O J E C T B / P / B	P R O J E C T B / P / B	P R O J E C T B / P / B	PRESENTATION	

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGAN. .ION. SI/SUD/80/003 TRAINING OMPONENT OF THE SUGAR REHABILITATION PR

NATIONAL SUGAR TRAINING CENTRE - SENNAR

WEEK No (1) FROM. 12th Nov. TO 17th

SAT.	SUN.	MON.	TUE.	WED.	THUR
Introduction to the Systems Approach to Training BYE	Training Needs Assessment. Trainee Specification - Job specification. BYE	Developing Modular Training Package. - Identifying MU. - Objectives - Job Analysis. BYE	Developing Modular Training Package. - Task Analysis. - Skill Analysis. - Steps of Work. BYE	Developing Modular Training Package - Identifying Elmnt. - Writing Objctvs. BYE	Developing Mod Training Packa - Assignments. - Prfrmnce Tas BYE
The Modular Concpt. BYE	Group Project Assignment Session BYE/POULI/BURGLAND	PROJECT BYE/POULI/BURGLAND	PROJECT BYE/POULI/BURGLAND	PROJECT BYE/POULI/BURGLAND	PROJEC BYE/POULI/BURG
PRIVATE STUDY	Individual Project Assignment Session BYE/POULI/BURGLAND	PROJECT BYE/POULI/BURGLAND	PROJECT BYE/POULI/BURGLAND	PROJECT BYE/POULI/BURGLAND	PROJEC BYE/POULI/BURG
PRIVATE STUDY	PROJECT WORK BYE/POULI/BURGLAND	PROJECT BYE/POULI/BURGLAND	PROJECT BYE/POULI/BURGLAND	PROJECT BYE/POULI/BURGLAND	TUTORI BYE/POULI/BURG

- 769 -

ANNEX (IV)

National Sugar Training Centre,
Sennar.

INSTRUMENTAITION TRAINING PROGRAMME

PROGRAMME PLAN.

Title: BASIC INSTRUMENT COURSE

Date:

NATIONAL SUGAR TRAINING CENTRE - SENNAR

PROGRAMME : Basic Instrument Control :

DURATION : 4 Week:

OBJECTIVE : Upon completing this Modular unit the Trainee will,

1/ Understand the Theory of Pressure & temperature and be familiar with the sensing elements of Pressure and temperature.

2/ Be able to check & calibrate pressure & temp gauges.

3/ Know how the closed loop is arranged and differenciate between supply & signal lines.

LOCATION : National Sugar Training Centre - Sennar

PARTICIPANTS : 3 from each Sugar Factory.
Inst. Technician & Engineers.

LANGUAGE : English.

AIM : To provide Basic Information Theory & practical in pressure & temp. measurement and Senser elements used.

Subject Structure.

No	%	Subject Fields.	Subjects.
1		Pressure Measurement	- Basic Theory of Pressure - Unit of Pressure measurement. - Term used in Pressure measurement. - Pressure Instrument Theory & Practical. - Equipment to lest Gauges Practical & Theory - Servicing of Pressure gauges. - Installation of Pressure gauges. - Calibration of link type Instrument . - Spring loaded pressure regulators.
2		Measurement of Temperature	- Introduction . - State of meter. - Direction of heat flow & types of heat Transfer. - Units of Temperature measurement. - Properties of material in temp. Measurement - Thermometers. - Temperature Indicating Substance.
3		Pipe Work	- Cutting Copper pipes using a Hacksaw. - Using Brass flare joint for copper Pipes. - Reaming stop Cock & gate Value.
4		Electrical	- Electrical Energy. - Electrical Fuse. - Simple Electric circuit ANALYTICAL MEASUREMENT PH AND CONDUCTIVITY

ELECTRICAL INSTRUMENT DEPARTMENT

INSTRUMENT COURSE LOSED - 10 JAN. 89

COURSE ACTIVITIES

	From 7 to 7.50		From 8 to 9	From 9 to 10	From 10 to 10.50	10.50 to 11	From 11 to 12	From 12 to 12.15	From 12.15 to 1.15	From 1.15 to 2		INSTRUCTOR ONLY from 5 to 9
SAT.	Theory		Theroy		Pract. Work		Pract. Work		Pract. Work			
SUND	Theory		Theory		Pract. Work		Pract. Work		Pract. Work			
MOND.	Theory	BREAK	Theory	BREAKFAST	Pract. Work	BREAK	Pract. Work	BREAK	Pract. Work	PRIVATE WORK		PREPARATION FOR WORK
TUES.	Theory		Theory		Pract. Work		Pract Work		Pract. Work			
WED.	Theory		Theory		Pract. Work		Pract. Work		Pract. Work			
THUR.	Theory		Theory		Pract. Work		Pract. Work		Pract. Work			

National Sugar Training Centre - Sennar

Date	Day	Theory	Practical Work
11 DEC	Sun.	Theory Basic Theory the & of Pressure ..nt	Practical Work Conecting & Duconnecting close Control loop with Air supply & signal lines.
12 DEC	Mon.	Theory Unit of Pressure measurement	Practical Work Ckeck the available equipment for measureing & testing manometer & Dead weight tester
13 DEC	Tue.	Theory Terms used in Pressure measurement	Check the graduation of the monometer & how to connect gauges for test practically
14 DEC	Wed.	Theory Equipment to test Gauges	Three group of work To test the dead weight tester & how to operate it.
15 DEC	Thur		Servicing Pressure gauges and calibrate
17 DEC	Sat		Practical Induidual Work go round Fire experment. 1- explain and connect close control loop - Then Des connect.
18 DEC	Sun.		2- Check Pressure ganges using manometer calibrate and prepare defect for the coming Trainee 3- Check use stand pressure gauge as refrence 4- Check the same with dead weight tester.
19 DEC	Mon.	Theory Link type Instrument	Serivice & clibrate the calibrating gauges - recorders
20 DEC	Tues.	Theory Spring loaded Pressure Gauge	Calibrate Preumatic recorder and service Pressure Gauges .
21 DEC	Wed.	Theory Introd- uction to temp. state of mater	Check the Senser used for temperature measurement Practically.
22 DEC	Thur	Direction of flow. Properties of materi in temp.	Check the senser of temp measurment and open and test pressure gauges

ANNEX (V)

NATIONAL SUGAR TRAINING CENTRE - SENNAR

ELECTRO PLAN TEST & MEASUREMENT

SG 8 5HH. TELEX - 81337 REFERENCE TO ELECTRO PLAN CATALOGUE

QTY.	UNIT DESCRIPTION	CODE OR ORDER INFORMATION	PRICE GUIDE 1987
2	Digital multimeters FLUKE MODEL 23	611-868	£ 118.00
10	FUSE FOR DIGITAL MULTIMETERS	611-874	£ 2.42
2	Soft case for FLUKE series	617-024	£ 14.50
1	80J-10 current	17-81-01	£ 25.00
1	RF probe for multimeters	17-62-10	£ 16.82
1	Fluke 37 Bench multimeter	17-25-00	£ 187.00
	TEXTRONIX		
1	50 MHz Oscilloscope	26-45-00	£ 750.00
1	COVER AND ACCESORY POUCH	26-46-01	£ P.O.A.
1	Viewing Hood for TEXTROWIX 50 MHz	26-98-01	£ 17.94
4	SPARE PROBE (6103)	26-46-03	£ 16.00
1		26- -0	£ 17.94
1	Spare connecting lead	26-90-11	£ 5.75
1	Spare Earth lead	26-90-12	£ 2.95
1	Rack of 5 Replacement tips	26-59-11	£ 3.00
4	Rack of 3 sprung hooks	26-53-12	£ 8.15
1	5 MHz Function Generator	28-30-00	£ 295.00
-			
1	BM 10 Megger tester	22-11-00	£ 261.90
1	PVC Test & carry case	22-11-01	£ 40.00
1	Rechargeable cells & charger	22-11-02	£ 37.80
16pos	RECHARGEABLE BATTERIES TYPE HP11		
1	HM 31/IWT hand held meter	21-68-00	£ 275.00
1	DP 1203 unconfigured	20-18-00	£ 225.00
1	Ana logue output (option)	20-18-01	£ 32.00
1	DP 1600 7 bar gauge (calibrator)	20-16-00	£ 801.00
3	DP 1700 2 bar gauge	22-11-00	£ 165.00
-			
1	General purpose probe	20-87-01	£ 23.00
1	Needle probe	20-87-04	£ 25.50
2	2007 Thermometer 5	20-85-01	£ 86.00
-			
1	301 two pen recorder	25-10-02	£ 578.00
5	Spare Pens CH1 (blue)	25-12-01	£ 70.50
5	Pack of 6 CH2 (red)	25-12-02	£ 70.50
10x	5 chart Roll (15m Roll)	25-12-05	£ 92.50
	0- 100 °C RT	25-14-51	£ 95.00
1	0- 10VDC	25-14-21	£ 62.00

NATIONAL SUGAR TRAINING CENTRE - SENNAR

QTY	UNIT DESCRIPTION	CODE OR ORDER INFORMATION	PRICE GUIDE 1987	
1	4 - 20 mA	25-14-31	£ 62.00	
1	0 - 1000 •C (TYPEK)	25-14-71	£ 79.00	
1	BENCH STAND CRADLE	25-11-05	£ 35.00	
1	P1 100 K Simulator	11-72-00	£ 185.00	
1	Decade Resistance box	11-27-00	£ 129.00	
1	Carrging case	11-50-01	£ 20.00	
1	1071 100 UF capacitance Box	11-37-00	£ 183.00	
1	Carrying case	11-50-01	£ 20.00	
1	1077 Trandsducer Simulator	11-48-00	£ 387.00	
-				
1	Lab power Supply 761-1	14-40-00	£ 178.50	
1	Lab 704 Power supply	14-33-00	£ 347.00	
1	Rack mounting Kit	14-33-50	£ 20.00	
1	AVo8 MK 5Multimeter	27-54-10	£ 187.00	
1	Leather Case standard	27-54-01	£ 37.80	
2	Set of Spares batterys			
2	Lead Kit	17-12-00	£ 11.98	
1	EW604 Electronic Vattmeter	27-50-00	£ 284.00	
-				
1	CE 120	10-53-00	£ 5.50	
	Note :- All Tlems to be supplied with asuitable operating manual & Protective Instruction.			
10	BNC plug- BNC plug,50 0,6m.	488-309	£5.22	52.20
10	BNC plug- BNC plug,50 1,2m.	488-315	£5.70	57.-
10	BNC plug- CROCODILE CLIPS,50 1,2m.	488-523	£3.78	37.80
10	BNC plug- 4 mm plugs 50 1,2m.	488-595	£4.44	44.40
10	BNC plug to 4 mm Binding Post Adaptors	455-999	£5.96	59.60
10	BNC ADAPTORS 50 T	455-832	£4.00	40.-
100met	EXTRA FLEXIBLE WIRE, STANDARD. RED	356-173	£1.66	6.64
100met	EXTRA FLEXIBLE WIRE, STANDARD. BLUE	357-069	£1.66	6.64
200pcs	IN-LINE STACKABLE PLUGS, BLUE	444-545	£0.38	76.-
200pcs	IN-LINE STACKABLE PLUGS, RED	444-567	£0.38	76.-
50pcs	CLIPS, CROCODILE STANDARD	423-021	£0.157	7.85
		SUMMARY	£ 4030.23.-	

QTY.	DESCRIPTION	TYPE
1	Precision Pneumatic Calibrator	FA 235

RS EXPORT CENTRE (July, October 1987)
P.O. Box 99
Corby - Northants NN 179 RS ENGLAND

QTY	DESCRIPTION	STOCK NO.
1	Transistor Checker	424-169
8	Battery PP3	591-081
1	Digital Voltaer Lester	425-128
1	Contiauity Checker	424-002
1	PP3 Changer Phrgin	591-152
2	240 VAC Cyclic (on/off) Timing range J-200S	349-917
4	Industrial Timers 48 x 48 mm 0-60 hr 240 V 50H²	346-453
3	500 VA 24V Primany 110 V Sec. (Trans)	207-605
2	Suitable Plug Prim & Sec. Terminal	488-719
3	13 HRC FUES	412-605
1	Trans. 100 VA 12V 4-IA RV4 1A	207-295
1	Trans. 100 VA 20V 2.5 H 200.2% A	207-318
1	Mains Trans 50 VA 9V 2.7A 9V 2.7A	207-566
1	Trans 20 VA 6V 1.6 A 6V 1.6A	207-138
5	Pk of Fuses 13A 1 inch Length	412-605
3	Pk of Fuses 10A 1 inch Length	422-598
5	Pk of Fuses 7A 1lnch Length	412-682
3	Heavy duty side cutter	544-487

