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ENCONET INTERNATIONAL

20705
(1 of 4)

"THINKING GLOBALLY
ACTING LOCALLY"

ENERGY AUDITING WORKSHOPS IN ETHIOPIA, TANZANIA AND UGANDA

FINAL REPORT - VOL I

RESTRICTED

8 November, 1993
ORIGINAL: ENGLISH

ENERGY AUDITING WORKSHOPS

IN

ETHIOPIA, TANZANIA AND UGANDA

UC/RAF/90/149 -ST/RAF/90/EO1

FINAL REPORT

Prepared by

ENCONET INTERNATIONAL Ltd., U.K.

Z. Morvay

Backstoping officer P de Moustier

United Nation Industrial Development Organization

Vienna

TABLE OF CONTENTS

1. INTRODUCTION

1.1. Background information

UNIDO in co-operation with UNDP and the Governments of Ethiopia, Tanzania and Uganda organised a two weeks workshop on energy auditing in each of the above mentioned countries.

ENCONET International Ltd was commissioned to execute the project. The project objectives were clearly outlined by the terms of reference (Annex I). The project was successfully implemented, and the activities performed, according to the terms of reference and subsequently developed aid-memoir (Annex II), were the following:

-preparation for preparatory mission
-briefing in Vienna at 5 March, 1993
-preparatory mission to the three countries concerned, 5 -27 April, 1993
-submission of an early report on preparatory mission at 30 April, 1993
-submission of draft report on preparatory mission at 13 May, 1993
-submission of draft interim report at 18 May, 1993
-submission of interim report at 20 June, 1993
-de-briefing in Vienna at 26 May, 1993
-workshop implementation in Debre Zeit, Ethiopia, 28 June - 9 July, 1993
-submission of report on the workshop in Ethiopia, 28 July, 1993
-workshop implementation in Dar Es Salaam, Tanzania, 2 - 13 August, 1993
-workshop implementation in Kampala, Uganda, 16 - 27 August, 1993
-submission of the reports on the workshops in Tanzania and Uganda, 2 Sept., 1993
-permanent communication with national counterparts and UNIDO offices in the countries involved, and selected equipment supplier
-final visit to UNIDO, de-briefing and delivery of training manuals, 15 Sept., 1993

This report will provide outlined description on the activities listed above, while the comprehensive information can be found in the previously submitted reports.

1.2. Approach to workshop preparation and implementation

The aim of the workshop was to strengthen the technical capabilities and skills of engineers in the involved countries on the activities related to the efficient use of energy in industry thus enabling them to carry out energy audits and identify ways of improving efficiency in energy consumption. The participants in the workshop are expected to apply the knowledge acquired to conduct future energy audit exercises in their respective companies.

Therefore it was decided to emphasise the practical aspects of energy auditing and transfer of know how and skills, rather than theoretical background and foundations of energy conservation and auditing.

The detail workshop programme is presented in Annex III. It shows the emphasise on practical aspects of the training, including energy auditing in the factory and resulted data processing and report preparation in the classroom. It also shows a strong emphasise on financial and management aspects of energy conservation project implementation.

2. PREPARATORY MISSION TO ETHIOPIA, TANZANIA, UGANDA

A one week preparatory mission to Ethiopia, Tanzania and Uganda, each, has been carried out by ENCONET International commissioned by UNIDO in Vienna.

The purpose of the mission, according to the terms of reference, was:
-to discuss the needs in energy auditing techniques,
-prepare logistics for the training course,
-assist in participants selection,
-to identify one plant for practical exercise,
-define a list of instruments to be delivered,
-to identify local counterpart and suitable institution which will be given the instruments after the workshop,
-to submit draft programme for the workshop.

2.1. General

Representatives from the Ministry of Mines & Energy and Ministry of Industry were met in all countries. They have expressed a great interest in the workshop and explained how important it was for industries to get training in energy auditing techniques. The discussions during the meeting included where to carry out the training course, the training program, which industries to include in the practical training and which measuring instruments to supply and use on the training course. Practical matters such as daily time scheduled, coffee breaks, lunch breaks and transportation to and from the industries during the practical training were also discussed.

It has been proven during discussions as a favourable approach to carry out a very practically oriented course focused on actual implementation of a detailed energy auditing programme. This fact was reflected in the subsequent elaboration of detailed workshop programme (Annex III)

The measuring instruments needed in order to be able to carry out the practical training were discussed and the recommended lists were approved by UNIDO (Annex IV).

2.2. Local counterparts

2.2.1. Ethiopia

Meetings were held with Ms Claudia Linke, UNIDO, Mr Tariku Tafere, Chief Power Engineer, Head, Bureau of Energy Conservation and Utilisation, Ethiopian Energy Authority, and Mr Birhanu Tibre Head of Technology Department, Ministry of Industry

Ethiopian Energy Authority was a local counterpart, and Mr Tariku Tafere in charge for workshop preparation (counterpart addresses are listed in Annex V)

2.2.2. Tanzania

Meetings were held with Mr Krasiakov and Ms Kostian, UNIDO, and representatives from Ministry of Industry, Ministry of Water, Energy and Minerals and TIRDO (Tanzanian Industrial Research and Development Organisation)

TIRDO was a local counterpart, and Mr Robert Nindie in charge for workshop preparation A project steering committee was established to facilitate workshop implementation

2.2.3. Uganda

Meetings were held with Mr Tabah and Mr Goekint, UNIDO, Mr J K Kakama and Mr B M Kakura, Ministry of Industry and Technology and Mr M S Wamboga, Ministry of Energy, Minerals and Environmental Protection

Both Ministries will cooperate in workshop implementation, being represented by their members as stated above Later on it was decided that Ministry of Energy, Minerals and Environmental Protection should be a local counterpart, and Mr Wamboga was in charge for workshop implementation

2.3. Selection of the participants

It was agreed that participants should be at least on the diploma level in engineering, in order to concentrate on practical aspects of energy auditing, assuming that necessary theory is known The participants should preferably keep a post of chief engineer, if coming from the industry

2.4. Selection of industry for practical training

To select an industry for the practical training, several companies were visited in each country. The main selection criteria were the following:

-energy intensive industry
-use of different form of energy or energy carriers
-prospects of operation at nominal capacity at the time of workshop
-vicinity to the workshop venue to avoid long travelling time.

Ethiopian Tannery, Tanzania Brewery Ltd., and Uganda Breweries Ltd. were selected for the practical training. The industries selected course were situated up to 30 minutes drive by car from the training centre. The transport was provided by local counterparts.

2.5. Time and venue

2.5.1. Ethiopia

The workshop was held from June 28 - July 8, 1993, at Ethiopian Management Institute (EMI) training centre, Debre Zeit, situated 45 km outside Addis Ababa. All participants and the consultants stayed at the training centre. The residential aspect of the workshop proved itself as a very important for the workshop success.

2.5.2. Tanzania

The workshop was held from 2 - 13 August, 1993, at TIRDO in Dar Es Salaam.

2.5.3. Uganda

The workshop was held from 16 - 27 August, 1993, in Kampala, at Uganda Management Institute.

3. METHODOLOGY AND PROGRAMME

Carrying out energy audit is essential to achieving saving, but does not produce savings itself. To achieve energy savings, audit must be integrated into entire sequence of events, starting with a commitment to energy conservation from end-user to top management, and proceeding to improved operation and maintenance procedures, quality control, financing and construction of energy conservation equipment, monitoring and follow-up

A meaningful energy conservation programme must include the implementation of the recommendations or opportunities identified by audit Experience has shown that the largest energy savings are achieved when energy conservation is viewed and implemented within the overall energy management context, beginning with top management commitment and following through to retrofit construction and follow-up monitoring (see Fig 1) Energy auditing being a complex procedures itself (see Fig 2) is only a part of the overall energy management procedure as shown by Figure 1

Our approach to teaching energy auditing is to present it firstly within the broader framework of energy conservation policy and overall energy management This is followed by short introduction to project planning and preparation which leads participants to the preparation for the preliminary energy audit. By this we come too practical aspects implementing energy auditing in industry which is followed by mix of lectures and practical exercise in the factory and in the classroom which takes participants through the all process of energy auditing as shown on Figure 2 In the end, the lectures were enlarged by providing basic insight into **environmental auditing** (see Fig 3), which is logical extension to the energy auditing, since the energy conversion processes are the largest contributors to environmental pollution

Following that pattern, a two weeks workshop is filled up with 1/3 of lectures in the classroom, 1/3 practical exercise in a factory and 1/3 of practical exercise in the classroom

The lectures cover all the topics which are described in the training manual, the content of which is shown in Annex VII During the lectures we try to bridge the gap between theory and practical problems as imposed by the factory serving as a case study The practical exercise consists of preparation for the initial and detail energy audit, preparation for measurement, conducting a full scale energy audit according to the prepared plan, data gathering and calculation, preparation energy balance and technical recommendation, financial analysis of energy saving opportunities, and preparation of the energy auditing report

Participants are divide into groups to facilitate practical exercise, and to practice group work such as project planning and management, joint analysis and solution of problems, discussions and interchange of their ideas, combination of different backgrounds in a coherent team, etc

The terms of reference required to train participants to be able to implement the energy auditing techniques by themselves in their respective factories Our experience has shown the best transfer of knowledge can be achieved if the participants are exposed to a real problem and required to solve it themselves with the trainers assistance That is why we put a strong emphasise on the practical exercise, which, by participants reactions, proved to be a favoured approach

4. PARTICIPANTS

The most of the participants were from industries where they were responsible for maintenance and energy sector, or shift or chief engineers. Few of them were technicians, and the rest were engineers from ministries of industry or energy.

There were 34 participants attending the workshop in Ethiopia. It reflects high interest and need for training in energy conservation topics in general, and energy auditing in particular. The workshop was organised as residential which contributed to the high attendance, but more important it facilitated interactions among participants and consultants, and provided more time for round table discussions and exchange of views.

The number of participants in Tanzania and Uganda was lower than planned (25 expected) and their level of knowledge was different, but smaller groups enabled more interactions and direct communications between consultants and the participants, so that individual requirements could be accommodated. The interest in the course was very high and participants were making plans to implement instantly in their own factories some of the techniques learned.

One of the reason for lower attendance was that awareness of the management on importance of energy conservation is low, therefore they were reluctant to release the staff from the work duties. Also, if the workshops would have been organised as a residential, it would have contributed to both higher attendance and more interactions between the consultants and participants, and among participants themselves.

5. IMPLEMENTATION OF THE WORKSHOPS

A brief introduction was provided to describe role and importance of energy auditing within the framework of an energy conservation programme. After that, the participants were carried through the energy auditing techniques, starting from the principles and project planing, techniques and measurements applied, up to technical and financial evaluation, recommendation of energy economy measures, and report writing.

The participants were working alongside with instructors during the classroom and field training. A set of worksheets was developed for each factory selected as a case study, to facilitate participants practical exercise.

A structured approach to energy conservation was presented. The starting point was to establish the facts through assembly and analysis of energy bills, applicable energy tariffs, data on production output and basic description of the process technology. The results of this step were:

-a clearer picture of energy use and costs
-a measure of relative importance of different energy uses
-a first attempt at seeing variation patterns over the year
-a better understanding of energy use as a basis for improvement

The assembled data was compared against typical standards to set targets for improvement and to determine the objectives for energy auditing in the factory. After that a walk-through energy audit was implemented, followed by detailed energy auditing.

Participants were divided into groups of up to 5 members. Each group was working independently on data gathering and subsequent analysis, and in the end each group produced a full report on energy auditing, a sample copy of which was submitted with the earlier reports.