QTY.	DESCRIPTION	STOCK No.
2	4" No. 2 Phillips Crosspoint	613-498
3	6" No. 3 " " " " " " "	613-505
3	Set Hexagon Keys (Metric set)	545-042
2	Spanner Com. Meteric A/F (mm)	549-555
2	Hammer 21 b.	600-846
2	Soft face Hammer	547-852
1	Nylon faces (1 pair)	547-868
1	Soft P.V.C. (1 pair)	547-876
1	Marking punches 0.9 (6 mm) set	613-381
1	Micrometer 0.25 (mm) Metric	549-101
1	Feeler gauges Metric	542-403
1	Radius gauges metric set	603-659
1	Depth gauges	603-738
1	Fluorescent bench magnifier	548-704
2	Replacement tubes	541-062
2	Eye glass	544-055
2	Power drill general duty (240 V - 400 W) Kit	408-395
1	10 mm Chuck & key	608-339
1	Chuck Key	608-604
1	Electro Preumatic Hammer (240V-500) drill	601-215
1	Chuck Adapter	601-237
2	Heave duty solering Iron 240V	547-032
3	Spare element 240V	547-054
1	Solering Iron stand	547-105

SPARE TOOLS

Honeywell Toolset Part No. 783789-001

4	Off	Complete Tool Rolls, each Contawing.
1-9	Off	Screwdriver 6" x 3.16" Blade
1-7	Off	½ Screwdriver 4" x ¼ Blade
1	Off	C/E Spanner ½ x 9.16" x AF
1	Off	C/E Spanner 3.8" x 7.16" x AF
1	Off	C/E Spanner 5.8" x 3.4' x AF
1	Off	Oil Can
1	Off	Adjustable Spanner 6"
1	Off	Adjustable Spanner 4"
1	Off	Box of Spanner & Tomey Bar 4 x 6 bar
1	Off	Watchmaker Brush 10"
1	Off	Dusting Brush ¾"
1	Off	Allen Key 1.8"
1	Off	Allen Key ¼"
1	Off	Allen Key 3.8"
1	Off	Allen Key 0-035"
1	Off	Inspection Mirror ¾"
1		Pair Tweezers
1	Off	Pinchuck
1	Off	Pocket thermometer (20 to 240 Degrees F.)
1	Off	Flat Needle File 5½.
1	Off	Solid Wire Keys
1	Off	Bristo Wernish No.2
1	Off	" " " " No.4
1	Off	" " " " No.5
1	Off	" " " " No.6
1	Off	" " " " No.8
1	Off	" " " " No.10
1	Off	Unbreak Wernish N1
1	Off	" " " " " V2
1	Off	O/W Spanner for No. 1&2 Nuts 12" x .095
1	Off	O/D Spanner 7.32" x ½"

ANNEX (VI)

IN PLANT TRAINING
(One from each plant)
RECOMMENDED FOR FELLOWSHIP

NAME ABDALLAH MOHAMMED ALI

GRADUATION Diploma in Electrical Engineering
3 years Course
Khartoum Polytechnic, College of Engineering Studies.

POSITION Engineer, Gunied Sugar Company, SIEMENS-GERMANY

NAME MOHAMMED ABDALLAH ELGORASHI

GRADUATION Secondary School

POSITION Instrument Technician, Sennar Sugar Company, FOXBORO-ENGLAND

NAME MOHAMMED ELNOUR ABDALLAH

GRADUATION Secondary School

POSITION Instrument Technician, Assalaya Sugar Company
Rabak-SUDAN FOXBORO-ENGLAND

NAME AMIN YOUSIF MAOHAMMED ALLOUB

GRADUATION Diploma in Electomics, Khartoum Polytechnic
3 years

POSITION Instrument Technician, New Halfa Sugar Company
SIEMENS-GERMANY

AGE 27 Years

NAME MUDAWI ELSADIG MUDAWI

GRADUATION

POSITION Head of Instrumentation & Electrical Engineering Department
Sugar Training Centre Sennar

AGE 38 years SIEMENS-GERMANY

ANNEX (VII)

ASSALAYA SUGAR COMPANY

Proposed Skill Upgrading Course for Factory Instrument Technicians Stage 1

Duration: 7 weeks off Job Training.

1 Week:	Safety - all aspects including electrical and compressed air safety.
3 Weeks:	Basic Pneumatics - Basic Physics, piping and valves. Pressure gauges, basic pneumatic principles.
3 Weeks:	Basic Electrics. Ohms Law in simple circuits, basic electronics, measuring circuits.

NOTE:

1. Safe working practice to be stressed at all times.
2. Each trainee will be issued with a log book to record notes and lectures during the course.
3. Monthly tests of practical and theoretical knowledge will be given to assess the trainees' aptitude.

Subject		Basic Skills
Safety (1 Week)		
	a	General aspects of safety including cleanliness, tidiness, regulations, fire hazards, machine guards and protective equipment.
	b	Electric Safety procedures including safe methods of isolation and testing.
	c	Safety hazards associated with compressed air.
	e	Electrical protection - short circuits and earth faults - fuses and circuit breakers, grades of protection.
	f	Moving coil and moving iron meters.
	g	Using the multimeter for measuring volts, amps and Ohms in D.C. and A.C. circuits. The meggar - its uses and dangers.
	h	The Wheatstove bridge circuit, Kirchoffs Law. Calculations and applications.
	i	Transformers. AC/DC generators. Chopper circuits, the diode, bridge rectifiers.
	j	Capitance, units of, in parallel and series circuits, uses of.

Basic Pneumatics.
(3 Weeks)

a Units of pressure and equivalents.

b Basic physics, Boyles Law, Charles Law, pressure ands flow relationships, specific gravity.

c Head, head calculations, units of head, differential pressure.

d Piping practices, identifying tube fittings, pipe threading and installation.

e Types of hand valves and their application.

f Pressure Measurement, safety in handling mercury, monometers, the Bourdon tube, pressure gauges, types and applications, the dead weight tester, test and calibration of pressure gauges.

g The simple pressure regulator. Principles of operation, maintenance and repair

h The principle of levers and moments.

i The flapper and nozzle system.

j The Force balance principle.

k Output booster relays. Theory of operation, repair and testing.

Basic Electrical.
(3 Weeks)

a Properties of conductors and insulators.

b Ohms Law applied to series and parallel circuits. Effects of temperature on resistance.

c Resistors, colour codes, types of, rating and uses.

d Effects of electric current - heating magnetism, induction, chemical effects and batteries.

ASSALAYA SUGAR COMPANY

Proposed Skill Upgrading Course for Factory Instrument Technicians Stage 2

Duration: 30 weeks off the Job Training.

1 Week:	Basic Course Review - pneumatic principles.
4 Weeks:	Measuring Systems - Flow primary measuring elements and transmitters.
3 Weeks:	Measuring Systems - Level - primary measuring elements and transmitters.
3 Weeks:	Measuring Systems - Temperature - primary measuring elements, circuits and transmitters.
3 Weeks:	Measuring Systems - Pressure - primary measuring elements and transmitters including vacuum.
1 Week:	Measuring Systems - pH, primary measuring elements and transmitters
4 Weeks:	Control Theory and Controllers - Theoretical and Practical.
4 Weeks:	Final Control Elements - valves and drives.
3 Weeks:	Miscellaneous Equipment - Control equipment not covered under previous headings.
4 Weeks:	Advanced Principles & Considerations - Application of knowledge learnt relative to the Sugar Industry.

NOTE:

1. Safe working practice to be stressed at all times.
2. Each trainee will be issued with a log book to record notes and lectures during the course.
3. Monthly tests of practical and theoretical knowledge will be given to assess the trainees' aptitude.

Subject		Basic Skills
Basic Course Review (1 Week)		
	a	General review of instrument and electrical basics.
	b	The Flapper and nozzle.
	c	The Force balance principle.
	d	Standard pneumatic and electical transmission systems.
Measuring Systems -		Flow.
(4 Weeks)		
	a	Basic principles and units of measurement reason for measurement, quantity meters, rate of flow meters
	b	Turbine type meters and counters, functions, applications, accuracy, repair disadvantages.
	c	Differential Pressure Systems, primary elements - venturi tubes, orifice plates, Pitot and annabar tubes, installation and tapping considerations for various process mediums. Head loss, applications accuracy, disadvantages.
	d	The differential pressure transmitter, theory of operation isolation and safety, putting into service, repair and calibration and maintenance.
	e	Variable area flowmeters, principles of operation, accuracy, applications, disadvantages.
	f	Magnetic Flowmeters. Theory of operation, accuracy, applications, repair and calibration. Cabling considerations - earthing.
	g	Square Root extractors - need for -theory of operation, repair and calibration.

Measuring Systems - Level
(3 Weeks)

a Direct and indirect methods, dipstick, sightglass, float operated devices, problems of open and closed tanks.

b Bubble Tubes. Principle of operation, applications, disadvantages, maintenance of, use of differential pressure transmitter with.

c Direct measurement with differential pressure transmitters including diaphragm types, open and closed tanks, wet and dry legs, suppression, elevation and head calculations.

d Displacer systems. Archimedes principle, theory of operation, applications, repair and calibration.

e Level switches, types, applications, repair and maintenance.

Measuring System - Temperature.
(3 Weeks)

a Units of measurement.

b Liquid Expansion thermometers, liquid in steel, gas expansion, vapour pressure and bi-metallic types. Temperature switches. Application, repair and calibration of all, cross ambient conditions, accuracy disadvantages.

c Resistance Thermometers. Principles of operation, types of, ranges, wiring of measuring circuits and receiving devices, testing and calibration of.

d Thermocouples. The Seebeck effect compensation for cold junctions. Types of thermocouples, standard tables, ranges, measuring and receiving instruments. Testing and calibration of care and use of the portable potentiometer.

Measuring System - Pressure.
(3 Weeks)

a Slack diaphragm type pressure indicators and transmitters. Principle of operation, applications, repair and calibration.

b Bourdon tube type pressure transmitters including spiral and helical type tubes, applications repair and calibration.

c Bellows and diaphragm type gauges.

d Vacuum guages and vacuum transmitters, repair and calibration of.

Measuring System - pH
(1 Week)

a Principles of hydrogen iou activity measurement - the pH scale, typical acids and alkalies, applications.

b Industrial pH electrodes, care and maintenance of.

c pH meters, repair and calibration of using voltage injection and buffer solutions.

d Effects of temperature on pH and buffet solutions.

e Daily and Weekly maintenance of on line systems.

Control Theory and Controllers.
(4 Weeks)

a Basic control principles. Open and closed loop systems, examples and applications of.

b On-off and Proportional only control theory and characteristics. Applications and limitations.

c Proportional plus integral control theory and characteristics. Applications.

d Proportional and integral and derivative control theory and characteristics.

e The Foxboro 100 series controller - principles of operation including automanual station and bumpless transfer units. Repair, maintenance and calibration of.

f Principles of controller timing.

Final Control Elements.
(4 Weeks)

a Basic principles and requirements of pneumatically and electrically operated final control elements.

b Pilot solenoid and electrically operated valves.

c On/off pneumatic actuators and types of valves they control - valve applications.

d Proportioning pneumatic control valves, operating principles, types of valve and typical applications, flow characteristics, pressure drop and valve sizing principles. Installation and maintenance.

e The Valve Positioner. Principle of operation, applications, calibration repair and maintenance.

f Damper controls, damper flow characteristic, repair and calibration.

Miscellaneous Equipment.
(3 Weeks)

a Pneumatic and electric recorders, day and strip type, maintenance repair and calibration.

b Pneumatic computing relays, principles of operation, applications, repair and maintenance of.

c P/I and I/P transducers, principles of operation, application, repair and calibration.

d Photo electric sensors and relays - principle of operation, routine maintenance, repair.

e Tacho generators, types of signal, indicators, maintenance and repair.

f Weighing machines, principles of operation, care, maintenance and calibration of.

g Electro-mechanical relays and relay logic circuitry - drawing standards, applications, fault finding.

Advanced Principles and Considerations
(4 Weeks)

a Symbol standards and reading and understanding Plant and Instrument Drawings (PID).

b Feed Forward and Cascade Control Loop principles. Theory, examples and benefits.

c Boiler drum level control, single, two and three element principles and benefits. Basic boiler theory and factors effecting level control.

d Basics of Juice Treatment and Evaporation and associated control problems.

e An introduction to logical fault analysis applying principles learned throughout the course.

f Modern control technology - a short review.

ASSALAYA SUGAR MILL

Saturday, 1988. 12.02

BROKEN EQUIPMENT

ITEM	:	Pressure precision gauges
MANUFACTURE	:	Wallace & Tiernan, England
PRESSURE RANGE		0 - 30 psi & (500 mm Vp)
MODEL #	:	FA - 145
INSTRUMENT CORRECTION	:	± 20°C Recommendation to change the instrument correction temperature to ± 30°C in tropical areas! relating to the temperature in Sudan.