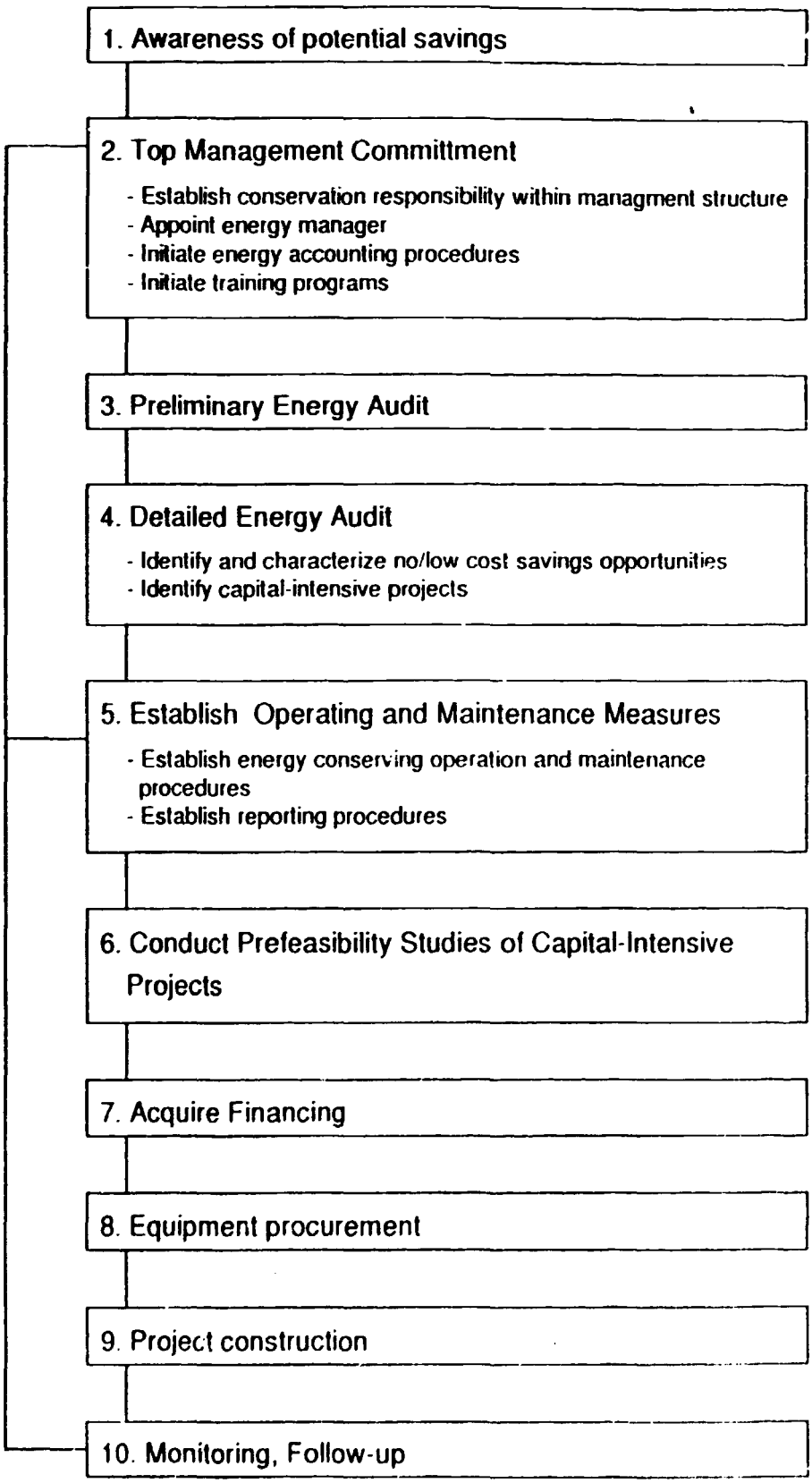

Figure 1 The Overall Energy Management Process

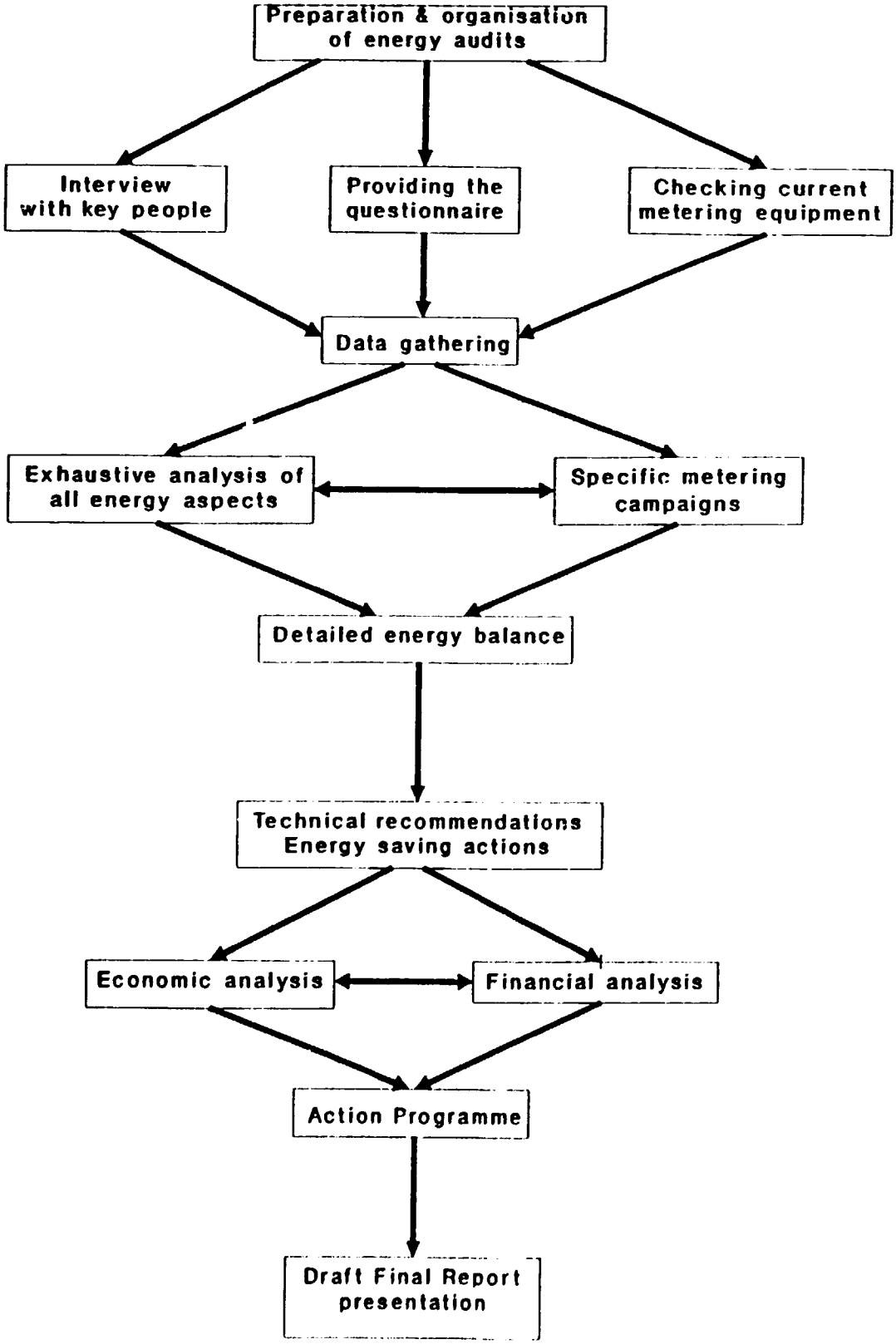

Figure 2. Scope of activities for energy auditing

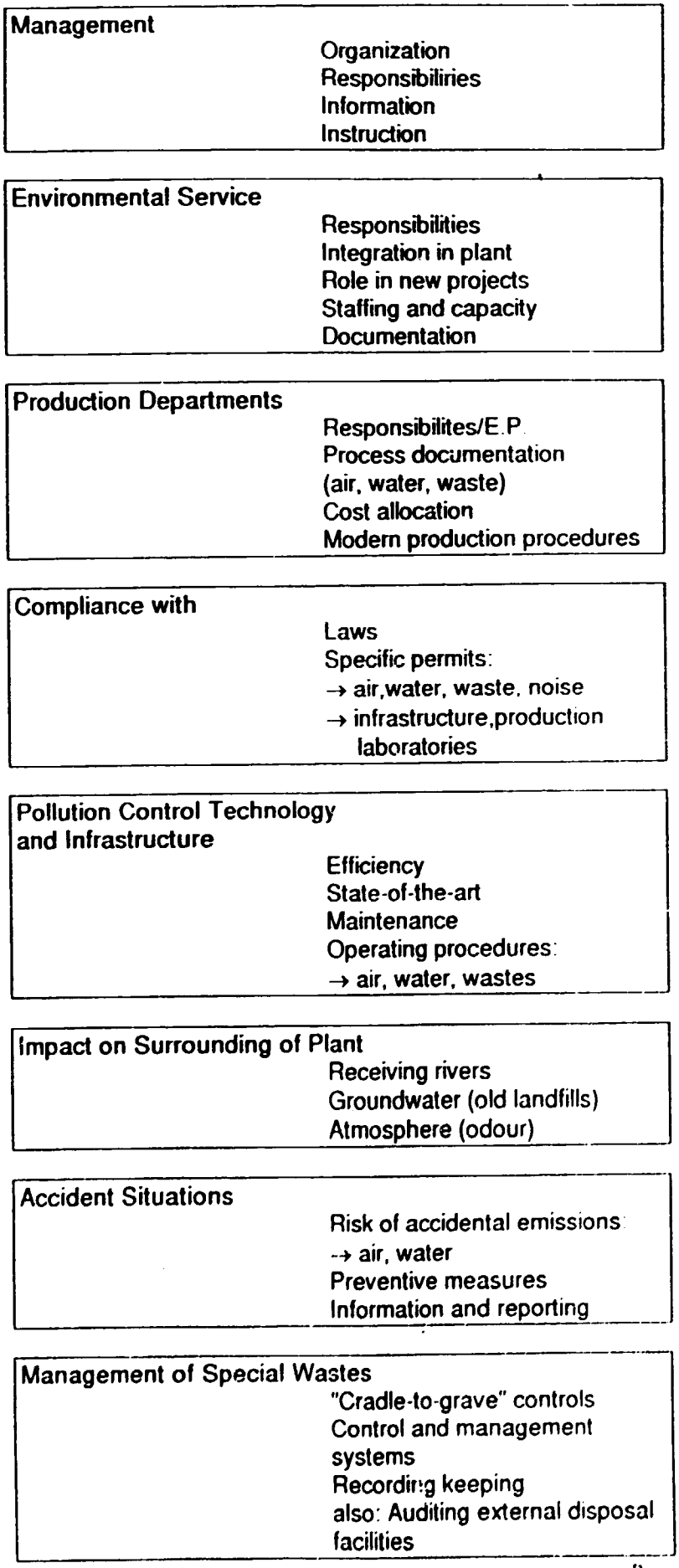

Figure 3. Environmental Auditing Focal Points

6. CONCLUSION AND RECOMMENDATIONS

Generally, there is a great need for training courses in energy auditing and industrial energy conservation in Ethiopia, Tanzania and Uganda. The completed course on energy auditing can be carried out a number of additional times in order to reach more industries, and participants from other regions of the countries. What is also lacking is awareness of energy conservation potentials on all levels: from the equipment operators, to engineers and managers, accountants and policy makers. This facts makes difficult to promote energy efficiency and introduce energy management into everyday practice.

The workforce in Ethiopia, Tanzania and Uganda has adequate level of theoretical knowledge. What is lacking, however, is the practical experience in how to carry out energy audits, identification and design of energy cost reducing measures and how to plan and carry out implementation of these.

The environmental auditing, which was briefly introduced, also raised considerable interest, which indicates that the needs for training and assistance in this area have to be assessed.

According to the participants remarks, the other problems are:

-lack of the support from top management,
-lack of the awareness on energy conservation potentials,
-missing or out of order instrumentation in the factories which is necessary to monitor and control energy consumption,
-lack of continuos energy consumption analysis and monitoring,
-lack of information on and availability of energy efficient technologies,
-need for additional training on preparation of financial proposals for energy conservation projects.

Regarding the workshop itself, the main remark was that the time was somewhat short for the ambitious programme prepared. In addition, in Tanzania and Uganda a remark was that the residential course would be probably more effective in achieving the training objectives. However, participants were pleased with the emphasise on the practical work, and some of the skills practised were revelation for quite a few of them.

To address the problems recognised, more workshops should be held as residential in other regions of Ethiopia, Tanzania and Uganda, and focused on particular industrial branches. This way it would be possible to go more in depth into related technologies and emphasise relevant practical aspects for the selected industrial branches. A breif outlines are drafted for potential further activities and attached as Annex VIII.

Pilot energy conservation projects should be carried out in close co-operation with the staff of selected industrial plants and local counterparts (Ethiopian Energy Authority, TIRDO in Tanzania and Energy Conservation Department, Ministry of Natural Resources in Uganda) which could continue the work in the future.

Another essential part is to increase the awareness of these questions among top management so that the companies really pay attention to energy conservation. In Tanzania, following the initiative of Dr. Hurry Suresh of UNDP, TIRDO managed to arranged a short meeting with some managers of the factories which sent their engineers to the workshop. A brief presentation was arranged for them, and their interest, questions, and reactions proved the need to increase the awareness of the top managers for energy conservation

To summarised, the following is recommended:

-to screen the needs for training on energy conservation and environmental problems in the countries for different target groups such as operators, engineers, managers, trainers, policy makers, financial people, etc.

-to prepare and held seminars for top management on financial aspects of energy conservation opportunities,

-additional workshops on energy auditing for specific industrial sectors in other regions of Ethiopia, Tanzania and Uganda,

-implementation of energy conservation projects in selected factories,

-training on use of UNIDO's ENERCOST software package.

7. WORKSHOPS ASSESSMENT

The assessment of the workshops was carried out by the staff of UNIDO, Vienna and UNDP, New York, as follows.

1 Ms. Betel Tasseu, UNIDO, Vienna - ETHIOPIA

2 Mr. Valentin Ischenko, UNIDO, Vienna - TANZANIA

3 Mr. Igor Loguinov, UNIDO, Vienna - UGANDA

4 Dr. Suresh Hurry, UNDP, New York - TANZANIA , UGANDA

8. ACKNOWLEDGEMENT

It is our pleasant duty to thanks to staff of Ethiopian Energy Authority, Addis Ababa, TIRDO, Dar Es Salaam, Energy Conservation Department, Ministry of Natural Resources, Kampala, and local UNIDO offices in Ethiopia, Tanzania and Uganda, who all did their best to facilitate successful workshops implementation.

The staff of Ethiopian Tannery, Tanzania Brewery and Uganda Brewery were also instrumental in providing opportunities for practical training.

The useful comments and suggestion of the workshops assessors contributed to achievement of the training objectives.

Finally, participants motivation and hard working approach were crucial for the Workshops success.

ANNEXES

ANNEX I

27 May 1992

TERMS OF REFERENCE

Energy Auditing Workshops

I. BACKGROUND AND PURPOSE OF THE PROJECT:

UNIDO in cooperation with UNDP and the Governments of Ethiopia, Tanzania, and Uganda will organize a two weeks workshop on Energy Auditing in each of the above countries. The workshops will be attended by 20 - 25 participants, i.e. professional personnel from public and private industrial enterprises. The training course will be developed by subcontractors in close cooperation with UNIDO.

Energy auditing is a key factor for the successful implementation of energy conservation programmes. The basic prerequisites for an effective energy auditing programme are a core of well trained managers to run programmes of energy utilization, engineers and technicians in this field, adequate equipment for on-the-spot measurements, support materials such as manuals, check-list, etc. and the continuing effort by the Governments to create national awareness of the importance of energy conservation and auditing among the small- and medium-scale industrial enterprises.

The purpose of energy audits is to provide factories with accurate means of recording energy consumption and costs, to make available to factories the information necessary for identifying real opportunities for energy savings, and to supply comprehensive and accurate data appropriate for national energy planning activities. They should be viewed as critical examinations of the factories' energy consumption.

In none of the three countries under reference has there been much training in energy conservation organized at the natinal level. Ad hoc on-the-job training for technicians and semi-skilled operators is being done at the plant level. For such training, however, the trainees are merely requested to observe what is being done by the engineers or foremen. Very little effort has ben made to devise comprehensive training programmes, supported by training materials and equipment to upgrade skills and expertise in energy auditing, produciton, management and conservation.

The workshop in each of the three countries will last two weeks and will be sponsored by UNIDO, UNDP and the Government of the particular country. In each country there will be about 25 participants drawn from both the private and public sector. Participants are expected to be engineers and other professional level people. Both the preparation for, and actual conduct of, the workshop will be undertaken by subcontractors who will work closely with UNIDO

The participants in these workshops are expected to apply the knowledge acquired to conduct future energy auditing exercises in their respective companies/institutions. Upon the completion of the workshops, the project will transfer one set of the portable diagnostic instruments to the authorities concerned in each of the countries involved. The portable diagnostic instruments will be kept under the custody of one central focal point and will

be made available on loan to the participants to carry out tasks relating to energy auditing. UNIDO and the local UNDP offices in each country will take the necessary action to ensure that the instruments will be available. Furthermore, each participant will be given one complete set of energy auditing training manual which will be used as reference material for future work.

2. AIMS OF THE PROJECT

The aim of the project is to strengthen the technical capabilities and skills of engineers/industrialists in Ethiopia, Tanzania and Uganda on the activities relating to the efficient use of energy in industry thus enabling them to carry out energy audits and identify ways of improving efficiency in energy consumption. Furthermore, the project will provide the counterpart organizations with portable diagnostic instruments which will be used for carrying out energy audits during the workshops. The portable diagnostic instruments will be transferred to selected ministries or institutions concerned upon completion of the workshop. These could be given out on loan for further energy auditing exercises by the participants in their respective companies/institutions if a loan system could be arranged and responsibilities apportioned.

3. SCOPE OF WORK

(a) The subcontractor will undertake a preparatory mission to Ethiopia, Tanzania and Uganda (about 8 days by country) in order to carry out the following tasks:

- Check the actual status and need for training in the area of energy auditing;
- Assist the authorities in the selection of participants in the workshop;
- Assist in the selection of an institution for allocation of the equipment and prepare recommendation for its use;
- Identify one plant for practical exercise on energy auditing during the workshops and carry out work through auditing of it for developing a case study for the workshop. The subcontractor will prepare a set of training material (approx. 100 copies) in the form of a manual along the lines of the workshop programme, including theoretical and practical parts and case studies.
- Select measuring instruments for the energy audits (a draft list of instruments is attached herewith) and provide exact specifications.
- Finalize with local authorities concerned and UNDP all logistic arrangements for the workshops,
- Submit a draft programme for the workshop and a draft report on the [illegible]

(b) Implementation of the workshop: The subcontractor will conduct a two weeks workshop which will be attended by 20 - 25 participants in each of the following countries: Ethiopia, Tanzania and Uganda. The teams will include 4 specialists:

The scientific coordinator of the workshop, an energy auditing specialist, who should attend the whole workshop;

3 specialists (1 chemical engineer, 1 electrical engineer, 1 financial analyst) for lecturing and exercises on relevant topics as described below.

- The second workshop should take place at least 1 month later and not more than 3 months after the first workshop.

The programme parameters of the workshop and of the manual will cover the following subjects:

- introduction to industrial energy conservation including alternative sources of energy and production systems;
- environmental and legal considerations;
- the need for energy conservation projects and a presentation of basic technology; Case Study
- basic principles of organizing energy management at enterprise level.
- how to analyze the energy systems and the energy utilization at a factory;
- technique of energy conservation
- energy audit principles and project planning;
- analysis on how to plan and carrythrough the energy audit and how this is connected to entire energy convervation project;
- description of the different types of measuring instruments to be used and the measuring methods to be involved in an energy audit and a presentation of the need for calibration, checking and repairing of the instruments;
- practical work how to use the energy measuring instruments and to carryout energy audits both of a separate energy user, e.g. a boiler, and of an entire plant.

basic calculation formulas to be used to calculate the different energy flows based on the measurements results.

how to prepare Energy Balance and Sankey diagram from given data.

practical measures to obtain a more efficient utilization of energy by means of saving and recovery measures, process changes, changing maintenance routines and by a changeover to cheaper energy sources. This must be discussed in order to inform the participants of the need for energy audits and what will be the final result of it.

ANNEX II

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

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AIDE- MEMOIRE

ENERGY AUDITING WORKSHOP

Organized by the United Nations Industrial Development Organization

to be held June - August 1993

in Ethiopia, Uganda, Tanzania

BACKGROUND INFORMATION

UNIDO in cooperation with UNDP and the Governments of Ethiopia, Tanzania and Uganda will organize a two weeks workshop on energy auditing in each of the above countries. The workshops will be attended by 20 - 25 participants, i.e. professional personnel from public and private industrial enterprises.

Energy auditing is a key factor for the successful implementation of energy conservation programmes. The basic prerequisites for an effective energy auditing programme are a core of well trained managers to run programmes of energy utilization, engineers and technicians in this field, adequate equipment for on-the-spot measurements, support materials such as manuals, check-list, etc. and the continuing effort by the Governments to create national awareness of the importance of energy conservation and auditing among the small- and medium-scale industrial enterprises.

The purpose of energy audits is to provide factories with accurate means of recording energy consumption and costs, to make available to factories the information necessary for identifying real opportunities for energy savings, and to supply comprehensive and accurate data appropriate for national national energy planning activities. They should be viewed as critical examinations of the factories' energy consumption

Ad-hoc on-the-job training for technicians and semi-skilled operators is being done at the plant level. For such training, however, the trainees are merely requested to observe what is being done by the engineers for foremen. Very little effort has been made to devise comprehensive training programmes, supported by training materials and equipment to upgrade skills and expertise in energy auditing, production, management and conservation.

THE AIM OF THE WORKSHOP

The aim of the workshop is to increase awareness of energy saving/conservation/management among people responsible for energy and use in industry, or dealing with energy conservation at other institutions, and thereby create a favourable climate for reduced energy use within the countries.

Objectives will be:

to train personnel from key industries and institutions in energy conservation techniques and specially on energy auditing;

to increase the awareness on energy conservation importance and potential within the selected companies where the case studies will be made;

and to train the personnel to be able to carry out energy conservation projects;

to provide a set of instruments for a selected national institution for further use by trained persons from the institutions itself or from other personnel responsible for energy conservation/management at company level.

DATE AND PLACE

Tentatively, the workshops will take place in Ethiopia, Uganda and Tanzania in June, July and August respectively. Precise date and place will be determined after the preparatory mission.

CANDIDATES PROFILE

The candidates should have a university education or equivalent educational background in chemical, mechanical, electrical engineering or relevant branch or engineering and should be employed with industry with one to four years of practical experience. The candidate should preferably be within the age group of 25 to 40.

They should be responsible for the energy sector in their respective companies or involved in energy conservation projects if coming from non industrial organizations. They should be at the level of chief engineer or supervisor or project manager. It is desirable that the candidates will be from both industrial and non industrial sectors.

Training Programme

The programme parameters of the workshop and of the manual will cover the following subjects:

- introduction to industrial energy conservation including alternative sources of energy and production systems

- environment and legal consideration

- the need for energy conservation projects and a presentation of basic technology: case study

- basic principles of organizing energy management at enterprise level

- how to analyze the energy systems and the energy utilization at a factory

- technique of energy conservation

- energy audit principles and project planning

- analysis on how to plan and carry through the energy audit and how this is connected to entire energy conservation project

- description of the different types of measuring instruments to be used and the measuring methods to be involved in an energy audit and a presentation of the need for calibration, checking and repairing of the instruments

- practical work how to use the energy measuring instruments and to carryout energy audits both of a separate energy user, e g. a boiler, and of an entire plant

- basic calculation formulas to be used to calculate the different energy flows based on the measurements results

- how to prepare energy balance and sankery diagram from given data

practical measures to obtain a more efficient utilization of energy by means of saving and recovery measures, process changes, changing maintenance routines and by a changeover to cheaper energy sources. This must be discussed in order to inform the participants of the need of energy audits and what will be the final result of it.

heat exchange systems and energy saving measures

refrigeration and cooling towers

- dryers, kilns and furnaces

- air compressors and compressed air systems

electrical systems (e.g. lightening, transformers, pick load management etc)

maintenance and operating routines

evaluation and financial analysis of energy auditing results and preparation feasibility studies for energy efficiency and improvements

ANNEX III

ANNEX III

ENERGY AUDITING WORKSHOP - DETAIL PROGRAMME

Day No 1

8.30 - 9.00 Opening of the workshop

9.00 - 9.30 Aim of the Workshop, Programme of the Workshop, Working methods

9.30 - 10.30 Presentation of participants and their problems

10.30 - 11.00 Coffee break

11.00 - 12.30 Introduction to Energy Conservation

12.30 - 14.00 Lunch

14.00 - 15.30 Energy management and Energy audit principles

15.30 - 16.00 Coffee break

16.00 - 17.00 Project planning

Lecturer all day: Dr. Z. Morvay

Day No 2

8.30 - 10.00 Practical energy auditing techniques
Description of energy auditing techniques
(Z Morvay)

10.00 - 10.30 Coffee break

10.30 - 12.00 Planning of measurements
Energy balances - Sankey diagrams
(Z. Morvay, Z. Tomsic, D. Gvozdenac)

12.00 - 13.00 Lunch

13.00 - 17.00 Preparation for the energy audits at factor - walk through audit
(Z. Morvay, Z. Tomsic, D. Gvozdenac)

Day No 3

8.30 - 10.00 Energy measurement equipment
(D. Gvozdenac, Z. Tomsic)

10.00 - 10.30 Coffee break

10.30 - 12.00 Description of the measuring instrument provided by UNIDO
(Z. Morvay, D. Gvozdenac, Z. Tomsic)

12.00 - 13.30 Lunch

13.30 - 15.00 Group exercises, in class-room, in the function and use of the measuring instruments
(D. Gvozdenac, Z. Tomsic)

15.00 - 15.30 Coffee break

15.30 - 16.30 Preparation for the energy auditing in the factory next day
(Z. Morvay)

Day No 4

8.00 Leaving for the factory

8.45 - 13.30 Energy audit at the factory:
Group exercises in energy auditing 5 groups, 5 members each, each group analyzing factory energy subsystems

13.30 - 14.30 Lunch

14.30 - 16.00 Processing the results and preparation for the next day of auditing

---

(Trainers: Z. Morvay, Z. Tomsic, D. Gvozdenac)

Day No 5

8.00 Leaving for the factory

8.45 - 13.30 Energy audit at the factory:
Group exercises in energy auditing

13.30 - 14.30 Lunch

14.30 - 16.00 Analysis of the results and experience and summarizing measuring results collected

---

(Trainers: Z. Morvay, Z. Tomsic, D. Gvozdenac)

Day No 6 Review of basic theoretical concepts

8.30 - 10.00 Fuels, boilers and combustion technology

10.00 - 10.30 Coffee break

10.30 - 12.00 Energy distribution systems and users
Steam, condensate and hot water systems
Ventilation systems
Heat exchange systems
(D. Gvozdenac)

12.00 - 13.30 Lunch

13.30 - 15.00 Electricity supply and distribution
Daily load curve, peak load, power factor
Transformers, motors, lighting