- Urgent needs of Testequipment in and output 20MA
- DC - Power Supplies
- Testoven for thermocouples
- Thermocompensator with a built-in manual temperature compensating unit. Manufacture: Norma, Vienna, Austria.
- Precision test unit for pressure gagues. Reference pressure gagues in different pressure ranges.
- Test pannel for pneumatic transmitters and controllers (max 6 bar).
- Movable pressure compressor (electrical supply).
- Movable test unit for current and pressure in and outputs in different measuring ranges. Type: Tc-4.
  Manufacture: Global Automation Services Limited, Basildon, Essex, England.
- Digital multimeters (Fluke 85), spareparts batteries SLF22, rechargeable batteries type: HpII.Rechargeable batteries type: HpII.
- Existing equipment in the workshop:
- 1 Avometer used by 8 instrument technicians.
- 1 Noronix temperature meter, 0 - 1100°C, Type: NTM 2A.
- 32 electricians works in the service group.

ASSALAYA

EL GONIED SUGAR COMPANY

URGENT NEEDS: Test Panel for Pneumatic Transmitters & Controllers
Max. 6.0 bar.

ALL EXISTING PRESSURE GAUGES MANUFACTURED 1962

PRESSURE COMPRESSOR (Moveable, Made in Denmark).

VALMET VALV TESTER, Air Test A8

MEASURING RANGES:-

0 - 10 kp/cm^2
0 - 1,0 kp/cm^2
0 - 1,5 kp/cm^2
2 - 6,0 kp/cm^2

KALYAN BOSE
SENIOR TRAINING OFFICER (ELECTRICAL AND INSTRUMENT)
TRAINING CENTRE
KENANA SUGAR CO.
P.O. BOX 2632
KHARTOUM SUDAN

SITE

39 FITZROY SQUARE
LONDON WIP 5LL

3 MANUALS IN HUDRAULICS, MLS - 765
MAINTENANCE OF HYDRAULICS EQUIPMENT
SPAREPART CATALOG
PICTURES OF VALVES, TRANSMITTERS, CONTROLLERS
FOXBORO, FISHER AND PORTER, FOXBORO HARMANN AND BRAUN
SIEMENS, LEEDS AND NORTHRUP.

BID LIST NUMBER: ASSALAYA BOILER 10
COST TABLE REF: AFR14060
DESCRIPTION: SPARE PARTS AND REPLACEMENTS FOR BOILER INSTRUMENTS

BID LIST TAG/MARK	QUANTITY	DESCRIPTION
		FOXBORO-YOXALL LIMITED REDHILL, SURREY, ENGLAND, RH1 2HL
		FOXBORO DIFFERENTIAL PRESSURE TRANSMITTER MODEL 13A1-MK2-LD
	10	SUPRESSION KIT, PART NO. U0122BS
	5	SOCKET HEAD SCREW, 5.40 X 3/16", PART NO. X116P.B.
	2	BRACKET, PART NO. 1386B
	10	SOCKET HEAD SCREW, 8.32 X 5/16", PART NO. U0124EZ
	20	PAN HEAD SCREW, 5.40 X 5/32", PART NO. X100ZB
	8	SPRING ASSEMBLY, PART NO. U0122HB
	5	SCALE, MIN-MAX/0-50, PART NO. U102TF
	10	RD. HEAD SCREW, 5.40 X 3/16", PART NO. 5137
	16	PLATES, PART NO. 1388S
		FOXBORO INSTRUMENT MAINTENANCE TOOLS and fixtures
	5	CALIBRATING FIXTURE,
	2	MICROMETER, ___________???
	5	TENSION SCREW, PART NO. C0135YR
	1	8" ORIFICE ASSEMBLY, FOXBORO SPEC. SHEET CO/3, STAINLESS ST. MAX. STEAM FLOW 70,000 LB/H, 25 KG/SQ CM, 437 DEG C WORKING STEAM FLOW 56,000 LB/H, 25 KG/SQ CM, 380 DEG C
	1	4" ORIFICE ASSEMBLY, FOXBORO SPEC. SHEET CO/4, STAINLESS ST. MAX. BOILER FEEDWATER FLOW 70,000 LB/H, 37.47 KG/SQ CM WORKING BOILER FEEDWATER FLOW 56,000 LB/H
	1	CONICAL ORIFICE ASSEMBLY FOR OIL FLOW MAX. OIL FLOW 8000 KG/H, 24.6 KG/ SQ CM

BID LIST NUMBER:ASSALAYA BOILER 10
COST TABLE REF: AFR14060
DESCRIPTION: SPARE PARTS AND REPLACEMENTS FOR BOILER INSTRUMENTS

BID LIST TAG/MARK	QUANTITY	DESCRIPTION
		FOXBORO-YOXALL LIMITED REDHILL, SURREY, ENGLAND, RH1 2HL
		FOXBORO DIFFERENTIAL PRESSURE TRANSMITTER MODEL 13A1-HK2-LD
	5	SOCKET HEAD SCREW, 5.40 X 3/16", PART NO. X116P.B.
	2	BRACKET, PART NO. 138GB
	10	SOCKET HEAD SCREW, 8.32 X 5/16", PART NO. U0124EZ
	20	PAN HEAD SCREW, 5.40 X 5/32", PART NO. X1002B
	5	SCALE, MIN-MAX/0-50, PART NO. U102TF
	10	RD. HEAD SCREW, 5.40 X 3/16", PART NO. 5137
	16	PLATES, PART NO. 138BS
		FOXBORO INSTRUMENT MAINTENANCE TOOLS AND FIXTURES
	5	CALIBRATING FIXTURE, PART NO. CO130LB/PSL
	5	8" ORIFICE plate, FOXBORO SPEC. SHEET CO/3, STAINLESS ST. MAX. STEAM FLOW 70,000 LB/H, 25 KG/SQ CM, 437 DEG C WORKING STEAM FLOW 56,000 LB/H, 25 KG/SQ CM, 380 DEG C
		BAILEY METERS AND CONTROLS LTD. 218 PURLEY WAY, CROYDON CR9 4HE ENGLAND
		AIR OPERATED CONTROL DRIVE TYPE AE 68, MODEL 7
		-BAILEY INSTRUCTION BOOK SECTION E P81-1, JUNE 1968, PAGE 24

BID LIST NUMBER:ASSALAYA BOILER 12

DESCRIPTION: SPARE PARTS FOR INSTRUMENT AIR DRYER
DRYVENT LIMITED
HOLLYGROVE HOUSE, STAINES ROAD
HOUNSLOW, MIDDLESEX, ENGLAND

BID LIST TAG/MARK	QUANTITY	DESCRIPTION
		AIR DRYING PLANT, TYPE RCL 38, SIZE E/8/51/D, 195 SCFM, WORKING PRESSURE 100 PSIG, SERIAL NO. 5523 INSTRUCTION BOOK SERIES C.2, ISSUE 2, MAY 1989
	1	TIMER ASSEMBLY COMPLETE, PART NO. 4429V-4429/IV TAG: TIMER assembly for instrument air dryer
	4	3 WAY SOLENOID VALVE, PART NO. 4613V TAG: 3 WAY SOLENOID VALVE FOR INSTRUMENT AIR DRYER
	2	1 INCH PISTON VALVE, PART NO. 5331 TAG: 1 INCH PISTON VALVE FOR INSTRUMENT AIR DRYER
	2	2 INCH PISTON VALVE, PART NO. 5335 TAG: 2 INCH PISTON VALVE FOR INSTRUMENT AIR DRYER
	2	PISTON VALVE SPARED KIT, PART NO. 5335/1 TAG: PISTON VALVE SPARES FOR INSTRUMENT AIR DRYER
	4	ABSORBER INSERT, PART NO. 5163/5 TAG: ABSORBER INSERT FOR INSTRUMENT AIR DRYER
	1	18 INCH THERMOSTAT, PART NO. 4457/2 TAG: THERMOSTAT FOR INSTRUMENT AIR DRYER
	1	NEON LIGHT, PART NO. 4759/V TAG: NEON LIGHTS FOR INSTRUMENT AIR DRYER

BID LIST NUMBER: ASSALAYA BOILER 13
COST TABLE REF: AFR14060
DESCRIPTION: SPARE PARTS FOR BOILER FEEDWATER PUMP
SULZER BROS. LTD.
SUN FOUNDRY, DEWSBURY ROAD
LEEDS 11, ENGLAND

BID LIST TAG/MARK	QUANTITY	DESCRIPTION
		BOILER FEEDWATER PUMP, SULZER TYPE HPL 4SN 30 12-1/2 L20, SERIAL NO. 83734, 278 CU M/H, 1250 FT HEAD, 2950 RPM, 490 HP, 8" INLET, 5" DISCHARGE
	4	PACKING BUSH FOR CASING ELEMENT, PART NO. 11.2 TAG: PACKING BUSH FOR BFW PUMP
	50	JOINT RING FOR CASING ELEMENT, PART NO. 11.12 TAG: CASING ELEMENT PACKING RING FOR BFW PUMP
	18	DIFFUSER AND GUIDE PLATE, PART NO. 20 TAG: DIFFUSER AND GUIDE PLATE FOR BFW PUMP
	15	PACKING BUSH FOR OVERFLOW PIECE, PART NO. 21.3 TAG: OVERFLOW PIECE PACKING BUSH FOR BFW PUMP
	2	PUMP SHAFT, PART NO. 31 TAG: PUMP SHAFT FOR BFW PUMP
	4	OFF-SIDE PACKING SLEEVE WITH HEX COLLAR, PART NO. 31.2 TAG: OFF-SIDE PACKING SLEEVE FOR BFW PUMP
	6	COUPLING SIDE SHAFT SLEEVE, PART NO. 31.24 TAG: COUPLING SIDE PACKING SLEEVE FOR BFW PUMP
	2	DISTANCE SLEEVE, PART NO. 31.28 TAG: DISTANCE SLEEVE FOR BFW PUMP
	6	BALANCE DISK, PART NO. [illegible] TAG: BALANCE DISC FOR BFW PU[illegible]
	2	COUNTER BALANCE DISC, PART NO. 32.1 TAG: COUNTER BALANCE DISC FOR BFW PUMP
	10	JOINT RING, PART NO. 32.11 TAG: JOINT RING FOR BFW PUMP
	6	WEARING RING FOR BALANCING DISC, PART NO. 32.2 TAG: WEARING RING FOR BALANCING DISC OF BFW PUMP
	6	WEARING RING FOR COUNTER BALANCING DISC, PART NO. 32.3 TAG: WEARING RING FOR COUNTER BALANCING DISC OF BFW PUM
	10	OFF-SIDE JOINT RING FOR BEARING SUPPORT, PART NO. 41.25 TAG: JOINT RING FOR BEARING SUPPORT OF BFW PUMP

DESCRIPTION: OIL BURNER SYSTEM
HAMWORTHY ENGINEERING LTD.
FLEETS CORNER, POLE
DORSET BH 17 7LA, ENGLAND

BID LIST TAG/MARK	QUANTITY	DESCRIPTION
		SPARE PARTS FOR OIL BURNER TYPE SHMK WITH QUICK RELEASE COUPLINGS
	20	ATOMIZER, ITEM NO. 10, PART NO. 33290/779 TAG: OIL BURNER
	2	GUN ASSEMBLY, COMPLETE TAG: OIL BURNER
	5	CAPNUT 3H MKII/2, MILD STEEL TAG: OIL BURNER
	10	FLEXIBLE HOSE, 1/2" NB X 4 FT LONG, WITH HANSEN 1/2" FPT QUICK RELEASE COUPLING TAG: OIL BURNER
		SPARE PARTS FOR OIL PUMP, HAMWORTHY TYPE SHA 660-13L3, SERIAL NO. G.O. 34985-01/02, PUBLICATION NO. PCH 1017
	2	INSERT, PART NO. 2 TAG: OIL PUMP SER. NO. G.O. 34985-01/02
	2	AUXILIARY BEARING, PART NO. 8 TAG: OIL PUMP SER. NO. G.O. 34985-01/02
	2	MAIN SCREW, PART NO. 12 TAG: OIL PUMP SER. NO. G.O. 34985-01/02
	2	AUXILIARY SCREW, PART NO. 13 TAG: OIL PUMP SER. NO. G.O. 34985-01/02
	4	JOINTS 5-3, PART NO. 22 TAG: OIL PUMP SER. NO. G.O. 34985-01/02
	4	JOINTS 2-5, PART NO. 24 TAG: OIL PUMP
	4	JOINTS 10-4, PART NO. 29 TAG: OIL PUMP SER. NO. G.O. 34985-01/02
	2	DEEP GROOVE BEARING, PART NO. 34 TAG: OIL PUMP SER. NO. G.O. 34985-01/02
	2	CIRCLIPS, PART NO. 35 TAG: OIL PUMP SER. NO. G.O. 34985-01/02
		SPARE PARTS FOR OIL PUMP, SERIAL NO. 35833-1, CAPACITY 22800 KG/H, 1450 RPM, INLET 100 MM, OUTLET 125 MM, INSTRUCTION BOOK DWG. A10430