15.00 - 15.30 Coffee break

15.30 - 16.30 Compressed air plants
(Z. Tomsic)

Day No 7

8.00 Leaving for the factory

8.45 - 13.30 Energy audit at the factory:
-filling the gaps from previous measurements
-establishing the energy flows in the factory

13.30 - 14.30 Lunch

14.30 - 16.15 Preparation of the energy auditing report

(Trainers: Z. Morvay, Z. Tomsic, D. Gvozdenac)

Day No 8

8.30 - 10.00 Principles of Energy Management
Monitoring and targeting
Role of energy manager
Computerized energy management systems
(Z. Morvay)

10.00 - 10.30 Coffee break

10.30 - 12.00 Software package for energy consumption analysis
(Z. Tomsic)

12.00 - 13.30 Lunch

13.30 - 14.30 Discussing energy conservation and recovery measures - completing the report
(Z. Tomsic, D. Gvozdenac)

14.30 - 15.00 Coffee break

15.00 - 16.30 Energy calculation based on measurement values from the energy auditing - report preparation
(Z. Morvay, Z. Tomsic, D. Gvozdenac)

Day No 9

8.30 - 10.00 Financial evaluation of energy conservation opportunities

10.00 - 10.30 Coffee break

10.30 - 12.00 Prioritizing energy conservation measures
Preparing financial proposals for energy conservation projects

12.00 - 13.30 Lunch

13.30 - 15.00 Financial evaluation of the energy conservation measures proposed for the factory

15.00 - 15.30 Coffee break

15.30 - 16.30 Finalizing the report on energy auditing in the factory

---

(Lecturer: Z. Morvay)

Day No 10

8.30 - 10.00 Financing energy conservation projects

10.00 - 10.30 Coffee break

10.30 - 12.00 Closing discussions
Evaluation of the course

12.00 - 13.30 Lunch

13.30 - 14.30 Delivering the Certificates of Completions

14.30 - 15.00 Closing the Workshop

(Lecturer: Z. Morvay)

ANNEX IV

ANNEX IV

MEASURING INSTRUMENTS FOR THE ENERGY AUDIT TRAINING COURSE - ETHIOPIA AND UGANDA

2 pcs Electronic thermometer, Testoterm

2 pcs Silicon paste

1 pcs Infrared non-contact thermometer

1 pcs Solomat humidity meter

1 pcs Testovent 490 air velocity meter

1 pcs Prandtl tube

1 pcs Micromanometer, electronic, digital

1 pcs Stop clock with 100 mm dial

1 pcs Bestobell steam leak detector

1 pcs Electrical energy analyser

2 pcs Clamp-on Multimeter MX 1200

1 pcs Combustion efficiency analyser Neotronics

1 pcs Lux Meter

2 pcs Notebook Computer, 4 MB RAM, 40 MB hard disc with Windows 3.1, MS Word 2.0, MS Excel 4.0

2 pcs Portable CANON Bubble Jet printer (BJ-10)

2 set diskettes 3.5" and ribbons

MEASURING INSTRUMENTS FOR THE ENERGY AUDIT TRAINING COURSE - TANZANIA *

1 set Spare parts for flue gas analysers

1 pcs Water pollution detection kit

1 pcs Temperature calibrator

1 pcs 486 desktop personal computer,
4 MB RAM, 80 MB hard disc, colour monitor,
with Windows 3.1, MS Word 2.0, MS Excel 4.0,

1 pcs EPSON letter quality matrix printer A3 format

2 set diskettes 3.5" and ribbons

1 pcs CANON photocopier MP 3050

1 set spares for photocopier

1 pcs Toshiba A/C

* NOTE

TIRDO (Tanzanian Industrial Research and Development Organisation), implementing agency for the project in Tanzania, has got already most of the instruments proposed on the list for Uganda and Ethiopia. These were supplied through the World Bank technical assistance project.

ANNEX V

ANNEX V

LOCAL COUNTERPARTS

1. Ethiopia - Contact person and institution for delivery of instruments

Mr. Tariku TAFERE, Ethiopian Energy Authority
Head, Bureau of energy utilisation and conservation

P.O. Box 8063, Addis Ababa

tel: (251) 1 18 24 97
fax: 51 78 74

2. Uganda - Contact person and institution for delivery of instruments

Mr. Michael Shem WAMBOGA, Ministry of energy, minerals and environmental protection
Head, Energy conservation department

Amber House, P.O.Box 7270, Kampala

tel: 41 234 861
fax: 235 119

3. Tanzania - Contact person and institution for delivery of instruments and specification for the spare parts requested

Mr. Robert NINDIE, Tanzanian industrial research and development organisation (TIRDO)
Head, Energy conservation department

P.O. Box 23235, Dar Es Salaam

tel: 68 822; 68 984
telex: 41409 TIRDO

ANNEX VI

ANNEX VI

ENERGY CONSERVATION AUDIT

INTERNAL CONTROL QUESTIONNAIRE

Table 1. Quantity of energy used and its cost for the last financial year

Type of energy	Tonnes	Litres	MJ	kWh	Price/ unit	Cost	Common basis MJ (kWh)	Cost per MJ (kWh)
Solid fuel								
Liquid fuel								
Gaseous fuel								
Electricity								
Other								
Total								

Table 2: Environmental

Type of energy	Offices	Factory	Warehouses
Energy use			
Lighting (kWh)			
Hot water MJ (kWh)			
Space heating MJ (kWh)			
Number of hours in actual use/month			
Space heating ratio			
MJ/m^2/month			

Table 3: Production

Type of energy	Machine shop consumption cost	Process A consumption cost	Process B consumption cost	Boiler house consumption cost
Energy use:				
Electricity (kWh)				
Lighting				
Machines				
Compressed air				
Heating				
Gas MJ or kWh				
Oil - litres or MJ(kWh)				
Solid fuel inc. waste (tonnes)				
Process heat and power				
Steam kg or MJ				
Electricity (kWh)				
Units of output				
Total energy used (kWh or MJ)				
Total energy cost				
Energy used/unit of output				
Energy cost/unit of output				

Table 4: Transport

Type of energy	Internal transport	Delivery, etc.
Petrol (litres)		
Diesel (litres)		
Lube oil (litres)		
LPG (MJ or kWh)		
Electricity (kWh)		
Vehicle mileage		
Freight carried (tonnes)		
Oil/petrol		
Consumption (per tonne km)		
Cost of fuel (per tonne km)		

ELECTRICITY DATA SHEET

Date: _____

The consumption and prices of Electricity used by Company for year .....

Year	Active energy						Reactive energy					
	High tariff		Middle tariff		Low tariff		High tariff		Middle tariff		Low tariff	
Month	Consumption kWh	Price/unit /kWh	Consumption kWh	Price/unit /kWh	Consumption kWh	Price/unit /kWh	Consumption kVArh	Price/unit /kVArh	Consumption kVArh	Price/unit /kVArh	Consumption kVArh	Price/unit /kVArh
January												
February												
March												
April												
May												
June												
July												
August												
September												
October												
November												
December												
January												

Maximum demand

Month	January	February	March	April	May	June	July	August	September	October	November	December	January
Maximum demand kVA													
Price per unit /kVA													
Working hours per month													
Number of shifts													

Energy conservation audit
Internal control questionnaire

Name of company .....
Location .....
Official(s) interviewed .....

A Control of energy

1 *Who is responsible for energy management?*
Name .....
Position in organisation.....
Who does he/she report to.....
Full time or part time.....
Qualifications, relevant experience.....
Staff.....

2 *How is energy consumption reviewed?*
From head office or on location.....
Continuously or periodically.....
According to a plan or irregularly.....

3 *If periodically, when was last review?*
....

4 *How is energy consumption analysed:*
a) by department;
b) by product;
c) by source;
d) by month or number of working days (shifts)
e) per month ;
f) by cost;
g) between lighting, hot water, space heating, power, refrigeration etc.;
h) between office, factory, warehouse, transport etc. (see Tables 2, 3, 4)?

5 *Does analysis identify the relationship between consumption of energy level of activity?*
.....

6 *What units of measurement are used?*
(Convert consumption of different sorts of energy into one unit - also into money.)
.....
.....
.....
.....
.....
.....
.....

7 *(a) What are the metering control arrangements?*
(N.B. This question includes: how frequently are readings taken; to what extent is there sub metering; what records are kept?)
.....
.....
(b) Is sub metering adequate?.....
(c) Should an energy management system be installed?
.....
(d) Would central data logging be cost effective?
Coal or other solid fuels.....
Steam.....
Gas.....
Electricity.....
Liquid fuels.....
Water.....
Others.....

8 *Is there an energy consumption forecast/budget?*
.....

9 *Have standards been set - i.e. standard energy consumption for each process or building?*
.....

10 *Is consumption compared with:*
a) previous periods;
b) other locations;
c) other companies;
d) other industries;
(Does the comparison take account of weather conditions and days worked?)
.....

11 *Has the managements set targets:*
a) for absolute levels of consumption;
b) for levels of consumption based on activity;
c) for levels of idle time;
d) for percentage cuts in consumption?

12 *(a) Does management consider information on energy consumption an essential part of the management information system?*
.....
(b) If not, why not?
.....

13 *What steps have been taken by way of propaganda or education of employees, to promote energy conservation?*
.....
.....
.....
.....

14 *What steps are being/have been taken in re-cycling energy - e.g. sale of by-products or scrap (having intrinsic energy content); reclamation of energy as heat from air, water, hot products etc.; using waste as a fuel?*

.....

.....

.....

15 *To what extent is planned maintenance in operation?*

.....

.....

16 *How often are different classes of plant inspected or tested - e.g. for corrosion, cracking, fouling, leaks, malfunctioning steam traps, inaccurate or inoperative control devices?*

.....

.....

.....

17 *Who controls capital spending budget?*

.....

18 (a) *Is there a list of energy saving investments under review, ranked in order of priority, with detailed costing and pay-back calculation?*

.....

(b) *If not, why not?*

.....

19 *Has a Sankey diagram been prepared?*

.....

B Sources of energy

1 *What are the sources of energy used?*
a) Coal or other solid fuels
b) Gas
c) Electricity
d) Liquid fuels
e) Other

2 (a) *What tariffs are used?*.....

(b) Why?.....

(c) When were they last reviewed?.....

(d) Can off-peak tariffs be used?.....

(e) Can you cut maximum demand?.....

(f) Can you improve power factors where it is economical to do so? .....

C Uses of energy

1 Buildings

(a) Is insulation adequate:
roof:.....
walls:.....
floors:.....
doors:.....
windows:.....

(b) For what period are buildings heated and lighted:
hours per day:.....
days per year:.....

(c) Is heating controlled manually; by thermostat, time clock etc.?
.....

(d) What is the temperature?.....

(e) Could the temperature be reduced?.....

(f) Does temperature vary from one part of the building to another?
.....

(g) Is ventilation excessive (often the major cause of heat loss)?
.....

(h) Are parts of the building heated unnecessarily?
.....

(i) Are energy efficient lighting fittings and controls used?
.....

2 Oil storage

(a) How are storage tanks heated?.....

(b) Are they kept at most economic temperature?.....

(c) Are they adequately insulated?..... .....

3 What are areas of high energy consumption?

.....
.....
.....
.....
.....

4 Is there any risk/evidence of unauthorised use or leakage?

.....

5 What further steps are being considered to optimise savings and profits?

.....
.....
.....

6 Processes

(a) Are pipes and tanks adequately lagged?.....
(b) Is condensate recovered?.....
(c) Is boiler and furnace efficiency tested?.....
(d) Are process temperature at lowest essential level?.....
(e) Is the optimum blowdown on boilers maintained?.....
(f) Is refrigeration plant operating efficiently?.....
(g) Are there leaks of steam, hot water or compressed air?.....

The internal control questionnaire will have highlighted the weaknesses and strengths of the energy management programme.

DATA COLLECTION SHEETS

ENCONET International

Walk Through Survey

Company: _____ Date: _____

Location: _____ By: _____

ITEM	LOCATION						
	AREA # 1	AREA # 2	AREA # 3	AREA # 4	AREA # 5	AREA # 6	AREA # 7
Trap Malfunction							
Trap Leaking							
Missing Insulation From Flanges							
Missing Insulation From Pipe							
Missing Insulation From Equipment							
Pipe Leaking							
Equipment Leaking							
Condensate Dumped to Sewer							
Steam Pressure Higher Than Required							
Equipment Operating When Not Required							
Visible Steam Plumes From Vents							
Control Adjustments Required							
Piping Systems Operating but Not Required							
Miscellaneous Comments							

Measuring, Metering and Monitoring

Checklist 15-1

Facility: _____ Date: _____

Location: _____ By: _____

Energy System	Metered Yes/No	Energy Consumed	Annual Cost	% Total	Metering Accuracy	Metering Confidence	Additional Metering
Total Heating							
Total Cooling							
Total Lighting							
Process Cost Centres							
•							
•							
•							
•							
•							
•							
•							
•							
•							
•							
•							
•							
•							
•							
•							
•							
Warehouse							
Boiler Plant							
Waste Treatment							
Maintenance Shop							
Refrigeration							
Kitchen							
Recreation							
Other							
•							
•							
•							

Pipe Insulation

Company: _____ Date: _____

Location: _____ By: _____

Steam pressure	..... kPa(gauge)	(1)
Pipe size	.....	(2)
Length of pipe	..... m	(3)
Heat loss from insulated pipe (Insulation manufacturer's data)	..... Wh/m·h)	(4)
Total operating time	..... h/yr	(6)

Steam pressure	..... kPa(gauge)	(1)
Pipe size	.....	(2)
Length of pipe	..... m	(3)
Heat loss from insulated pipe (Insulation manufacturer's data)	..... Wh/m·h)	(4)
Total operating time	..... h/yr	(6)

Steam pressure	..... kPa(gauge)	(1)
Pipe size	.....	(2)
Length of pipe	..... m	(3)
Heat loss from insulated pipe (Insulation manufacturer's data)	..... Wh/m·h)	(4)
Total operating time	..... h/yr	(6)

Steam pressure	..... kPa(gauge)	(1)
Pipe size	.....	(2)
Length of pipe	..... m	(3)
Heat loss from insulated pipe (Insulation manufacturer's data)	..... Wh/m·h)	(4)
Total operating time	..... h/yr	(6)

Steam Trap Survey

Company: _____ Date: _____

Location: _____ By: _____

ITEM	COMMENTS
Identification	
Trap Type	
Type of Service	
Line Size	
Trap Size	
Operating Pressure	
Condition of Trap	
Type of Test Used to Determine Condition	
Date Trap Last Serviced	
Date Next Service Required	
Miscellaneous Comments	

WORKSHEET

ELECTRIC MOTORS

Electric motor							
Electric motor nameplate power	kW						
Number of phases							
Rated voltage, V_r	V						
Rated full load current, I_r	A						
Rated full load power factor, $p.f._r$							
Measured voltage, V	V						
Measured current, I	A						
Measured power factor, p.f							
Rated motor efficiency (nameplate), $Effn_r$							
Nameplate shaft power output	kW						
Unit electrical energy cost, Ce							
Unit fuel cost (No. 2 oil), Cf							
Operation time, h	hr						
Measured voltage-loaded, V_l	V						
Measured current-loaded, I_l	A						
Operation time-loaded, h_l	hr						
Measured voltage-unloaded, V_{ll}	V						
Measured current-unloaded, I_{ll}	A						
Measured power factor-unloaded, $p.f_{ll}$							
Operation time-unloaded, h_{ll}	hr						

QUESTIONNAIRE for

OIL-FIRED BOILER PLANT

STEAM BOILERS

- Quantity of boilers: _____ units
  - Type of boiler: _____
    capacity of steam generation: _____ t/h
    nominal power _____ MW
    annual consumption of oil steam boiler: _____ t
  - Type of boiler: _____
    capacity of steam generation: _____ t/h
    nominal power _____ MW
    annual consumption of oil steam boiler: _____ t
  - Type of boiler: _____
    capacity of steam generation: _____ t/h
    nominal power _____ MW
    annual consumption of oil steam boiler: _____ t

- Total installed capacity of steam generation: _____ t/h

- Overall nominal power: _____ MW

- Total consumption of the crude oil equivalent (in case that all boilers are operated simultaneously): _____ t/h

- Anticipated use of available capacities (the level of simultaneous operation): _____ %

- Anticipated duration of the working period:
  _____ hours a day or _____ day a year

- Annual consumption of the crude oil equivalent in steam boilers:
  _____ t

- Higher heating value of fuel (state units) : _____

- Oil storage tanks:
  In the open or underground
  Storage temperature of oil: _____ ^{0}C
  Handling temperature of oil: _____ ^{0}C

- Economisers: _____

- Methods of Blowdown _____
  Boiler blowdown flowrates _____
  Control of blowdown: _____
  Waste heat recovery from blowdown: Y / N

- Condensate recovery: Y / N

- Feed water supply
  Water treatment: Y / N

Boiler Efficiency Test

Company: _____ Date: _____

Location: _____ By: _____

Boiler Number: _____ Fuel Fired: _____

Rated Capacity: _____ Test No: _____

Pressures & Temperatures

Steam pressure at boiler outlet	..... kPa	(1)
Steam temperature at boiler outlet	..... °C	(2)
Water temperature at boiler inlet	..... °C	(3)
Combustion air temperature	..... °C	(4)
Fuel temperature	..... °C	(5)
Gas temperature leaving boiler	..... °C	(6)

Unit Quantities

Enthalpy of steam at boiler outlet	..... kJ/kg	(7)
Enthalpy of feed water to boiler	..... kJ/kg	(8)
Heat absorbed per kg of steam (7-8)	..... kJ/kg	(9)
Higher heating value of fuel (state units)	.....	(10)

Hourly Quantities

Actual water evaporated	..... kg/h	(11)
Rate of fuel firing (state units)	..... kg/h	(12)

Flue Gas Analysis

	% Volume	
CO_2	.....	(16)
O_2	.....	(17)
CO	.....	(18)
N_2 by difference	.....	(19)
Excess air	.....	(20)

MONTHLY SUMMARY OF COST OF OIL FUELS (STEAM RAISING)

Period
From:
To:

Location:
Fuel classification:
Steam pressure:

Month	Opening Stock	Closing Stock	Deliveries	Consumption	Cost of Deliveries	Price per litre		Steam Raised		Efficiency
	litres	litres	litres	litres		Scheduled	Actual	kg	kg per litre	per cent

ANNEX VII

ANNEX VII

ENERGY AUDITING TRAINING MANUAL CONTENT

1. Introduction to industrial energy conservation

1.1. Introduction to energy conservation
1.2. Energy and environment in developing countries
1.3. Fundamental concepts - example of OECD countries
1.4. Developing countries & energy conservation
1.5. Ways to improve energy efficiency
1.6. Industrial energy conservation - potential savings, investment requirements, economics

2. Energy auditing

2.1. Introduction
2.2. Energy conservation project planning
2.3. Role of energy auditing
2.4. Methodology of energy auditing
2.5. Instrumentation and measurement

3. Industrial energy systems - description and basic analysis

3.1. Heat energy (steam and water)
3.2. Electricity
3.3. Refrigeration and heat pumps
3.4. Compressed air
3.5. Heating, ventilating and air-conditioning
3.6. Water systems

4. Components of industrial energy systems - analysis and calculation

4.1. Boilers
4.2. Water treatment
4.3. Steam and condensate systems
4.4. Thermal insulation
4.5. Heat exchangers
4.6. Electric motors
4.7. Transformers and capacitors
4.8. Lighting
4.9. Compressors
4.10. Process furnaces, dryers and kilns
4.11. Instrumentation and control

ANNEX VIII

PROJECT PROPOSAL

"Seminars for top management on Energy Conservation"

1. BACKGROUND

A two weeks Energy Auditing Workshop has been recently completed in Debre Zeit, Ethiopia. The workshop was attended by 34 participants from industry and related ministries. They have shown a great interest in the Workshop subject and reemphasized the dire need for such Workshops and knowledge in Ethiopian industry. They have also pointed out importance of top management support for energy conservation project implementation.
To start the work with reduced energy use in industry it is a prerequisite that the top level management is dedicated and committed to an energy conservation program. To achieve this it is necessary with information about the positive results that can be achieved by an energy conservation project.

2. THE PROJECT

2.1. The project objective

The objective of the project is to increase awareness of energy question among top management and thereby create a favorable climate for reduced energy use within the industrial sector.
The organization and promotion of a company's energy saving activities is an important part of an energy conservation project. Top management must be dedicated and committed to an energy conservation program, they must be willing to provide the resources, both personnel and funds, as required. They must believe that energy conservation is most important for the future health of their company.

2.2. OUTPUT

The project output is:
- A written material covering the subject of the seminar
- A report covering the execution of the training.

2.3. ACTIVITIES

Short seminars, approximately 2 days, should be held to inform management about energy questions and make them aware of what gain their company could have from an energy conservation project The numbers of participants should be about 20 at each seminar.

The subjects of the seminar should be:

- A description of the need for energy conservation projects
- A description of the work schedule for an energy conservation project
- Some for the industrial subsector in question feasible energy conservation measures
- Case studies of energy conservation project already carried through
- Financing Energy Conservation Projects

PROJECT PROPOSAL

"Training course in energy conservation for food processing industry"

1. BACKGROUND

The work force in Ethiopia has a high theoretical level. What is lacking is, however, the practical experience in how to carry out energy audits, identification and design of energy cost reducing measures and how to plan and carry out the implementation of these. To get this knowledge UNIDO assistance, in among others the form of training program, are required. The food processing industry, being both energy intensive and particularly important for the country, is the best subsector to start with.

2. PROJECT OBJECTIVE

The first objective of the presented project is to train personnel from key food processing industries and institution in Ethiopia in energy conservation technique.

Another objective is to generally increase knowledge within the selected industries about energy conservation and to train the personnel of a selected agency in Ethiopia to be able to carry out energy conservation projects.

A third objective is to increase the general awareness in the Ethiopia society about energy conservation.

The main results of the training courses will be:

- the engineers from the plants shall be able to regularly carry out energy audits at the plant and to update the energy balance regularly
- the engineers will be informed on how the energy costs at their industry can be reduced
- the engineers can train and inform their colleagues in energy conservation technique
- the engineers from the counterpart agency shall be able to continue the work in more industries of the same industrial branch and extend it to more branches of industry.
- Many engineers both from plants and from the Ethiopian institutions will be trained, both theoretically and practically, in energy conservation technique. This is the best way to see to that interest in energy conservation will be spread among as many as possible. These engineers can, following the training course, train and inform their colleagues in energy conservation.

2.1. OUTPUT

The project output is

- A training manual adopted to the food processing industrial branch that the training is directed to
- A report covering the execution of the training.

2.2. ACTIVITIES

Each training course in energy conservation technique can be held for 20 engineers and technicians. This training course will take up both practical and theoretical matters in the area of industrial energy conservation. Practical group exercises will be performed in selected factories, e.g. measurements.

The training course will be performed by three consultants. Local experts should be included as trainers as well.

The course should include the following:
- a description of the need for energy conservation projects and a presentation of basic energy technology
- a description of how to analyze the energy system and the energy utilization of the factory
- an analysis of how to plan and carry through the energy audit and how this is related to the entire energy conservation project
- a description of the different types of measuring instruments to be used for the energy audit and the measuring methods to be involved, and a presentation of the need for calibration, checking and repairing of the instruments
- a description of the basic calculation formulas to be used to calculate w the different energy flows based on the measurement results
- discussions on practical measures to obtain a more efficient utilization of energy by means of saving and recovery measures, process changes and by a change over to cheaper energy sources.

The training course will use different methods of instruction such as lectures, exercises, group discussions and case studies. The materials has to be adopted to the specific needs and to specific processes in the food processing.

The training course will be combined with in-plant training during the practical exercises e.g. in measurement techniques etc.

An approximate duration for each course is 2 weeks.

PROPOSAL FOR REGIONAL PROJECT

"Energy conservation and energy management in industry"

1. Background

Recently completed preparatory mission to Ethiopia, Tanzania and Uganda, and a two weeks energy auditing workshop in Ethiopia, have indicated a great need for policy development, training and implementation of energy conservation programmes in the region.

Several focal points may be recommended:

-Energy conservation policy development
-Energy auditing/management techniques and practice
-Instrumentation and control in industrial energy systems
-Financing energy conservation projects
-Demonstration aspects: full scale implementation of small projects

2. Special consideration

The project should also aim at promoting technical cooperation among the countries in the region, in the area of manpower development/training. It is proposed to identify training institution which could be designated as a center of excellence for training in energy management and to develop a skills of personnel in important industrial branches. Ethiopian Management Institute with its excellent facilities could be a suitable candidate.

3. Project objectives

The first objective of the project is to execute a complete energy conservation project for selected factories in the participating countries, and to use these industries as a demonstration projects for promotion of industrial energy conservation in the region.

Another objective is to create knowledge within selected industries about energy conservation.

Third objective is to increase the general awareness in the countries about energy conservation.

Fourth objective is to assist in developing energy conservation policy as a part of a countries overall energy strategies, which should provide framework for energy conservation project implementation.

Fifth objective is to prepare feasibility studies for larger scale projects and to demonstratethrough that the ways and means for financial evaluation of energy conservation projects and their financing.