12	WEAR RING, PART NO. 32.2 TAG: WEARING RING FOR LOW CAP. BFP
13	WEAR RING, PART NO. 32.3 TAG: WEARING RING FOR LOW CAP. BFP
10	JOINT RING, PART NO. 41.25 TAG: JOINT RING FOR LOW CAP. BFP
3	OFF-SIDE BEARING BUSH, PART NO. 43 TAG: OFF-SIDE BEARING BUSH FOR LOW CAP. BFP
3	COUPLING SIDE BEARING BUSH, PART NO. 42 TAG: COUPLING SIDE BEARING BUSH FOR LOW CAP. BFP
8	COUPLING SIDE LANTERN BUSH, PART NO. 51.4
7	IMPELLER FOR LOW CAPACITY BFP, PART NO. 30 TAG: IMPELLER FOR LOW CAPACITY BFP
6	KEY FOR IMPELLER, PART NO. 31.11 TAG: KEY FOR IMPELLER OF LOW CAP. BFP
1	PUMP COUPLING COMPLETE TAG: PUMP COUPLING FOR LOW CAP. BFP

20	OIL SEAL, COMPONENT NO. G 979, ITEM NO. 58
10	CAM SHAFT AND PINION, COMPONENT NO. D 45045C, ITEM NO. 61
20	O-RING GASKET, COMPONENT NO. DO 113C, PART NO. 64
20	BEARING, COMPONENT NO. H 253, ITEM NO. 66
10	CIRCLIP, COMPONENT NO. H 230, ITEM NO. 68
10	ROLLER PIN, COMPONENT NO. G 948, ITEM NO. 68
10 CANS	MOLY GREASE CONTAINING ROCOL, COMPONENT NO. MT 285, PACKED IN 1 LB CAN

	10	Pilot stem spring comp no. 6971 , Item no.44
	20	Pilot beam spring comp no. 6957, Item no.34
	10	Adjusting nut comp no. G 968 Item no. 27
	10	Eye bolt comp no. H 252 Item no. 28
	10	Adj. pibot comp. no. G 967, Item no. 29
Page 31,	10	Pilot valve assy Model AE68 Comp no. G 989, Item no.2

3	AUXILIARY BEARING, PART NO. 8 TAG: OIL PUMP SER. NO. 35633-1
18	ADJUSTING SCREWS, PART NO. 18 TAG: OIL PUMP SER. NO. 35633-1
10	O-RING, PART NO. 23 TAG: OIL PUMP SER. NO. 35633-1
4	O-RING, PART NO. 84 TAG: OIL PUMP SER. NO. 35633-1
4	O-RING, PART NO. 86 TAG: OIL PUMP SER. NO. 35633-1

2	DRIVE SIDE LANTERN BUSH, PART NO. 51.4 TAG: DRIVE SIDE LANTERN BUSH FOR BFP
6	LANTERN RING, PART NO. 53.1 TAG: LANTERN RING FOR BFW PUMP
2	COUPLING SIDE BEARING BUSH, PART NO. 42 TAG: COUPLING SIDE BEARING BUSH FOR BFW PUMP
2	MOUNTING DISC FOR DIFFUSER AND GUIDE PLATE, PART NO. 13.35 TAG: MOUNTING DISC FOR BFW PUMP
6	IMPELLER FOR BFW PUMP
6	KEY FOR IMPELLER, PART NO. 31.11 TAG: KEY FOR IMPELLER OF BFW PUMP
1	PUMP COUPLING COMPLETE TAG: PUMP COUPLING FOR BFW PUMP

LOW CAPACITY BOILER FEEDWATER PUMP,SULZER TYPE HPL 20-10-20, SERIAL NO. 84736, 235 GPM, 1250 FT HEAD, 2950 RPM, 5" INLET, 4" DISCHARGE

25	JOINT RING FOR CASING ELEMENT, PART NO. 11.12 TAG: JOINT RING FOR CASING ELEMENT OF LOW CAP. BFP
6	LARGE WEARING RING, PART NO. 11.12 TAG: LARGE WEARING RING FOR LOW CAPACITY BFP
15	PACKING BUSH FOR OVERFLOW PIECE, PART NO. 21.3
6	DIFFUSER AND GUIDE PLATE, PART NO. 20 TAG: DIFFUSER AND GUIDE PLATE FOR LOW CAPACITY BFP
2	PUMP SHAFT, PART NO. 31 TAG: PUMP SHAFT FOR LOW CAPACITY BFP
3	OFF-SIDE SHAFT SLEEVE WITH HEX COLLAR, PART NO. 31.2 TAG: OFF-SIDE SHAFT SLEEVE FOR LOW CAPACITY BFP
5	COUPLING SIDE SHAFT SLEEVE, PART NO. 31.24 TAG: COUPLING SIDE SHAFT SLEEVE FOR LOW CAPACITY BFP
5	DISTANCE SLEEVE, PART NO. 31.26 TAG: DISTANCE SLEEVE FOR LOW CAP. BFP
3	BALANCE DISC, PART NO. 32 TAG: BALANCE DISC FOR LOW CAP. BFP
3	COUNTER BALANCE DISC, PART NO. 32.1
10	JOINT RING, PART NO. 32.11 TAG: JOINT RING FOR LOW CAP. BFP

15 KIT SP 6801 FOR DRIVE TYPE AE 68PB, CYLINDER ASSEMBLY
SP 6801 INCLUDING:
-1 ROD PACKING, E 113
-1 FELT, E 709
-2 GASKET, H 191
-1 ROD O-RING, H 191
-2 PISTON O-RING, DO 123C

15 KIT SP 6803 FOR DRIVE TYPE AE 68PB, CYLINDER ASSEMBLY
SP 6801 INCLUDING:
-1 BRAKE LEVER SPRING, D 466
-1 BELLOW, D 466
-1 SPRING, G 506
-1 SPRING, G 507
-2 BRAKE LEVER, D 42976C

15 KIT SP 6920 FOR DRIVE TYPE AE 68PB, CYLINDER ASSEMBLY
SP 6801 INCLUDING:
-2 PILOT VALVE SLEEVES, E 427
-2 PILOT VALVE SEATS, E 429
-1 CAM ROLLER PIN, G 948
-1 PILOT BEAM SPRING, G 597
-1 ~~RANGE~~ SPRING G-27 PSI, G 969
-1 PILOT VALVE STEM SPRING, G 971
-1 PILOT VALVE SPRING, G 981
-3 FILTER SPRINGS, G 984
-1 PILOT VALVE PLUG SPRING, G 987
-1 BELLOWS AND PIPING, G 992
-1 PILOT VALVE STEM, G 999
-2 CIRCLIPS, H 233
-1 SPEED CONTROL WASHER, H 238
-1 ENVELOPE, H 239
-2 CIRCLIPS, H 245
-3 FILTERS, H 314
-1 PETCOCK LUBRICANT, H731
-1 RANGE SPRING 3-15 PSIG, L 300
-3 O-RINGS, DO 100C
-3 O-RINGS, DO 101C
-1 CAM ROLLER, D 46057S

-BAILEY INSTRUCTION BOOK E P81-1,
15 28A "SHAKE PROOF" WASHER,
ITEM NO. 16

10 28A X 5/16" HEX HEAD SCREW, ITEM NO. 17

15 UPPER DRIVE ARM, COMPONENT NO. G 945, ITEM NO. 18

20 48A X 1/4" ROUND HEAD SCREW, ITEM NO. 45

20 48A STANDARD WASHER, ITEM NO. 46

20 VALVE HANDLE, COMPONENT NO. G 951, ITEM NO. 47

20 NEEDLE ROLLER RACE, COMPONENT NO. H 290, ITEM NO. 55

SPARES FOR DEAS - WEIGHT TESTER . SERIAL NO. 9143 FIG 280 L :

ITEM	PART NO.	DESCRIPTION	Q T Y
1	PA/536	Leather Bucket	1
22	PA/2868	Leather Back - Up Washer	1
2	PP 45 - 7	Bonded Seal	1
3	PP 45 - 1	Bonded Seal	1
4	51108	Bearing	1
5	PA/2322/1	Sub- Assembly of Nut Spindle with stop.	1
20	P/9482	Barrel	1
21	PA/2773	Piston Head	1
23	PA/570	Bucket Holder	1
7	PP 45 - D	Bonded Seal	1
8	Q/7671	Piston/Cylinder Assembly	1
9	PP 45 - C	Bonded Seal	1
2	PP 45 - 7	Bonded Seal 3/8" BSP	1
10	PP 45 - 8	Bonded Seal ½ BSP	1
24	PP 45 - 3	Bonded Seal 1/4" BSP.	1

PACKING LIST - AS MENTIONED IN MAINTENANCE & OPERATING INSTRUCTIONS :

THE TESTER SUPPLIED COMPRISES :

ITEM (D) TOOL ROLL CONTAINING :

1 - CONNECTION 3/8" BSP.
1 - CONNECTION 1/2" BSP.
1 - ANGLE CONNECTION.
1 - ADAPTOR 1/4" BSP.
1 - ADAPTOR 1/2" BSP
1 - SPIRIT LEVEL.
4 - FEET.
1 - POINTER REMOVER.
1 - POINTER PUNCH.
2 - SPANNERS.
1 - ALLEN KEY.
1 - PACKET OF MISCELLANEOUS SEALS

ITEM (E) :-

1 - DUST COVER.

BUDENBERGE GAUGES :-

ITEM	DESCRIPTION	Q T Y
1	Mercurry - IN - Steel Thermometer No. (227924) Range 0 - 120°C	25
2	Absolute pressure Gauges Stainless steel Diaphragm Two Scale 0 ± 76 Cm Hg. Range .	20
3	Absolute Pressure Gauges Stainless Steel Diaphragm Scale 0 - 76 Cm Hg.	20
		Q T Y
4	Pressure Gauges (HYDRULIC) Range 0 - 120 Kg/Cm^2 connection ½" BSP	20
5	Pressure Gauges Range 0 - 10 Kg/Cm^2 connection ½" BSP	20
6	Standard Pressure Gauges 0 - 25 PSIG X 0 - 2 Kg/Cm^2 with ½" BSP. Connection (Two Scales)	5
7	Absolute Pressure Gauges 0 - 760 mm Hg. with connection ½" BSP (STANDARD)	2
8	Absolut Pressure gauges 0 - 760 mm Hg. with connection ¼" BSP STANDARD .	3
9	Pressure Gauges to Read Air pressure 3 - 15 PSIG INTO 0 - 25 Kg/Cm^2 SCALE .	5
10	Mercurry in Steel Thermometer Scale 0 - 300°C	5
11	Mercury in Steel Thermometer Scale 0 - 400°C	2
12	Pressure Gauges Ranges 0 - 40 Kg/Cm^2 with connection ½" BSP.	5
13	Pressure Gauges Ranges 0 - 40 Kg/Cm^2 with connection ¼" BSP.	5
14	Pressure Gauges Ranges 0 - 10 Kg/Cm^2 with connection ½" BSp	10
15	Pressure Gauges Range 0 - 20 Kg/Cm^2 with connection ¼" BSP.	10
16	Pressure Gauges Ranges 0 - 50 Kg/Cm^2 with connection ½" BSP.	10

THOMAS BROADBENT & SONS LIMITED,
HUDDERS FIELD.
YORKSHIRE HDI 3 ER
ENGLAND.

PNEUMATIC SPARES PARTS FOR WHITE SUGAR CENTRIFUGAL MACHINES, SERIAL NO. H 91751 - 8 .

ITEM	DESCRIPTION	Q T Y
1	Plough Multi Module Panel.	3
2	Brake and feed Multi Module Panel Patent No. 1293147 PROD. No. MM 66 BS.	3
3	4 Way Solenoid Valve Ref. No. 9 - 170 -113-00 - 02-50 HZ Schrader No. 43114 MS - 100	10
4	" 0 " Ring Ref. No. 6 - 715 - 180 - 49 - 07 SCHRADER No. 3454 - 40	50

ITEM	DESCRIPTION *	Q T Y
5	Piston Cup Ref. No. 6 - 716 - 092 - 39 - 00 SHARDER NO. 53004 P - 5	40

BESTOPELL MOBREY LIMITED
190 - 196 BATH ROAD
SLOUGH, SLI 4 IN, ENGLAND.