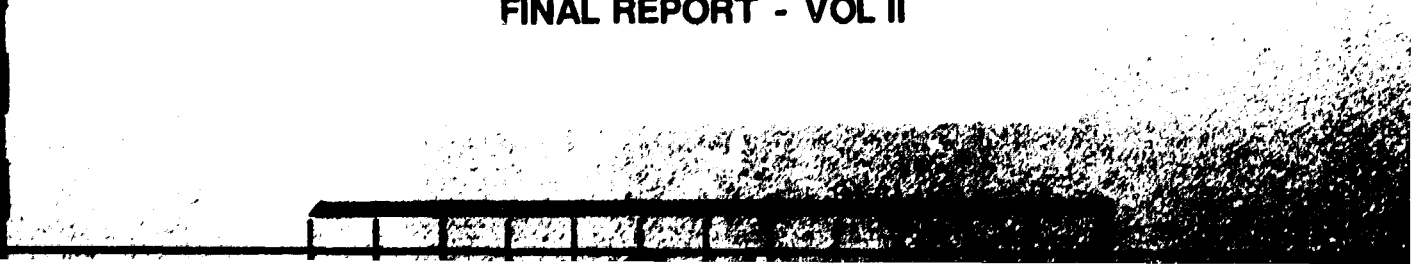
ENSOURCE
INTERNATIONAL

20705
(2 of 4)

"THINKING GLOBALLY
ACTING LOCALLY"

ENERGY AUDITING WORKSHOP
IN
ETHIOPIA

FINAL REPORT - VOL II



RESTRICTED

8 November, 1993
ORIGINAL: ENGLISH

ENERGY AUDITING WORKSHOP

IN

ETHIOPIA

UC/RAF/90/149 -ST/RAF/90/EO1

FINAL REPORT

Prepared by:

ENCONET INTERNATIONAL Ltd., U.K.

Z. Morvay

Backstoping officer: P. de Moustier

United Nation Industrial Development Organization

Vienna

TABLE OF CONTENTS

TRAINING COURSES ON ENERGY AUDITING

in

Debre Zeit, Ethiopia
Ethiopian Management Institute

28 June - 9 July 1993

1. BACKGROUND AND OBJECTIVES OF THE COURSES

UNIDO, in co-operation with the Governments of Ethiopia, and UNDP, has organised a Training Course on Energy Auditing in Ethiopia 16 -27 August, 1993. The training courses were attended by 34 participants in Ethiopia. The participants were from the Ministries and from public and private enterprises. The training course was developed by ENCONET International in co-operation with UNIDO. ENCONET International staff members conducted the course.

In order to prepare for the training course a preparatory mission was carried out by ENCONET International staff members to Ethiopia during April 1993. This mission was requested by the Governments and UNIDO.

During the mission ENCONET International carried out the following tasks:

- checked the actual status and the need for training in the area of energy auditing
- assisted in the selection of participants
- visited industrial plants and identified one plant for carrying out practical training
- developed training course manual based on identified needs
- selected measuring instruments for the energy audits
- finalised with local authorities concerned and UNIDO all logistic arrangements for the course

The aim of the training course was to strengthen the technical capabilities and skills of engineers in Ethiopia on the activities relating to the efficient use of energy in industry thus enabling them to carry out energy audits and identify ways of improving efficiency in energy consumption

Based upon the discussions and findings during the preparatory mission a specially designed training course manual of approx. 800 pages was prepared. The manual is comprehensive and includes parts for individual study.

A training course program was agreed upon during the preparatory mission and is described in the Annex III. The training comprised of lectures, educational films

presentation, practical exercises, work in syndicates and report preparation. The training was carried out as per programme attached. The lecturers for particular topics are indicated in the programme.

A list of the portable measuring instruments delivered to Ministry of Natural Resources, Ethiopia, and used during training, is attached to this Volume.

The course objectives and timing were both rightly conceived which was proved by high interest in the course, motivation of the participants (34 of them), and the importance assigned by the authorities and media (see attachments).

The course was organized on residential basis at excellent facilities of Ethiopian Management Institute, which was important fact for the Workshop success.

2. PARTICIPANTS

The most of the participants were from industries where they were responsible for maintenance and energy sector, or shift or chief engineers. Few of them were engineers from ministries of industry or energy. Their corresponding place of work is indicated in the list attached. Generally, the level of knowledge of the participants was very high. What they were mostly lacking, was the practical experience how to put this knowledge into practice.

The number of participants was higher than expected, which created some difficulties with implementation of the practical part of the course, but fact that the course was residential and the group work enabled more interactions and direct communications between consultants and the participants, so that individual requirements could be accommodated. The interest in the course was very high and participants were making plans to implement instantly in their own factories some of the techniques learned.

3. ACHIEVEMENTS

Energy Auditing Manual A comprehensive manual on industrial energy conservation was prepared for the training course All participants received a copy of the manual The aim of the manual is to allow th. participants to continue studying individually

Practical Training The participants' main problem was lack of practical experience and awareness of realistic energy savings possibilities, which has confirmed the initial orientation to concentrate the workshop on practical aspects of Energy Auditing The practical training at the Ethiopia tannery was a very important part of the course This was when participants were trained in all the practical aspect of Energy Auditing, and the things that could be most easily applied to their own factories

Group Work To be able to cope with the limited time and instrumentation available, participants were divided into 5 groups and a group leader was nominated for each group Each group was given a task to analyse 7 energy subsystems in the tannery according to the schedule prepared by trainers (see attachments) and to prepare a report on energy auditing findings It was a simultaneous training in project management and energy auditing The group leaders were responsible to organise the work within the groups and distribute the specific tasks to the group members The groups were also holding the round table discussions, and members were exchanging experience from their own factories on everyday problems

Groups were created having in mind participants background trying to achieve right blend of mechanical and electrical engineers in each group Group leaders were selected with the assistance of local counterpart who was more familiar with participants abilities at the beginning of the course Group leaders are inicated on the list of participants

Systematic Approach Each participant was given a set of data collection forms and basic data on energy consumption/production in the breweries These were used as worksheets helping them to advance through energy audit practical techniques in a systematic manner (see Annex VI) Participants pointed out the appreciation of the practical emphasize of the workshop, and the practical work with the instruments, measurements and exercise in the factory in particular Basically, their main remark was that they wanted to have more time for the practical work, but otherwise they were very satisfy with and receptive for the methodology applied

Report Preparation As a result each group has delivered a quite comprehensive report on energy auditing results They were working on the report preparation independently, with trainers helping them when necessary In the end, reports were evaluated by trainers, and relevance of the experience gained to the problems in participants own factories was discussed

All the reports were quite comprehensive The participants demonstrated understanding of the energy auditing objectives and principles in their reports They managed to cover all the important aspects of energy auditing in their reports within the

time available The differences between the reports of particular groups were mostly in the completeness of report sections Some group spent more time on, for example, accurate calculation of the radiation heat losses of the boiler on the account of analysis of refrigeration system The reason for that was the lack of experience in assessing the relative importance of single tasks within the overall objective of assessing the energy conservation opportunities in the whole factory The particular interest was paid for translating energy savings into monetary savings, describing this way the financial benefit of the energy conservation opportunity implementation

Deliveries. Each participant received a copy of training manual, energy audit questioner, and set of worksheets. National counterparts were provided with the set of instruments. In addition, a set of 12 short video films (15 min. each) describing relevant topics in energy auditing, ENCONET's software package for energy consumption analysis, and a copy of ENERCOST - UNIDO software for financial evaluation of energy conservation opportunities were also provided to the local counterparts

Local counterpart . Mr. Tariku Tafere of Ethiopian Energy Authority was instrumental in providing the facilities for workshop implementation. He assured faultless organization of all logistic arrangements and smooth running of the workshop We discussed the workshop programme during the preparatory mission and prior the workshop, and the methodology proposed and applied was praised by Mr Tafere We can recommend Mr Tafere as a resource person for the future programmes

The local counterpart provided for transportation for participants and trainers, daily refreshments, lecture room and facilities, photocopying and secretarial assistance

4. RECOMMENDATIONS

There is a great need for training courses in energy auditing and industrial energy conservation in Ethiopia The completed course on energy auditing can be carried out a number of additional times in order to reach more industries, and participants from other regions What is also lacking is awareness of energy conservation potentials on all levels from the equipment operators, to engineers and managers, accountants and policy makers This facts makes difficult to promote energy efficiency and introduce energy management into everyday practice

The workforce in Ethiopia has adequate level of theoretical knowledge What is lacking, however, is the practical experience in how to carry out energy audits, identification and design of energy cost reducing measures and how to plan and carry out implementation of these

The environmental auditing, which was briefly introduced, also raised considerable interest, which indicates that the needs for training and assistance in this area have to be assessed

According to the participants remarks, the other problems are

-lack of the support from top management,
-lack of awareness on energy conservation potentials,
-missing or out of order instrumentation in the factories which is necessary to monitor and control energy consumption,
-lack of continuous energy consumption analysis and monitoring,
-lack of information on and availability of energy efficient technologies,
-need for additional training on preparation of financial proposals for energy conservation projects

Regarding the workshop itself, the main remark was that the time was somewhat short for the ambitious programme prepared, and that the residential course would be probably more effective in achieving the training objectives However, participants were pleased with the emphasize on the practical work

To address the problems recognised, more workshops should be held but as a residential in other regions of Ethiopia, and focused on particular industrial branch This way it would be possible to go more in depth into related technologies and emphasise relevant practical aspects for the selected industrial branch

Pilot energy conservation projects should be carried out in close co-operation with the staff of selected industrial plants and local counterpart - MINISTRY OF NATURAL RESOURCES, which could continue the work in the future

Another essential part is to increase the awareness of these questions among top management so that the companies really pay attention to energy conservation

To summarised, the following is recommended

-to screen the needs for training on energy conservation and environmental problems in the countries for different target groups such as operators, engineers, managers, trainers, policy makers, financial people, etc

-to prepare and held seminars for top management on financial aspects of energy conservation opportunities,

-additional workshops on energy auditing for specific industrial sectors in other regions of Ethiopia,

-implementation of energy conservation projects in selected factories,

-training on use of UNIDO's ENERCOST software package

5. ACKNOWLEDGEMENT

It is our pleasant duty to thanks to staff of Ethiopian Energy Authority, Adis Ababa, and local UNIDO office in Ethiopia, who all did their best to facilitate successful workshops implementation. The staff of Ethiopia Tannery were also instrumental in providing opportunities for practical training.

Finally, participants motivation and hard working approach were crucial for the Workshop success.

ATTACHMENTS

NAME AND NUMBER OF PARTISIPANTS WHO ARE GOING TO PARTICIPATE ON THE TRAINING OF ENERGY AUDITING FOR 14 DAY'S AT DEBRA-ZEYIT MANAGEMENT INSTITUITE.

NO.	NAME OF PARTICIPANTS	NAME OF ORGANIZATION	QUANTITY
1	Ato Asnake Tegenawe	Ethiopian Hotels Administration	1
2	" Elias Kefela	Mugher Cement Factory	
3	" Degefu Debele	" " "	2
4	" Taddessa Melaku	Addis Tyre CO.S.C.	1
5	" Negeru Mulualeme	BaharDar Oil Factory	
6	" Gebru Bezuayehu	" " " "	2
7	" Yoseph Abrehame	Addis Ababa Cigarette Factory	1
9	" Mekonene Gedawe	Ethiopian Electric Light & Power Authority	1
10	" Akelilu Negatu	Kombolchia Textile Factory	1
11	" Gashaw Egegu	National Alcohol & Liquor	1
12	" Genene Endale	Basic Energy Saving Glass Factory	1
16	" Melaku Kebede	Wonge Paper Factory	
17	" Abrahame Teshome	" " "	2
18	" Tesfaye Zeleke	Meta Brewery	1
19	" Zewdu Tafesse	Addis Ababa Brewery	1
20	" Hashem Gemale	Ministry of Industry	1
21	" Yohannesse Tsega	Awassa Textile Factory	1
22	" Fekeru Hailu	Dire Dawa Textile Factory	1
23	" Beserat Tesfaye	Harare Brewery	1
24	" Abebe Adanekulu	BaharDar Textile Factory	1
25	" Mohammed Bekur	Ministry of Urban Development and Construction	1
26	" Berhanu Belaye	Ethiopia Tannery	1
27	Master Mersha Demoze	Shoa Robet Tobacco Factory	1
28	w/t Yetmyet Berhanu	Ethiopian Energy Authority	
29	Ato Getasetege AmdeTesion	" " "	
30	" Azanaw Aklog	" " "	
31	" Tekeleyohannes Amde	" " "	4
32	" Amanuel Haile	Addis Ababa Cement	1
33	" Gedey Gamochen	Minstry of Health	
34	" Tamerat Cherenet	" " "	2

Need for Energy Conservation Stressed

by a STAFF REPORTER

Participants of a workshop on energy auditing were reminded yesterday that there was great need for exploring the possibility of reducing excess energy costs.

Referring to representatives of factories attending the parley, Ato Fantahun Akalu, Vice Minister of the Ethiopian Energy Authority, said energy saving is one area to make factories both more efficient and profitable. "As has been proved by studies here and abroad", he noted, "energy savings can go from 25-50 per cent of your energy expenses".

The two-week workshop underway at the Ethiopian Management Institute at Debre Zeit was organized by UNIDO (United Nations Industrial Development Organization) in cooperation with UNDP (United Nations Development Program) and the Ethiopian Energy Authority and is being attended by 35 participants. These are all professional personnel from public and private industrial enterprises, according to a press release.

The aim of the workshop is to increase awareness of energy saving (conservation) management among people responsible for energy and use in industry, or dealing with energy conservation at other institutions, and thereby create a favourable climate for reduced energy use within the country.

The workshop is expected to cover introduction in industrial energy conservation, including alternative sources of energy production systems, environment and legal considerations, basic principles of organizing energy management at enterprise level, technique of energy conservation, energy audit principles and project planning, etc.

Other than the one being now held here, similar workshops on energy auditing will be held in Tanzania and Uganda, the press release said.

Source - Ethiopian Herald - Tuesday 29 June 1993

SYSTEMS	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	INSTRUMENTS
1 BOILER HOUSE	MONDAY 14-16	TUESDAY 9-11	TUESDAY 11-13	TUESDAY 14-16	WEDNESDAY 9-11	Flue gas anal., Pyrometer, Pitot-Prandl probe, Thermometer
2. STEAM & HOT WATER	TUESDAY 9-11	MONDAY 14-16	WEDNESDAY 11-13	TUESDAY 11-13	TUESDAY 14-16	"Bestobel", Pyrometer, Manometer
3. CONDENSATE RETURN	TUESDAY 14-16	TUESDAY 11-13	MONDAY 14-16	WENSDAY 9-11	TUESDAY 9-11	Stop-watch, Thermometer, Basket
4 COMPRESSED AIR & DISTRIBUTION SYSTEM	TUESDAY 11-13	TUESDAY 14-16	TUESDAY 9-11	MONDAY 14-16	WEDNESDAY 11-13	Thermometer, Anemometer
5 FRESH WATER TREATMENT SYSTEM	TUESDAY 14-16	MONDAY 14-16	TUESDAY 14-16	MONDAY 14-16	TUESDAY 14-16	Collection of available data
6 WASTE WATER TREATMENT SYSTEM	TUESDAY 14-16	MONDAY 14-16	TUESDAY 14-16	MONDAY 14-16	TUESDAY 14-16	Collection of available data
7 ELECTRICITY SYSTEM	WEDNESDAY 11-13	WEDNESDAY 9-11	TUESDAY 14-16	TUESDAY 9-11	MONDAY 14-16	On site measurement clip-on A-meter
8 DRAYERS 1	WEDNESDAY 9-11	WEDNESDAY 11-13			TUESDAY 11-13	Anemometer, Thermometer
8 DRAYERS 2			WEDNESDAY 9-11	WEDNESDAY 11-13		Anemometer, Thermometer
9 TRANSPORT	MONDAY 14-16	TUESDAY 14-16	MONDAY 14-16	TUESDAY 14-16	MONDAY 14-16	Collection of available data
10. WASTE MATERIAL	MONDAY 14-16	TUESDAY 14-16	MONDAY 14-16	TUESDAY 14-16	MONDAY 14-16	Collection of available data

ENCONET International

GROUP 1	MONDAY 14-16	TUESDAY 9-11	TUESDAY 11-13	TUESDAY 14-16	WEDNESDA 9-11	WEDNESDAY 11-13
SYSTEM 1						
SYSTEM 2						
SYSTEM 3						
SYSTEM 4						
SYSTEM 5						
SYSTEM 6						
SYSTEM 7						
SYSTEM 8						
SYSTEM 9						
SYSTEM 10						

GROUP 2	MONDAY 14-16	TUESDAY 9-11	TUESDAY 11-13	TUESDAY 14-16	WEDNESDA 9-11	WEDNESDAY 11-13
SYSTEM 1						
SYSTEM 2						
SYSTEM 3						
SYSTEM 4						
SYSTEM 5						
SYSTEM 6						
SYSTEM 7						
SYSTEM 8						
SYSTEM 9						
SYSTEM 10						

GROUP 3	MONDAY 14-16	TUESDAY 9-11	TUESDAY 11-13	TUESDAY 14-16	WEDNESDA 9-11	WEDNESDAY 11-13
SYSTEM 1						
SYSTEM 2						
SYSTEM 3						
SYSTEM 4						
SYSTEM 5						
SYSTEM 6						
SYSTEM 7						
SYSTEM 8						
SYSTEM 9						
SYSTEM 10						

GROUP 4	MONDAY 14-16	TUESDAY 9-11	TUESDAY 11-13	TUESDAY 14-16	WEDNESDA 9-11	WEDNESDAY 11-13
SYSTEM 1						
SYSTEM 2						
SYSTEM 3						
SYSTEM 4						
SYSTEM 5						
SYSTEM 6						
SYSTEM 7						
SYSTEM 8						
SYSTEM 9						
SYSTEM 10						

GROUP 5	MONDAY 14-16	TUESDAY 9-11	TUESDAY 11-13	TUESDAY 14-16	WEDNESDA 9-11	WEDNESDAY 11-13
SYSTEM 1						
SYSTEM 2						
SYSTEM 3						
SYSTEM 4						
SYSTEM 5						
SYSTEM 6						
SYSTEM 7						
SYSTEM 8						
SYSTEM 9						
SYSTEM 10						

MEASURING INSTRUMENTS FOR THE ENERGY AUDIT TRAINING COURSE

2 pcs	Electronic thermometer, Testoterm incl. long, short,surface and immersion temp. probes
2 pcs	Silicon paste
1 pcs	Infrared non-contact thermometer
1 pcs	Solomat humidity meter with probes
1 pcs	Testovent 490 air velocity meter with probe
1 pcs	Prandtl tube, long
1 pcs	Micromanometer, electronic, digital
1 pcs	Stop clock with 100 mm dial
1 pcs	Bestobell steam leak detector
1 pcs	Electrical energy analyzer
2 pcs	Clamp-on Mulimeter MX 1200
1 pcs	Combustion efficiency analyzer Neotronics
1 pcs	Lux Meter
2 pcs	Notebook Computer, 4 MB RAM, 40 MB hard disc with Windows 3.1, MS Word 2.0, MS Excel 4.0
2 pcs	Portable CANON Bubble Jet printer (BJ-10)
2 set	diskettes 3.5" and ribons

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20708
(3 of 4)

"THINKING GLOBALLY
ACTING LOCALLY"

ENERGY AUDITING WORKSHOP
IN
TANZANIA

FINAL REPORT - VOL III

RESTRICTED

8 November, 1993
ORIGINAL: ENGLISH

ENERGY AUDITING WORKSHOP

IN

TANZANIA

UC/RAF/90/149 -ST/RAF/90/EO1

FINAL REPORT

Prepared by:

ENCONET INTERNATIONAL Ltd., U.K.

Z. Morvay

Backstoping officer: P de Moustier

United Nation Industriai Development Organization

Vienna

TABLE OF CONTENTS

TRAINING COURSES ON ENERGY AUDITING

in

Dar Es Salaam, Tanzania

TIRDO

2 -13 August 1993

1. BACKGROUND AND OBJECTIVES OF THE COURSES

UNIDO, in co-operation with the Government of Tanzania, and UNDP, has organised a Training Course on Energy Auditing in Tanzania 2 -13 August, 1993. The training courses were attended by 13 participants in Tanzania. The participants were from the Ministries and from public enterprises. The training course was developed by ENCONET International in co-operation with UNIDO. ENCONET International staff members conducted the course.

In order to prepare for the training course a preparatory mission was carried out by ENCONET International staff members to Tanzania during April 1993. This mission was requested by the Governments and UNIDO.

During the mission ENCONET International carried out the following tasks:

- checked the actual status and the need for training in the area of energy auditing
- assisted in the selection of participants
- visited industrial plants and identified one plant for carrying out practical training
- developed training course manual based on identified needs
- selected measuring instruments for the energy audits
- finalised with local authorities concerned and UNIDO all logistic arrangements for the course

The aim of the training course was to strengthen the technical capabilities and skills of engineers in Tanzania on the activities relating to the efficient use of energy in industry thus enabling them to carry out energy audits and identify ways of improving efficiency in energy consumption

Based upon the discussions and findings during the preparatory mission a specially designed training course manual of approx. 800 pages was prepared. The manual is comprehensive and includes parts for individual study.

A training course program was agreed upon during the preparatory mission and is attached as Annex III. The training comprised of lectures, educational films presentation, practical exercises, work in syndicates and report preparation. The training was carried out as per programme attached. The lecturers for particular topics are indicated in the programme.

A list of the portable measuring instruments delivered to Ministry of Natural Resources, Tanzania, and used during training, is attached.

The course objectives and timing were both rightly conceived but the attendance was lower than expected - 13 participants. Due to financial constraints of local counterpart course couldn't be organised as residential, neither the support (travel and accommodation) for the participants outside the capital could be provided. Consequently, the participants were mostly from the capital or nearby towns.

2. PARTICIPANTS

The most of the participants were from industries where they were responsible for maintenance and energy sector, or shift or chief engineers. Few of them were technicians, and the rest were engineers from ministries of industry or energy. Their corresponding place of work is indicated in the list attached.

The number of participants was lower than planned (25 expected) and their level of knowledge was different, but smaller groups enabled more interactions and direct communications between consultants and the participants, so that individual requirements could be accommodated. The interest in the course was very high and participants were making plans to implement instantly in their own factories some of the techniques learned.

All of the participants were regularly attending the workshop. From time to time some of them were required to attend short meetings at their workplace. This is also a reason more which supports residential type of workshop organization, because in that case disruption by regular work duties would be minimal.

One of the reason for lower attendance was that awareness of the management on importance of energy conservation is low, therefore they were reluctant to release the staff from the work duties. Also, if the workshops would have been organised as a residential, it would have contributed to both higher attendance and more interactions between the consultants and participants, and among participants themselves.

3. ACHIEVEMENTS

Energy Auditing Manual A comprehensive manual on industrial energy conservation was prepared for the training course. All participants received a copy of the manual. The aim of the manual is to allow the participants to continue studying individually.

Practical Training. The participants' main problem was lack of practical experience and awareness of realistic energy savings possibilities, which has confirmed the initial orientation to concentrate the workshop on practical aspects of Energy Auditing. The practical training at the Tanzania breweries was a very important part of the course. This was when participants were trained in all the practical aspect of Energy Auditing, and the things that could be most easily applied to their own factories.

Group Work To be able to cope with the limited time and instrumentation available, participants were divided into 3 groups and a group leader was nominated for each group. Each group was given a task to analyse 5 energy subsystems in the brewery according to the schedule prepared by trainers (see attachments) and to prepare a report on energy auditing findings. It was a simultaneous training in project management and energy auditing. The group leaders were responsible to organise the work within the groups and distribute the specific tasks to the group members. The groups were also holding the round table discussions, and members were exchanging experience from their own factories on everyday problems.

Groups were created having in mind participants background trying to achieve right blend of mechanical and electrical engineers in each group. Group leaders were selected with the assistance of local counterpart who was more familiar with participants abilities at the beginning of the course. Group leaders are inicated on the list of participants.

Systematic Approach. Each participant was given a set of data collection forms and basic data on energy consumption/production in the breweries. These were used as worksheets helping them to advance through energy audit practical techniques in a systematic manner (see Annex VI). Participants pointed out the appreciation of the practical emphasize of the workshop, and the practical work with the instruments, measurements and exercise in the factory in particular. Basically, their main remark was that they wanted to have more time for the practical work, but otherwise they were very satisfy with and receptive for the methodology applied.

Report Preparation As a result each group has delivered a quite comprehensive report on energy auditing results. They were working on the report preparation independently, with trainers helping them when necessary. In the end, reports were evaluated by trainers, and relevance of the experience gained to the problems in participants own factories was discussed.

All the reports were quite comprehensive. The participants demonstrated understanding of the energy auditing objectives and principles in their reports. They managed to cover all the important aspects of energy auditing in their reports within the

time available The differences between the reports of particular groups were mostly in the completeness of report sections Some group spent more time on, for example, accurate calculation of the radiation heat losses of the boiler on the account of analysis of refrigeration system The reason for that was the lack of experience in assessing the relative importance of single tasks within the overall objective of assessing the energy conservation opportunities in the whole factory The particular interest was paid for translating energy savings into monetary savings, describing this way the financial benefit of the energy conservation opportunity implementation

Deliveries Each participant received a copy of training manual, energy audit questioner, and set of worksheets National counterparts were provided with the set of instruments as specified in the attachments and remaining copies (up to 26) of the manual In addition, a set of 12 short video films (15 min each) describing relevant topics in energy auditing, ENCONET's software package for energy consumption analysis, and a copy of ENERCOST - UNIDO software for financial evaluation of energy conservation opportunities were also provided to the local counterparts

Local counterpart Mr Robert Nindie was instrumental in providing the facilities for workshop implementation We discussed the workshop programme during the preparatory mission and prior the workshop, and the methodology proposed and applied was praised by him We can recommend Mr Nindie as a resource person for the future programmes

The local counterpart provided for transportation for participants and trainers, daily refreshments, lecture room and facilities, photocopying and secretarial assistance

5. RECOMMENDATIONS

There is a great need for training courses in energy auditing and industrial energy conservation in Tanzania The completed course on energy auditing can be carried out a number of additional times in order to reach more industries, and participants from other regions What is also lacking is awareness of energy conservation potentials on all levels from the equipment operators, to engineers and managers, accountants and policy makers This facts makes difficult to promote energy efficiency and introduce energy management into everyday practice

The workforce in Tanzania has adequate level of theoretical knowledge What is lacking, however, is the practical experience in how to carry out energy audits, identification and design of energy cost reducing measures and how to plan and carry out implementation of these

The environmental auditing, which was briefly introduced, also raised considerable interest, which indicates that the needs for training and assistance in this area have to be assessed

According to the participants remarks, the other problems are:

-lack of the support from top management,
-lack of awareness on energy conservation potentials,
-missing or out of order instrumentation in the factories which is necessary to monitor and control energy consumption,
-lack of continuous energy consumption analysis and monitoring,
-lack of information on and availability of energy efficient technologies,
-need for additional training on preparation of financial proposals for energy conservation projects.