ITEM	DESCRIPTION	Q T Y
1	Penumatic Mobary Switches Dimentional Details the same as SOI/P 83 (Customer Fletcher & Stewert, January, 1975)	3
2	Penumatic Mobry Switches Dimetional Dital the same as SOI/P 83. with rod Length 1 Foot	3
3	Level Switches for Bulk Materials type No. MFI - D 3 AA, Serial No. 75 - 10	3

3	1	00 133 SP	Primary Measurement Point (Red).
4	1	00 133 ST	Secondary Set Pient and Measurement Pointer Pointer (Black) .
5	20	00 133 SA	0 - Ring 5/32 ID X 9/32 OD .
6	8	DO 116 SB	0 - Rings, 11/64 ID X 5/16 CD .
7	1	00 135 SB	Aspirator Assembly .
8	2	00 135 BF	Gasket .
9	10	MO 129 AA	Tubing .
10	1	00 134 BP	Gasket .
11	1	Co 133 AX	Transmitter Assembly .
12	2	00 138 PT	Tube .
13	2	DO 102 EW	Nozzle .
14	1	00 133 AY	Receiver Assembly .
15	1	00 142 EA	Switch Assembly .
16	36	00 127 CK	0 - Ring, 1/8 ID X 1/4 OD
17	2	00 141 FF	Gasket .
18	1	00 142 AA	Secondary Controller .
19	2	00 141 DA	Gasket .
~~20~~	~~10~~	~~00 134 AK~~	

PROPORTIONAL PLUS RESET UNIT :-

20	2	00 135 BF	Gasket .
21	1	00 141 XE	Primary Control Unit Assembly .
22	16	00 134 EX	0 - Ring , 39/64 ID X 3/4 OD .
23	16	00 134 XW	0 - Ring , 23/64 ID X 1/2 OD .
24	4	00 134 CL	0 - Ring , 51/64 ID X 15/16 OD .
25	8	00 127 CM	0 - Rings, 1/8 ID X 1/4 OD .
26	2	C 7135 BK	Relay , M 40C.
27		00 100 EM	Gasket .
28	2	B 1270 PX	Gasket . 2

SWITCH ASSEMBLY:-

29	2	00 134 ER	Gasket .
30	2	00 134 FP	Diaphragm .
31	2	00 134 ES	Gasket .
32	4	00 134 EA	Retaining Ring .

CONTROL UNIT ASSEMBLY :-

33	8	00 134 EC	Retaining Ring .
34	8	00 134 EB	Retaining Rings.
35	2	00 134 LL	Nozzle .
36		00 136 EP	Rollers .

Item	Qty	Part No.	Description
38	4	CO 134 LC	Matched Pairs of bellow assembly .
39	2	CO 134 BP	Gasket . 38
40	16	CO 134 EX	0 - Ring , 39/64 ID X 3/4 OD . 91
41	16	CO 134 KW	0 - Ring , 23/64 ID X 1/2 OD . 51
42	4	CO 134 CM	Retaining Ring . (TANK ASSEMBLY)
43	2	DO 116 NY	0 - Ring 3/4 ID X 7/8 OD . 2
44	2	CO 123 AS	0 - Ring 3/16 ID X 5/16 OD .177
45	2	CO 134 KK	Gasket .

MANIFOLD ASSEMBLY :-

46	3	CO 134 TF	Gasket .
47	3	XO 145 LS	0 - Ring .
48	3	UO 118 CE	0 - Ring .
49	3	CO 134 TE	Gasket .
50	3	Co 127 CM	0 - Ring .
51	2	Co 133 PL	Restrictor
52	21	BO 128 AA	Tubing ,

RECOMMENDED SPARES FOR (15) MODEL
102 PNEUMATIC CONSOTROL SHELVES
AND TYPE 102 CONNECTOR SET STYLE ' B '

1	1	CO 138 ZC	Power plug assy. (110 / 220 V) (B1 , C1 , M1 , P3 , S1 ,) .
2	6	CO 135 ET	Screen ,
3	5	CO 123 AX	' O ' Ring .
4	6	BO 110 AB	' O ' Ring .
5	1	CO 138 XB	Below Pneumatic plug assy . M130 M , M130P , M130F, M130Z Controllers without EXt. Comm. to Reset bellows (CO, cl , c2) .
		CO 138 ZA	M130M , M130P , M130Z with Ext. Comm. to reset bellows M130B , M130PB , M130FB batch or M130MC cascade controller M130PX, M130PK computsrcot controllers (BO , B1 , B2 , B3).
	1	Below CO 130 QX	Pneumatic plug assy . Indicator manual station and 1, 2 or 3 Pen recorder with electric chart drive (Mo, M1 , M2 , M3).

Item	Qty	Part No.	Description
		CO 130 PM	Reoorder with 4 pens and recorder with pneumatic chart drive (PO , P1, P4).
7	32	CO 135 AM	Spring .
8	32	CC 135 AL	Valve mouldings .
9	24	CO 135 AP	' O ' Ring .
10	28	UO 103 FP	Screen .
	4	M 6119 CA	Chart drive Voltage 240 Volt 50 C/S Speed 1 REV/ 24 HR .

SPARES FOR TYPE C VERNIER VALVACTOR

YOKE MOUNTED :-

12	5	B - 105 PM	8 - 32 Nut .
13	5	B - 105 PC	Flexure Assembly
14	5	B - 105 PP	Weasher .
23	5	B - 105 PR	Spindle .
22	5	B - 105 KZ	Casket .
29	2	C - 100 FK	Relay assemble
30	5	C - 100 ES	Casket .
32	5	B - 105 NS	Rostrictor .
33	15	C - 107 OM	" O " Ring
35	5	B - 105 NR	Nozzle .
36	5	B - 105 NB	Flappor .
20	10	C - 112 AE	Strainers .
21	10	U - 103 FP	Screen .
12	5	B - 105 SC	Gasket .
14	5	C - 127 FP	" O " Ring (¼ " ID)
15	5	B - 105 RT	Spring .

FOXBORO PNEUMATIC SPARES FOR :-

MODEL 557 PNEUMATIC SUGAR ROOT EXTRACTOR :-

12	X - 116 - EF	5 - 40 X ½ Socket H. Cap screws .
8	U - 118 - FB	Plate .
4	10441	5 - 40 X ½ R.H. Screw .
4	U - 118 -BY	Flexure .
6	X - 116 - KN	8 - 32 X ½ Socket H. Screws .
15	45703	8 - 32 X 3/16 Socket H. Screw .
	U - 118 - MT	Tube and Nozzle assembly .
15	C - 123 -AS	Oring 3/16 " ID 5/16 " OD .

Item	Qty	Part No.	Description
		U - 118 - ER	Clamp (holds Item 7).
		7507	5 - 40 X 3/16 Fil.H. Screw (holds clamp).
	10	X - 116 - RC	4 - 48 X 3/16 Knurled socket H. camp Screw .
9		U - 118 - EN	Spring Assembly .
	4	U - 118 - BC	Breackel Assembly
	2	U - 118 - BK	Zero Screw .
	4	U - 118 - BL	Bushing
	10	U - 118 - BM	Washer .
	6 6	X - 106 - CB	Retaining Ring .
	6	4X- 116 - RF	4 - 48 X 5/16 B.H. Screw .
	6	U - 118 - AY	Column .
	16	1584	8 - 32 X ½ R.H. Screw .
	15	U - 118 - EB	Vent Screen .
	7	U - 118 - AZ	Force Bar Assembly .
		U - 118 - FR	Bellows Assembly (A) .
	6	N - 126 - CP	Washer .
	5	U- 118 -AR	Screw .
	12	X - 100 - ET	10 - 32 X Fil . H. Screws with lock washers .
	8	U - 118 - FL	Stop .
	6	U - 118 - CP	Braket .
	15	U) 123 - AM	Bellows Assembly (c)
	20	13317	8 - 32 X 5/16 R.H. Screws with lock washers .
	10	U - 118 - FM	Bracket Assembly .
	10	U - 118 - CR	Pinion .
	10	U - 104 - AY	Arbor .
	10	U - 118 - FP	Sleeve ,
	7	U - 118	Body Assembly .
	7	25926	8 - 32 NUT .
30	5	U - 118 - EA	Helical Tension Spring .
31	5	X - 104 - BM	8 - 32 Elastic Stop Nut .
-	5	U - 101 - LL	Sleeve behind Item 30 .
-	5	X - 104 - CY	8 - 32 Nut (holds Sleeve) .
32	5	x - 116 - RA	8 - 32 y 2 BH Screw

COVER ASSEMBLY AND ADJACENT PARTS :-

276	7	U - 118 - EB	Diaphragm (B) .35
277	15	E - 118 - EC	O - Ring 17/8" ID X 2" OD .34
278	6	U - 118 - AS	Spring Assembly . 32

A joint programme in Sudan under Sudan Sugar Rehabilitation Project Between SPIC and UNIDO

Project Title : Training component of the Sudan Rehabilitation Project (Credit 1506 SU)

Project Number: SF/SUD/86/003

To : Mr. W. KAMEL
Chief, Section for Integrated Industrial Projects

From : ABD EL AZIM BEDEWY
Expert in Sugar Technology

Duty station : Sennar Sugar Training Centre

Subject : Final report

Purpose of the project :

To provide short_term advisory services to monitor the development of the implementation of Phase I of the project and to assist the Government and UNIDO to decide on the mode of actions to be taken to formulate the project document for Phase II.

The overall purpose of the project SF/SUD/86/003 is to strengthen the training capacity of S.S.T.C. for audio_visual methodologies, materials and techniques for a modular training system for performance oriented criterion referenced training for up_grading the technical know_how and supervisory skills of training officers, trainers and instructors.

Contents

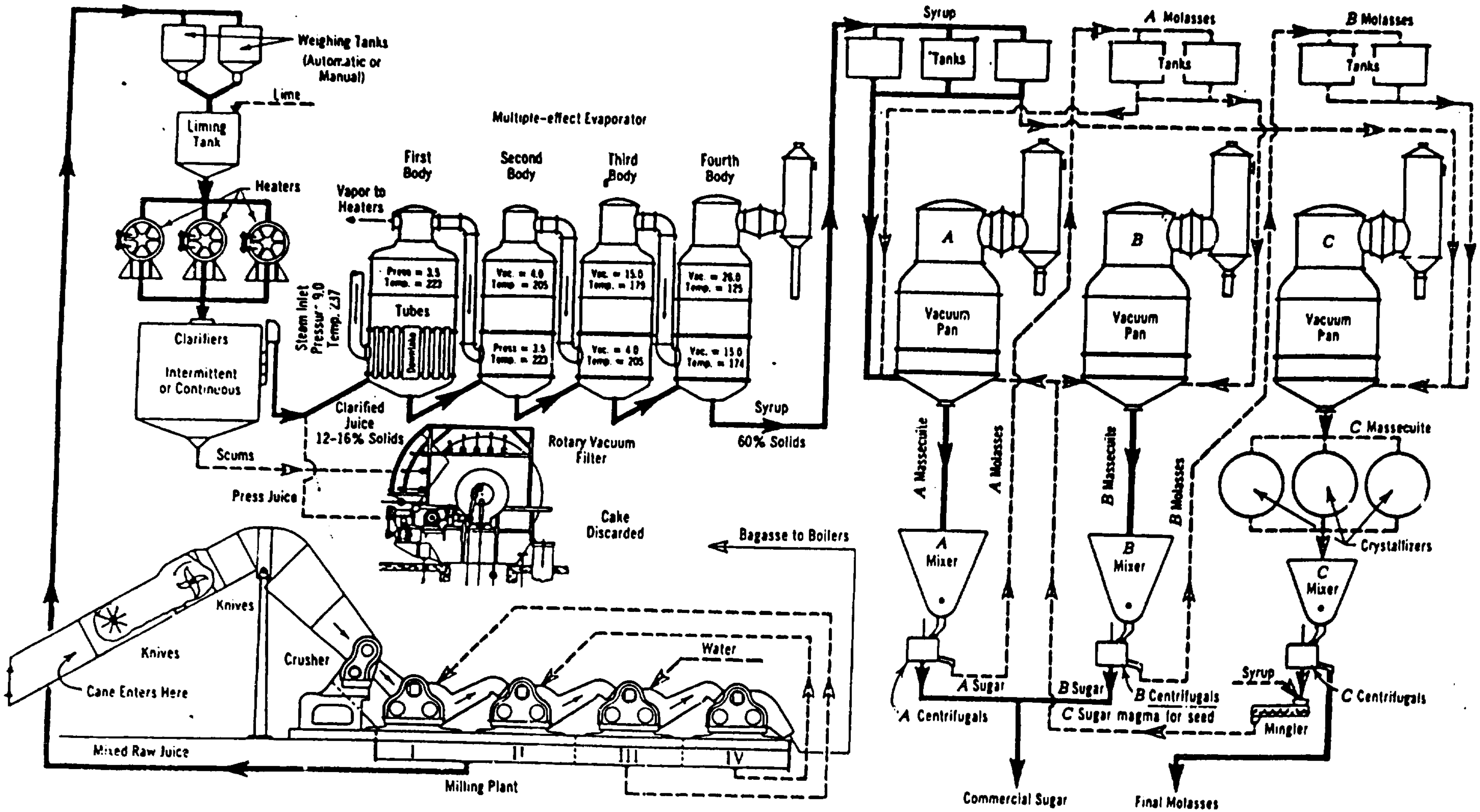


FIGURE Flow Diagram of Raw Sugar Factory.

-Manpower requirements and qualifications

-Jop Description for the supervisors for sugar technology

Introduction

In order to write down the detailed informations regarding the manpower reguirements and qulifications needed for the production sector in a sugar mill from the sugar technology point of view, the expert finds it necessary to draw a scheme and descripe briefly the outline of process for manufacturing cane sugar aiming to define and explain the actual jop description of the workforce.

1- Outline of Process for Manufacturing cane suger

1.1_ The attached flow diagram shows the process as carried out in modern plants.

1.2_ *Extraction of Juice*

Juice extraction by crushing the cane between massive roller is the first step in suger processing. The cane is first prepared for grinding by revolving knives that cut the stalks into chips, by heavily grooved crushers that break the cane and express a large part of the juice. Mills consist of multiple units of three_roller combinations through which the crushed cane or bagasse successively passes. To aid in the extraction of the juice sprays of water or thin juice directed on the blanket of bagasse as it emerges from each mill. unit help to leach out the suger. The process termed imbibition.

In best milling practice more than 95% of sugar in the cane goes into the juice, this being called the extraction. The final bagasse, in most sugar mills goes to the boilers as fuel, although bagasse is used as a raw material for wallboard or paper manufacture.

1.3_ *Puification of Juice: (Clarification)*

The clarification process des gned to remove both soluble and insoluble impurities in the cane juice, using milk of lime and heat as clarifying agents. Heating of limed juice coagulates albumin, fats, waxes and gums and precipitate.

The precipitated muds seperate from the clear juice by sedimentation using continuous closed_tray clarifiers. The muds are filtered on rotary_drum vacuum filters. The filtered juice returns goes directly to clarified juice and the press_cake is discarded. A wide variety of the lime and heat treatment has devoloped by the application of phospho_defecation or sulpho_defecation process aiming to improve the clarity of the juice.

1.4_ *Evaporation*

The clarified juice contains about 85% of water. Two_thirds of this water is evaporated in vacuum multiple effects consisting of a succession of vacuum_boiling bodies arranged in series that each succeeding body has a higher vacuum and therfore boils at a lower temperature. The syrup leaves the last body continuously with about 65% solids and 35% water.

1.5_ *Crystallization*

Crystallization takes place in a single_effect vacuum pans, where the syrup is evaporated until saturated with sugar. Evaporation continues until we get a mixture of crystals and syrup forming the so called massecuite. The strike is discharged though a foot valve into a mixer or crystallizer. The boiling of massecuites and the reboiling of the molasses are carefully controlled and carried out by boiling systems chosen to suit many conditions.

1.6_ *Centrifugalling or Purging: Reboilig Molasses*

The massecuite from mixer is drawn into revolving machines called centrifugals lined with perforated wire cloth or metal sheets. This perforated lining retains the sugar crystals while the mother liquor or molasses passes out.

In the three_boiling system as shown in the flow diagram, the first boiling using pure syrup yields sugar and A_molasses, which is returned to another vacuum pan to be re_boiled forming B_massecuite which in turn yields a second crop of crystalls. A_sugar and B_sugar consititute the commercial output of the factory. The B_molasses in turn is re_boiled on a footing of syrup to form C_massecuite. The C_sugar is mingled with syrup and used as footing for A & B_massecuite.

The final molasses which is a heavy viscous materials is usually used as a raw material for several industries.

1.7_ *Draying and Packing*

After the suger has been discharged from the centrifugals it has to be conveyed to the drier due to the fact that the purged sugar usually contains ±0.7% water. After drying suger has a moisture content ±0.05%. The dry granular sugar is packed either in jute bags or kraft paper sacks.

2- *Manpower Organization*

In order to achieve a good managment for sugar processing and to establish a perfect supervising and close controlling system for the different areas of activities in direct concern with producing sugar, the sugar factory is divided into two main sections, let us nominate these two sections as section A and section B. Each of these two sections is subdivided into 3 stations as follows.

2.1_ *Section.A*

This section comprises all areas of activities starting from juice extraction and ending by syrup production and is subdivided into the following subsections:

1_ Juice extraction and treatment station.

2_ Clarification and mud filtration station.

3_ Evaporation station.

Therefore the management of section A is carried out by a General Supervisor assissted by three supervisors each is responsible for one of the three stations. The jop description and qualification of the above mentioned staff will be outlined later.

2.2_ *Section.B*

This section comprises all areas of activities starting with syrup boiling and ending with sugar packing. It is subdivided into the following section:

1_ Crystallization station.

2_ Centrifugalling station.

3_ Drying and packing station.

Management of section B is carried out by a General Supervisor assissted with three supervisores, each is responsible for supervising one of the three stations. The jop description and qualification of the above mentioned staff will be outlined latter.

3- Due to the fact that sugar factories are working in the three_shift system to cover 24 hours work for continuous production, each shift should need the following staff:

1_ Superintendent

2_ General supervisors

6_ Supervisors

Therefore the whole staff for 3_shift will be:

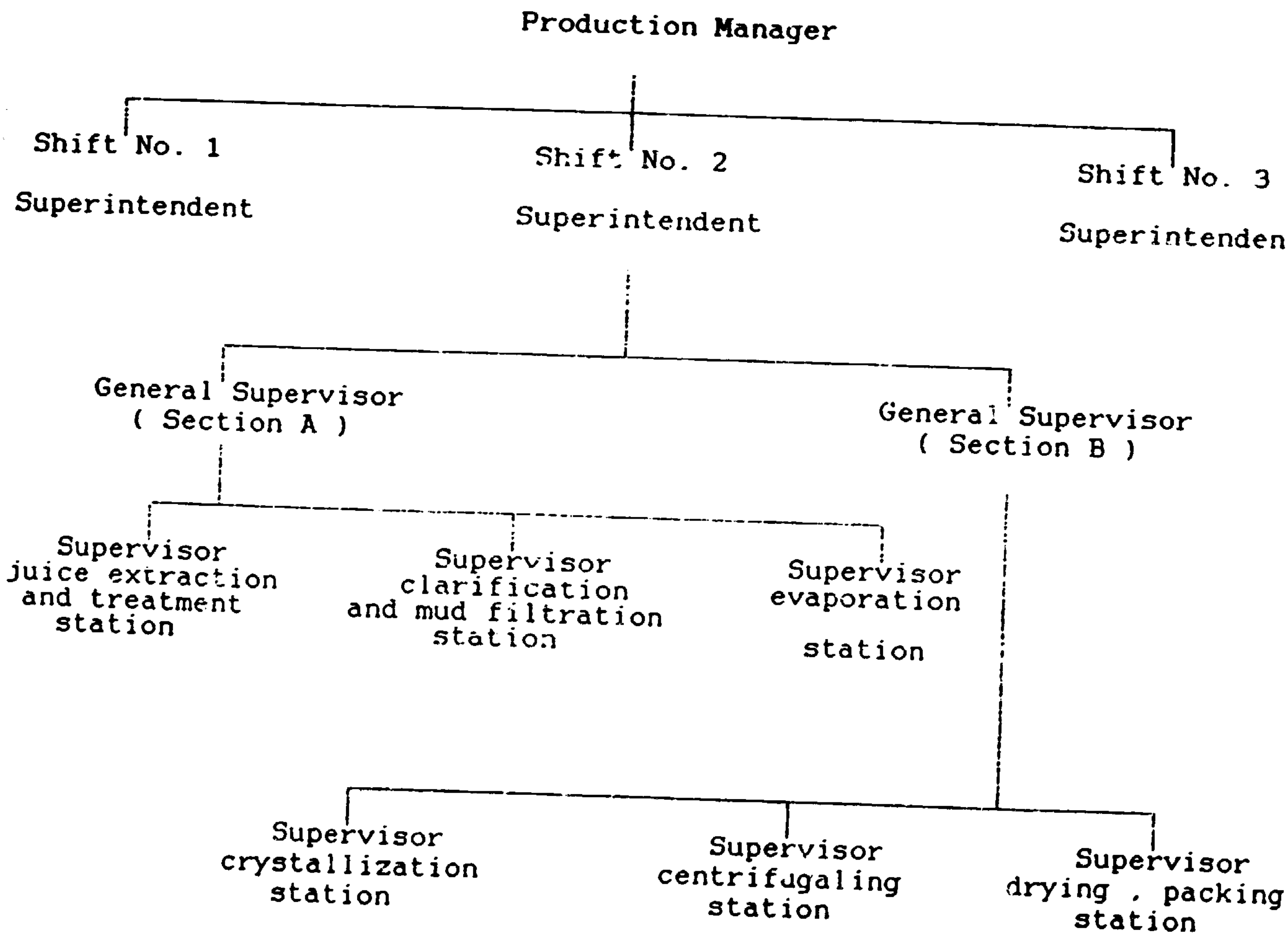
One Production Manager.

Three Superintendent

Six General Supervisors

Eighteen supervisores

MANPOWER ORGANIZATION CHART :



Job Description

Post title : Production manager

Qualifications: Academic

Expertise : Post experience at least 16 years.

Supervisor : Factory manager

General Description of the jop : Planning to operate the factory at full capacity and best quality, also the follow up processing results and find out solution to relate problems. Also to rationlize input rates in order to maximize factory productivity.

Duties and capacities :

1. To participate with factory managers in laying-out the plan to turn the factory at full capacity of machinery and to produce at best standards.
2. To follow-up processing results. To give technical guidance and administrative orders to

achieve production plan.

3. Responsible for production quality at entire phases in order to insure quality of final specified products.

4. To give operation orders particularly concerning safety of personnel and equipment.

5. Planning to rationalize input requirements, to review specifications thereof, to procure proper materials and to maintain sufficient supplies required for the processing season.

6. Planning to economize wrapping materials at proper specifications; to procure and maintain sufficient supplies of same.

7. Responsible for correct storing of products and input requirements to avoid deterioration.

8. In charge of achieving proper rates of materials consumption, to economize power and input requirements in order to attain optimum costs.

9. To study and follow-up training programs at his department and in charge of raising personnel

skills, to follow-up their works and to evaluate their achievements.

10. To study locations of bottle-necks or shortages, to recommend amendments, improvements and rehabilitation of factory equipment to overcome obstacles that may affect quantity or quality of products.

Job Description

Pos title : Manager, laboratory and quality control department.

Qualifications: Academic

Expertise : 16 years

Supervisor : Factory manager

General description of the jop : In charge for studying, recommending criterion for various phases of production, to designate control positions and to define ways and means of its execising, limits of margins, to organize its course as well as to apply chemical control on phases of production.

Duties and capacities :

1. In charge for soundness of chemical control as aforementioned .
2. Responsible for exercising control over various sources of losses and to recommend means of their avoidance.

3. To study and recommend processing standards as well as to designate control locations throughout operation and processing. Also take necessary measure to up-grade quality to the desired level.
4. In charge of analysing supplied materials by purchasing department.
5. Planning research programs, oversee trials to ameliorate processing in order to attain proper specifecations.
6. To recommend specific training courses for personnel at the department under his charge He is responsible for raising their skills, to follow-up their achievements and to evaluate their works.
7. In charge for control that wrapping materials are identical to specifications.
8. To participate with production manager to study and finding-out solutions to technical obstacles that may confront production or may affect its quantity or quality.

Job Description

Post title : Production superintendent

Qualifications: Academic

Expertise : 14 years

Supervisor : Production manager

General description of the jop : To follow-up achieving production programs per shift which he is in charge, efficiently and at the required quality.

Duties and capacities :

1. To follow-up operating equipments throughout his shift at maximum capacity and best quality.
2. To recommend proper amendments pertaining production scheme in order to raise production efficiency and quality.
3. To study means to avoid bottlenecks either in quantity or quality.
4. To follow up progress of training courses rendered to his assistants to raise their

skills.

5. To study technical means to treat reasons of losses in production.

6. To study and recommend obstacles that may confront running the factory either from the angle of production quantity or quality.

7. To achieve ratios of input according to approved standards in order to achieve optimum costs.

8. To follow-up maintenance of equipment to avoid any possible delay at the shift which he is in charge.

9. Responsible for soundness of equipment and safety of personnel at his shift.

10. To carry-out whatever capacities of production manager as delegated.

Job Description

Post title : Manager, research and planning

Qualifications: Academic

Expertise : 14 years

Supervisor : Production Manager

General Description of the jop : To carry-out studies concerning production plans and their amendaments, also concerning power - consumption decrease, economizing input requirements, to avoid production bottle-necks at the factory, to follow-up reasons for losses in materials and products, to give orders to avoid shortages, to follow-up training courses and to raise personnel skills.

Duties and capacities :

1. Prepares necessary studies to achieve production plans for the shift who presides over.
2. Prepares studies concerning power reduction and in-put consumption to attain approved standards

and to rationalize production costs.

3.To study actual ratios of materials and various input requirements. Also he analyses reasons of deviation in production costs.

4.To recommend amendments pertaining production plan at the factory to attain production increase in quantity and quality.

5.To search for reasons of losses in materials and production at all processing stages, in the meanwhile giving orders to treat any deviation in results.

6.To oversee training course at the department and care to raise personnel skills and following-up their works as well as evaluate their achievements.

7.To recommend amendments to avoid shortages and to study ameliorations, rehabilitation of factory equipment leading to raise production and improve its quality.

8.Planning to economize wrapping-materials at proper specifications.

9.To recommend what he deems fit to solve technical and administrative obstacles in order to attain factory objectives.

Job Description

Post title	:	General supervisor, production division
Qualifications	:	Academic or high school or intermediate (adv.level) (ord. level)
Experience	:	8 years - 13 years - 15 years
Supervisor	:	Production superintendent
General Description of the job	:	In charge of carrying out ordinary works at his division to attain maximum efficiency at best quality and to avoid reasons for losses. Also to care for safety of personnel and equipment at his division.

Duties and capacities :

1. Responsible for the attentive running of work at his division and in charge of carrying out the duties of the division at maximum efficiency and to insure production quality.
2. In charge of control, distribution of work among personnel who are accountable for any

defect also in charge of industrial safety.

3. To carry-out approved processing instructions within his sphere of work to achieve working objectives at the appropriate technical standards.

4. In charge to avoid material waste, to care for maintenance, input materials and power consumption.

5. In charge of preparing orders according to specific instructions and to follow-up implementation theirof.

6. Responsible for safety of personnel and equipment, to care for proper maintenance and performance at factory workshop.

7. In charge of maintenance work at his devision efficiently.

8. To recommend appropriate amendments pertaining industrial operations, to care for equipment storage and means of their maintenance.

9. To suggest training courses to raise personnel skills at his division.

10. To follow-up storage of spare parts and in-put materials at his division.

Job Description

Post title	:	Supervisor, production division	
Qualifications:		High school (adv. level)	or Intermediate (ord. level)
Experience	:	5 years	7 years

General description of the Job : To oversee production operations, maintenance work at his division, to care for proper use of tools and machinery, to supervise day-to-day works and care for the proper use of equipment and materials.

Duties and capacities : 1.To oversee production hangars, to control production and maintenance work at proper technical standards, to rationalize use of materials, tools and equipment.

2.To supervise specific production sections within his responsibility and to follow-up day-to-day works according to proper technical standards.

3. To avoid industrial and mechanical waste.

4. To attain production standards according to instructions.

5. To oversee operation cycles including putting machines "on" or "off" to carry out maintenance and periodic cleaning.

6. To care for running the proper number of factory equipment according to nstructions.

7. To rationalize use of industrial materials and chemicals.

8. Administrative and technical control over personnel at his division and he is in charge of their training and improving their skills.

9. In charge of industrial safety and proper tidiness at work-sites.

Sugar Technology Trainer: Required specifications:

Qualifications : Academic, preferrably from any of the following faculties:

a.B.Sc. (Science), Faculty of Science (chemistry and physics).

b.B.Sc. (Agriculture), food industries & physics)

c.B.Sc. Chemical Engineering.

Expertise : All activities pertaining sugar industry , processing practice, control, management, training in respect of sugar technology particularly at developed countries training centres and preferably participated in similar symposiums and related courses, having capacity to explain and exhibit technical datum to trainees in an expressive style.

Post experience: 10 years at least in practical activities in addition to operational and production management.

Field of expertise:

Sugar technology trainer should have practised in operational management as follow:

1. In the field of chemical control in sugar industry particularly:

   a) Practising all sorts of chemical analysis.

   b) Having keen knowledge of technical specifications for various processing stages.

   c) Analysing laboratory information to conclude positive and negative aspects of this industry.

2. Practised quality control, particularly:

   a) Knowledge of local and international standardized specifications of final product (i.e. sugar)

   b) Knowledge of permissible margins in standardized specifications, localy and abroad.

   c) Knowledge of factors having effects on products quality.

   d) Treatment of product in breach of standard specifications and ways to avoid non-conformity theirof.

3. Practised and supervised production operations management starting from production supervisor up to production super intendent till promotion to production manager in a period less than 3 years.

4. Practised and supervised production activities quantity and quality for a period not less than five years.

5. Had the chance to visit sugar factories at advanced countries, and having know-how of recent technolcgy in order to avail of this up-to-date technology in our local factories.

6. Availed of opportunities to participate in conferences and training courses to be informed of up-to-date means of industrial management.

7. Having the potentiality to transfer technical know-how and to explain same to trainees in a convincing and simplified style to prepare a new technical generation.

Connection between central training headquarter and branch training centres:

Objectives:

Amongst main objectives at production factories is to devélop technical new-comers enabled to carry-out industrial operations, in order to achieve optimum profits at least costs which leads in general to improve economic situation of the state.

Training centers:

Most tremendous industrial corporations having more than one branch, seek to constitute main training centres beside training units at each factory. In such a case inter-relations between main training centre and units may be as follows:

1. Main training centre lay-out technical training programs in production, engineering and administrative aspects while training units "or branches" carry-out those programs.
2. Main training centre supervises implementation of training courses as above mentioned.
3. A frame work of training techniques is defined and level of

tranees at factory units will be designated.

4. Main centre evaluates all aspects of training activities, and estimate annual allocations required to meet expenses through an annual budget.

Level of training materials at main training centre:

Training at main centre will be restricted to carry-out advanced training courses particularly in the field of sugar technology and to stress on managerial training as follows:

1. Economics of sugar industry together with an introduction to up-to-date industrial techniques in developed countries which would lead to progress of local industry in both aspects; technically and economically.
2. Recent techniques of quality control in industry to be a valuable assist to sugar technicians and managers and to propogate knowledge about temporary specifications.
3. Disseminate knowledge about pollution as a resultof sugar industry and means of treatment, particularly drainage and how to regenerate drainage water.
4. Economization of power consumption in sugar industry.
5. Sugar industry's by - products and economics of processing

bagasse and molasses through converting industries to serve national economy.

6. To recongnize alternative industries and materials to produce alternative sugar products.
7. To teach and diseminate information concerning recent industrial researches with the avowed purpose to develop industry and to reduce costs.
8. To prepare training courses in the spfere of human and social relations to improve work environment and in order to attain good relationships between managers and workers.
9. To designate and treat waste and how to eliminate losses in materials and power.

Level of training materials at training units:

Training units at factories carry-out training technicians on production processes at various levels to suit supervisors, foremen or ordinary workers. Training will be on-site. Materials to be delivered at units include the following:

1. Simplification of operation instructions including equipment maintenance at various work-locations.
2. To clarify technical aspects that lead to avail optimum

capacity of equipment.

3. To explain industrial safety instructions with the objectives to care for workers health and safety of equipment.
4. To train workers on plans for maintenance of mechanical or electrical machinery or other tools for measuring and control.
5. To train workers on maintenance programs to avoid shut-downs and delays consequently achieve maximum productivity.

Conclusion:

In case of presence of a main training center with affiliated units, the function of the main centre will be restricted to managerial training on advanced level prevailed in developed industries including economics, technical and administrative curricula. This main centre will lay-out training programs and supervise their implementation at affiliated units.

While training units be charged to train formen and workers to raise their technical skills and enhance the daily achievements. Adoption of such a plan would raise productivity and profitability.

Applied researches and development of sugar industry:

First: In order to enable training units to carry-out researches in the sphere of sugar industry, those units should be provided with semi-industrial experimental plant for applying research, and must be supplied with measure and control equipment and related instruments to define and register research industrial variables. Those experimental units would help clarifying industrial processes and assist in rendering objective researches for industrial evolution.

Second: When production season is over at sugar factories, managers would be convened to exhibit technical problems which had negative results either in quantity or quality. At the meeting, and through exhibiting obstacles, a research scheme would be recommended and to select the experimental unit to be charged with implementation in collaboration with training centre.

Third: Most important problems that confronted production factories in the previous season were as follows:

1. Decline in cane-juice specifications during January and

February of last season due to cane inflicted by frozen weather chemical treatment was necassary to overcome this deterioration.

2. High degree of cane-juice viscosity and it was imperative to search for economic chemical materials to reduce vicosity.

3. An increasing rate of loss in molasses. Whereas it was required to find ways and means to control this loss and improve commercia! product.

__Fourth:__ Bearing in mind item three above, a research scheme was carried out depending on experimental unit. When experiments were over, findings are to be dissimenated and propagated to follow up their technical and economic effects.

Research Programme

I- Juice Treatment

Introduction

- The existing system of clarification applied in our factories is as follows:-

1_ Heating the cane juices up to 70°C

2_ Liming the hot juice with a milk of lime to PH 9.5

3_ Sulphitation to PH 7.5

4_ Reheating the treated juice up to 104°C

5_ Decantation

The disadvantage of this classical process is that we obtain a slightly turbid juice out from the clarifiers and a slight increase of purity between the mixed juice and the clear juice.

In order to amelurate the characteristics of the clear juice aiming to obtain better yield, it is requested to carry out the following research Programme on the experimental plant.

Research Procedure & Objectives

Objectives

Application of fractional liming and double heating system in order to achieve the following objectives:-

1_ Obtain a good clarity for the clarified juice.

2_ Obtain a higher purity difference between the mixed juice and the clear juice i.e. purity of clear juice is ±2 degree higher in purity compared with the mixed juice purity.

Procedure

1_ Add milk of lime at 15 Be' to the cold mixed juice ±25°C after being analyzed to determine. the brix purity, reducing sugars, ashes, gums and waxes.

2_ The addition of lime in 3 alternatives is as follows:-

2.1_ First alternative consists of adding the lime to the juice to increase the PH from 5.5 up to 6.0

2.2_ Second alternative consists of adding the lime to the cane juice to increase the PH from 5.5 up to 6.3

2.3_ Third alternative consists of adding the lime to the cane juice to increase the PH from 5.5 up to 6.6

3_ After the addition of lime in the three alternatives, the limed juice has to be heated to raise the temperature from ±25°C up to ±70°C.

4_ Re_liming of the hot treated juice in the previously stated alternatives to increase the PH of each alternative with addition of sulphur dioxide to PH 7.5 degree.

5_ Reheating the sulphated juice of the three alternatives up to ±104°C and then settling in 3 different experimental clarifiers to get a clear juice representing the 3 alternatives.

6_ Analyze the clear juice to determine the clarity purity, residual gums and waxes.

7_ Draw the necessary curves on a sheet to make a comparison between the results obtained in the 3 alternatives to define the optimum condition for fractional liming and the proper PH value useful to get better results.

8_ Carry out the same experiment of treatment applying the existing system which consists of heating at first and liming to 9.5 PH, then the sulphitation.

9_ Repeat the above mentioned procedure regarding the existing system of treatment and the modified system than make a statistical evaluation of the obtained data.

10_ Define the best condition for juice treatment.

II- Factors Affecting the exhaustability of Molasses

Introduction

Since the sugar lost in the final molasses constitute more than 60% of the total losses in the sugar industry, a great numbers of research programmes were established to define the factors affecting and being responsible for these high losses in molasses.

Due to the fact that non_sucrose of molasses has great influence on the degree to which the molasses can be exhausted, the research Programme was established to define the relation between the method or precisely the system of treatment and the exhaustability of molasses this is because the system applied for juice treatment usually has a great influence on the residual ash content of the clarified juice and consequently on the ash content retained in the molasses.

Procedure

1_ The clear juice obtained from both systems of treatment i.e. the classical and the fractional liming system is first analyzed to determine:

Purity, Reducing sugar, Ash, Gums and dextran, Clarity.

2_ Let us assume that the clear juice obtained from the classical system of treatment is termed A_juice and the clear juice obtained from the fractional liming system is termed B_juice.

3_ Evaporate A_juice until we get a concentrated syrup with 65 Brix.

4_ Boil the syrup to form A_massecuite.

5_ Centrifuge the A_massecuite and re_boil the mother liquor which will be around 60_62 degree purity. Analyze the mother liquor before re_boiling to determine:

Purity, Reducing sugar, Ash, Gums and dextrans, PH.

6_ Cool the re_boiled mother liquor which forms the B_massecuite with a rate of cooling amounting to 1.5°C per hour. Do not use cold water for cooling the B_massecuite in the crystallizer.

7_ When the massecuite is ±50°C, purge and collect the mother liquor for analyses to determine:

Purity, Reducing sugar, Ash, PH.

8_ Repeat the above mentioned procedure using B_juice.

9_ Repeat the experiment ten times and statistically evaluate the results obtained to define the relation between the system of juice treatment and the exhaustability of molasses.

<u>N.B.</u> This research Program can never be performed without the existence of an experimented plant.

Modular system for conventional educational and training programme in sugar technology

Purpose and objectives

• The participants in the modular system for conventinal educational and training programme dealing with all areas of activities in sugar industry from the sugar technology point of view will receive education and initial training in the various fields of technology with direct concern with sugar industry.

They will have the opportunity to exchange experience and discuss specific technical problems facing them during their work in the factory.

The purpose and objecti 's of this training programme is to highlight the whole range of technical problems arising in production and quality control services and to study the interactions between the different sections of the factory and the various areas of activities and to provide the know-how. based on practical experien ce for solving the raised problems.

The participants in the training programme will be made aware of the importance of the essential function of the equipments and instruments in the process.

They will study and be informed of the role of the sugar technology and its importance in the production process. They will be aware of the importance of the exchange of information and the co-ordination of sugar production activities.

They will learn what should be demanded in order to make a close control for the sugar process.

Proposed Dates

This programme should be better performed in the off-season period i.e. after the end of the crushing season in order to attract and give the chance to the greatest number of the managers and supervisors to participate without creating a negative influence on the productivity of the estate sugar factories.

Duration

Normaly the performance of the educational and training programme in sugar technology needs to be covered within six weeks in the training centre plus one week covering the study tours in the existing sugar factories for more explanation in the plants.

Target group :

The participatns attending the programme should be not more than 25 in order to create the atmospher of maximum obatinable benefit.

- Plant general managers or departmental managers mainly production manager, technical manager and engineering managers of factories and workshops.
- Superintndent, general supervisors, supervisors in both production and engineering department.
- Director and training staff of sennar National training Center.
- Staff of vocational training of the operators of the sugar factories.

Module I. sugar chemistry

1. Physical and chemical properties of sugar and non-sugar.
   1.1. Chemical properties of sucrose.
   1.2. Structure of sucrose molecule.
   1.3. Synthesis of sucrose.
   1.4. Decomposition of sucrose.
   1.5. Biochemical reactions.
2. Physical properties of sucrose
   2.1. Crystallized sucrose
   2.2. Solubility, crystallization, calorific vlaue, viscosity and surface tension.
3. Physical and chemical properties of reducing sugars
   1. Physical properties.
   1.1. Physical properties of dextrose solutions.
   1.2. Physical properties of levilose solutions.
   1.3. Physical properties of invert sugar solutions.
   2. Chemical properties.
   2.1. Chemical reactions of dextrose and levilose with organic reagents.
   2.2. Chemical reactions of dextrose and levulose with

inorganic reagents.

2.3. Decomposition reactions.

2.4. Oxidation reactions.

4. The complex organic nonsugars of high molecular weight.

4.1. Cellulose and hemicelluloses.

4.2. Lignin, proteins, pectins and starch.

4.3. Uses of bogasse.

5. Physical and chemical properties of colored non-sugars.

5.1. Chemical reactions of colored decomposition products.

5.2. Removal of color by precipitates and adsobants .

5.3. General prinicples of color measurement.

Module II the agents used in sugar manufacture

In order to bring about certain desirable changes in the nature of the materials processed in a sugar factory, extensive use is made of chemical agents.

1. Limestone

1.1. The burning process (Theoretical and practical.

1.2. The qulity of limestone suitable for sugar manufacture.

2. Lime

2.1. The slaking process.

2.2. The quality of lime.

2.3. Milk of lime.

3. Sulphur

3.1. The quality of sulphur suitable for sugar manufacture.

3.2. The combusion process and equipments.

3.3. The properties of sulphur dioxide gas.

4. Phosphoric acid and its salts.

4.1. Quality of phosphoric acid and its salts.

4.2. Composition of phosphates.

4.3. Phosphates in clarification operations.

4. Soda

4.1. Quality of caustic soda

4.2. Soda ash.

5. Carbon

5.1. Animal chorcoal

5.2. Vegetable carbon

5.3. Evaluation of carbons

6. Diatomaceous agent

6.1. Quality of keiselguhr

6.2. Uses in sugar manufacture

Module III purification of cane juice

1. Chemical technology of the purification process

1.1. Clarification stages

1.2. Screening of suspended non-sugars

1.3. Composition of non-sugars.

1.4. Effect of heating and pH

1.5. Optimum conditions for purification

2. Fundamental reactions of the clarification process

2.1. Composition of cane juice

2.2. Liming process including cold liming, hot liming and fractional liming.

2.3. Fractional liming and double heating

2.4. Compound clarification

2.5. Reactions of clarifications

2.6. Physical chemistry of clarification

2.7. Practical effects of clarification

3. Technology of the clarification process

3.1. Liming

3.2. Heating

3.3. Liming and heat sequance

3.4. Floc-formation and floc-conditioning

3.5. Auxiliary defecants

4. Subsidation equipments

4.1. Intermittent subsiders

4.2. Continuous subsiders.

5. Clarification of cane juice by sulphitation process

5.1. Origin and development of sulphitation process

5.2. Technology of sulphitation process

5.3. Properties of reagents and fundamental reactions

6. Clarification of cane juice by carbonation process

6.1. Origin and development of carbonation process

6.2. Single and double carbonation

6.3. Filter station

6.4. Purification effects of carbonation process

6.6. Technology of single and double carbonation

7. Clarification of cane juice by phospho-defecation process

7.1. Origin and development

7.2. Technology of phospho-defecation process

Module IV evaporation

1. Heat transfer

1.1. The laws covering heat transfer

1.2. Properties of sugar solutions which affect heat flow in evaporators

1.3. Numerical values of the heat transfer

2. Principles of steam economy in evaporation

1. The design of evaporators

1.1. Reynold's law

1.2. Boiling point elevation

1.3. Heat transfer coefficient

1.4. Methods for evaporator calculations

1.5. Entrainment prevention

1.6. Effect of sealing on heat transfer

3. Uses of juice vapours in sugar manufacture

3.1. In juice heaters

3.2. In boiling pans

3.3. In thermo-compressors

4. Heat losses

4.1. Radiation and convection losses

4.2. Incondensable gases

4.3. Air leaks

4.4. Condenser water

5. Steam requirements for different system of evaporation

5.1. Practical consideration

5.2. Typical examples

Module V technology of evaporation process

1. The chemistry of evaporation process

1. Reducing sugars in juices in the evaporation process
2. Effect of pH on chemical reactions in evaporation process
3. Scale formation

3.1. Mechanism of scaling

3.2. Rate of scaling

3.3. Composition of evaporator scales

3.4. Physical characterisitics of scales

4. Color formation
5. Condensates
6. Principles in construction and design of evaporators

2. Cleaning of evaporators

1. Cleaning of scaled heating surfaces
2. Classification of the rate of scaling
3. Mechanical and chemical cleaning
4. Chemicals required for scale removal
5. Control of the efficiency of cleaning operations
6. Cleaning of evaporators on the vapour side
7. Advantage and disadvantage of chemical cleaning

Module VI sugar boiling and crystallization

1. Technology of sugar crystallization

1. The aim of crystallization
2. Fundamental in the practice of sugar boiling
3. Significance of natural and mechanical circulations
4. Application of conductivity control
5. Technical control instrument for conductivity control
6. Technological investigations on the crystallization process

2. Chemistry of crystallization

1. Decomposition of sucrose during crystallization
2. Decomposition of reducing sugars
3. Non sugars affecting crystallization

3. Vacuum Pans

1. General characteristics
2. Different types of calandria
3. Different types of heating elements
4. Circulation in vacuum pans
5. Rehabilitation of mechanical circulation

6. Necessity of mechanical circulation

7. Basis of design

4. Boiling systems

1. Factors controlling the boiling systems

2. Technology of boiling

3. Types of boiling systems and boiling procxedures

3.1. Single einwarf

3.2. Double einwarf

4. Boiling systems recommended for raw sugar factories

5. Boiling systems adapted in sugar refineries

6. Boiling scheme (3. boiling and 4. boiling scheme)

5. Control methods and equipments

1. Importance of control equipment

2. Basic data and dfinitions

2.1. Solublity of pure sucrose and impure sugar solutions

2.2. Boiling point elevation

2.3. Supersaturation

3. Pan control equipment

4. Automatic control equipments

6. Crystallization of massecuites by cooling

1. Factors affecting crystallization by cooling

1.1. Supersaturation coefficient

1.2. Saturation temperature

1.3. Viscosity

1.3. Purity

1.4. Crystal content and size

1.5. Dilution

2. Technology of crystallization by cooling

3. Types of crystallizers and cooling systems

4. Construction and shape of cooling elements

5. Time need for efficient cooling of different types of massecuites.

6. Design parameters of crystallizers

7. Maximum recovery of sucrose from law grade massecuites

Module VII centrifugation

1. Theory of the centrifugal process

1. Theory of centrifuging
2. Practical aspects of centrifuging
3. Methods of expressing the elimination of mother liquor
4. Centrifugal operations

4.1. Mechanical considerations

4.2. Power considerations

4.3. Process considerations

5. Porosity of linings and basket wall
6. Spin before wash
7. law grade massecuites
8. Washings
9. Spin after wash
10. Technology of centrifuging

2. Engineering principles of sugar centrifugals

1. Framework - suspension

1.1. Framework rigidity

1.2. Swinging of the basket during spinning

2. The basket

2.1. Dimensions and manufacturing tolerances

2.2. Perforations of the basket

2.3. Condition of the innersurface

2.4. Materials, maintenance and legal rulings

3. Mechanical unloaders

4. Outline of principles for construction

5. Influence of perforations and thickness of the perforated liners on puring

6. Batch and continuous centrifugals

<u>Module VIII. drying, packing and storage of sugar</u>

1. Technology of sugar drying and storage
2. Factors affecting drying of sugar
3. Types of sugar dryer
4. Calculations for a sugar dryer
5. Factors causing deterioration of sugar
6. Types of sugar store
7. Packing of sugar
8. Scales used for weighing the bags

Module IX malasses and bagasse

A. Molasses

1. Mechanical theory of molasses formation
2. Chemical theory of molasses formation
3. Final molasses
3.1. Major compnents
3.2. Minor components
3.3. General properties
4. Factors affecting and controlling exhaustability of molasses
5. Utilization of molasses
5.1. Recovery of the molasses sugar
5.2. Fermentation of molasses for the production of alcohol, baker yeast and fodder yeast
5.3. Production of citric acid, aconitic acid, butanol and actone
5.4. Production of dextran from molasses
6. Uses of molasses in cattle feed and other feed product
7. Differences between beet and cane molasses
8. Storage of molasses especially cane molasses

B- Bagasse

1. Quantity obtained per ton of cane

2. Physical and chemical composition of bagasse

3. Storage of bagasse

4. Bagasse presses

4.1. Balling press

4.2. Briquetting press

5. Uses of bagasse

5.1. Fuel

5.2. Raw material for manufacture of fireproofed insulating boards , used for building purposes

5.3. Raw material for manufacture of paper pulp

5.4. Raw material for manufacture of various industrial solvents

6. Calarific value of bagasse

6.1. Gross calorific value of wet and dry bagasse

6.2. Nett calorific value of wet and dry bagasse

7. Combusion of bagasse

7.1. Reactions of combusion

7.2. Properties of gaseous products of combusion

7.2. Composition of flue gases

7.3. Calculation of combusion temperature

8. Weight of steam per unit weight of bagasse

Module X chemical and quality control

1. Purpose of chemical control
2. Basis of factory control
3. Outline of factory control
4. Boiling house control
5. Mill control

5.1. Fundamental equation

5.2. International methods

5.3. Basic data for mill control

6. Available sugar formaulas
7. Calculation and determination of factory sugar losses
8. Studies on undetermined factory losses
9. Calculation of sugar losses in boiling house processes
10. Systems of cane sugar factory control
11. Analytical methods used in cane sugar factory

11.1. Sampling methods and equipments

11.2. Analytical procedures used in cane sugar factory

12. Sugar industry wastewater effluent
13. Special techniques for analysis of sugars and non-sugars
14. Methods of cane purchase
15. Special equipments and measuring instruments used in direct concern with chemical and quality control
16. Official local and international targets.
17. Calculation of material and thermal balance
18. Preparation of factory production reports.