Regarding the workshop itself, the main remark was that the time was somewhat short for the ambitious programme prepared, and that the residential course would be probably more effective in achieving the training objectives. However, participants were pleased with the emphasize on the practical work, and some of the skills practiced were revelation for some of them.

To address the problems recognized, more workshops should be held but as a residential in other regions of Tanzania, and focused on particular industrial branch. This way it would be possible to go more in depth into related technologies and emphasize relevant practical aspects for the selected industrial branch

Pilot energy conservation projects should be carried out in close co-operation with the staff of selected industrial plants and local counterpart - TIRDO, which could continue the work in the future

Another essential part is to increase the awareness of these questions among top management so that the companies really pay attention to energy conservation.

Following the initiative of Dr. Hurry Suresh of UNDP, TIRDO managed to arranged a short meeting with some managers of the factories which sent their engineers to the workshop. A brief presentation was arranged for them, and their interest, questions, and reactions proved the need to increase the awareness of the top managers for energy conservation.

To summarized, the following is recommended:

-to screen the needs for training on energy conservation and environmental problems in the countries for different target groups such as operators, engineers, managers, trainers, policy makers, financial people, etc.

-to prepare and held seminars for top management on financial aspects of energy conservation opportunities,

-additional workshops on energy auditing for specific industrial sectors in other regions of Tanzania,

-implementation of energy conservation projects in selected factories,

-training on use of UNIDO's ENERCOST software package

5. ACKNOWLEDGMENT

It is our pleasant duty to thanks to staff of TIRDO, Dar Es Salaam, and local UNIDO office in Tanzania, who all did their best to facilitate successful workshops implementation. The staff of Tanzania Brewery were also instrumental in providing opportunities for practical training.

Finally, participants motivation and hard working approach were crucial for the Workshop success.

ATTACHMENTS

ENERGY AUDITING WORKSHOP

PARTICIPANTS LIST

NAME	INSTITUTION/INDUSTRY REPRESENTED	
1. Mr. Kobelloh Leo.J.	Tanzania Breweries Ltd. P.O.BOX.9013. DAR-ES-SALAAM.	Group Leader
2. Mr. Matei Mapunda	TIRDO, P.O. BOX 23235, DAR-ES-SALAAM	
3. Mr.Phidelis Lassway	National Bicycles Co. P.O. BOX 2827 DAR-ES-SALAAM	
4. Mr.Limbu Julius Kajilo	Friendship Textile Mill Ltd. P.O.BOX 20842 DAR-ES-SALAAM	Group Leader
5. Mr.Michael Haonga	Tanzania News Agency, P.O BOX 4755, DAR-ES-SALAAM.	
6. Mr. Magessa, D.M.	Tanzania Petroleum Dev.corp P.O. BOX 2774, DAR-ES-SALAAM.	
7. Mr. Prosper R. Lutegar.ya	Ministry of Water, Energy and Minerals (Energy Department), P.O. BOX 2000, DAR-ES-SALAAM	
8. Justin Tarimo	TIRDO, P.O. BOX 23235, DAR-ES-SALAAM.	Group Leader
9. Mr. Kazonda, S.M.	DARBREW LTD. P.O. BOX 21251, DAR ES SALAAM.	
10. Mr. Mtulimbogo, V.	TIRDO, P.O. BOX 23235, DAR-ES-SALAAM	

11. Mr. J.J. Mbago	TIRDO, P.O. BOX 23235, DAR-ES-SALAAM
12. Mr. A. Abeid	TIRDO, P.O. BOX 23235, DAR-ES-SALAAM
13. Mr. Kilemo,N.	TIRDO, P.O. BOX 23235, DAR-ES-SALAAM

MEASURING INSTRUMENTS FOR THE ENERGY AUDIT TRAINING COURSE - TANZANIA *

1 set Spare parts for flue gas analyzers

1 pcs Water pollution detection kit

1 pcs Temperature calibrator

1 pcs 486 desktop personal computer,
4 MB RAM, 80 MB hard disc, color monitor,
with Windows 3.1, MS Word 2.0, MS Excel 4.0,

1 pcs EPSON letter quality matrix printer A3 format

2 set diskettes 3.5" and ribons

1 pcs CANON photocopier MP 3050

1 set spares for photocopier

1 pcs Toshiba A/C

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* NOTE

TIRDO (Tanzanian Industrial Research and Development Organization), implementing agency for the project in Tanzania, has got already most of the instruments proposed on the list for Uganda and Ethiopia. These were supplied through the World Bank technical assistance project.

WORKPLAN FOR THE PRACTICAL ENERGY AUDITING

IN THE TANZANIA BREWERY

ENERGY SYSTEMS	GROUPS		
	1	2	3
1. STEAM	THURSDAY 9^{00}	THURSDAY 10^{30}	FRIDAY 9^{00}
2. COMPRESSED AIR	FRIDAY 9^{00}	THURSDAY 9^{00}	THURSDAY 10^{30}
3. REFRIGERATION	FRIDAY 10^{30}	FRIDAY 9^{00}	THURSDAY 9^{00}
4. ELECTRICAL	THURSDAY 10^{30}	FRIDAY 10^{30}	MONDAY 9^{00}
5. WATER	MONDAY 9^{00}	MONDAY 9^{00}	FRIDAY 10^{30}
6. OTHERS			

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20705
(4 of 4)

"THINKING GLOBALLY
ACTING LOCALLY"

ENERGY AUDITING WORKSHOP
IN
UGANDA

FINAL REPORT - VOL IV

RESTRICTED

8 November, 1993
ORIGINAL: ENGLISH

ENERGY AUDITING WORKSHOPS

IN

UGANDA

UC/RAF/90/149 -ST/RAF/90/EO1

FINAL REPORT

Prepared by:

ENCONET INTERNATIONAL Ltd., U.K.

Z. Morvay

Backstoping officer: P. de Moustier

United Nation Industrial Development Organization

Vienna

TABLE OF CONTENTS

TRAINING COURSES ON ENERGY AUDITING

in

Kampala, Uganda

Uganda Management Institute

16 -27 August 1993

1. BACKGROUND AND OBJECTIVES OF THE COURSES

UNIDO, in co-operation with the Governments of Uganda, and UNDP, has organised a Training Course on Energy Auditing in Uganda 16 -27 August, 1993. The training courses were attended by 17 participants in Uganda. The participants were from the Ministries and from public enterprises. The training course was developed by ENCONET International in co-operation with UNIDO. ENCONET International staff members conducted the course.

In order to prepare for the training course a preparatory mission was carried out by ENCONET International staff members to Uganda during April 1993. This mission was requested by the Governments and UNIDO.

During the mission ENCONET International carried out the following tasks:

- checked the actual status and the need for training in the area of energy auditing
- assisted in the selection of participants
- visited industrial plants and identified one plant for carrying out practical training
- developed training course manual based on identified needs
- selected measuring instruments for the energy audits
- finalised with local authorities concerned and UNIDO all logistic arrangements for the course

The aim of the training course was to strengthen the technical capabilities and skills of engineers in Uganda on the activities relating to the efficient use of energy in industry thus enabling them to carry out energy audits and identify ways of improving efficiency in energy consumption

Based upon the discussions and findings during the preparatory mission a specially designed training course manual of approx. 800 pages was prepared. The manual is comprehensive and includes parts for individual study

A training course program was agreed upon during the preparatory mission and is attached as Annex III. The training comprised of lectures, educational films presentation, practical exercises, work in syndicates and report preparation. The training was carried out as per programme attached. The lecturers for particular topics are indicated in the programme.

A list of the portable measuring instruments delivered to Ministry of Natural Resources, Uganda, and used during training, is attached.

The course objectives and timing were both rightly conceived but the attendance was lower than expected - 17 participants (see attachments). Due to financial constraints of local counterpart course couldn't be organised as residential, neither the support (travel and accommodation) for the participants outside the capital could be provided. Consequently, the participants were mostly from the capitals or nearby towns.

2. PARTICIPANTS

The most of the participants were from industries where they were responsible for maintenance and energy sector, or shift or chief engineers. Few of them were technicians, and the rest were engineers from ministries of industry or energy. Their corresponding place of work is indicated in the list.

The number of participants was lower than planned (25 expected) and their level of knowledge was different, but smaller groups enabled more interactions and direct communications between consultants and the participants, so that individual requirements could be accommodated. The interest in the course was very high and participants were making plans to implement instantly in their own factories some of the techniques learned.

All of the participants were regularly attending the workshop. From time to time some of them were required to attend short meetings at their workplace. This is also a reason more which supports residential type of workshop organization, because in that case disruption by regular work duties would be minimal.

One of the reason for lower attendance was that awareness of the management on importance of energy conservation is low, therefore they were reluctant to release the staff from the work duties. Also, if the workshops would have been organised as a residential, it would have contributed to both higher attendance and more interactions between the consultants and participants, and among participants themselves.

3. ACHIEVEMENTS

Energy Auditing Manual. A comprehensive manual on industrial energy conservation was prepared for the training course. All participants received a copy of the manual. The aim of the manual is to allow the participants to continue studying individually.

Practical Training. The participants' main problem was lack of practical experience and awareness of realistic energy savings possibilities, which has confirmed the initial orientation to concentrate the workshop on practical aspects of Energy Auditing. The practical training at the Uganda breweries was a very important part of the course. This was when participants were trained in all the practical aspect of Energy Auditing, and the things that could be most easily applied to their own factories.

Group Work. To be able to cope with the limited time and instrumentation available, participants were divided into 3 groups and a group leader was nominated for each group. Each group was given a task to analyse 5 energy subsystems in the brewery according to the schedule prepared by trainers and to prepare a report on energy auditing findings. It was a simultaneous training in project management and energy auditing. The group leaders were responsible to organise the work within the groups and distribute the specific tasks to the group members. The groups were also holding the round table discussions, and members were exchanging experience from their own factories on everyday problems.

Groups were created having in mind participants background trying to achieve right blend of mechanical and electrical engineers in each group. Group leaders were selected with the assistance of local counterpart who was more familiar with participants abilities at the beginning of the course. Group leaders are inicated on the list of participants.

Systematic Approach. Each participant was given a set of data collection forms and basic data on energy consumption/production in the breweries. These were used as worksheets helping them to advance through energy audit practical techniques in a systematic manner (see Annex VI). Participants pointed out the appreciation of the practical emphasize of the workshop, and the practical work with the instruments, measurements and exercise in the factory in particular. Basically, their main remark was that they wanted to have more time for the practical work, but otherwise they were very satisfy with and receptive for the methodology applied.

Report Preparation. As a result each group has delivered a quite comprehensive report on energy auditing results. They were working on the report preparation independently, with trainers helping them when necessary. In the end, reports were evaluated by trainers, and relevance of the experience gained to the problems in participants own factories was discussed.

All the reports were quite comprehensive. The participants demonstrated understanding of the energy auditing objectives and principles in their reports. They managed to cover all the important aspects of energy auditing in their reports within the

time available. The differences between the reports of particular groups were mostly in the completeness of report sections. Some group spent more time on, for example, accurate calculation of the radiation heat losses of the boiler on the account of analysis of refrigeration system. The reason for that was the lack of experience in assessing the relative importance of single tasks within the overall objective of assessing the energy conservation opportunities in the whole factory. The particular interest was paid for translating energy savings into monetary savings, describing this way the financial benefit of the energy conservation opportunity implementation.

Deliveries. Each participant received a copy of training manual, energy audit questioner, and set of worksheets. National counterparts were provided with the set of instruments as specified in attachments and remaining copies (up to 26) of the manual. In addition, a set of 12 short video films (15 min. each) describing relevant topics in energy auditing, ENCONET's software package for energy consumption analysis, and a copy of ENERCOST - UNIDO software for financial evaluation of energy conservation opportunities were also provided to the local counterparts.

Local counterpart. Mr. M.S. Wamboga and Mr. W.M. Wakoli of MINISTRY OF NATURAL RESOURCES were instrumental in providing the facilities for workshop implementation. We discussed the workshop programme during the preparatory mission and prior the workshop, and the methodology proposed and applied was praised by Mr. Wamboga. Unfortunately, he got ill after the first day of the workshop, so could not work more closely. Therefore Mr. Wakoli was in charge to provide the necessary logistical support.

The local counterpart provided for transportation for participants and trainers, daily refreshments, lecture room and facilities, photocopying and secretarial assistance.

4. RECOMMENDATIONS

There is a great need for training courses in energy auditing and industrial energy conservation in Uganda. The completed course on energy auditing can be carried out a number of additional times in order to reach more industries, and participants from other regions. What is also lacking is awareness of energy conservation potentials on all levels from the equipment operators, to engineers and managers, accountants and policy makers. This facts makes difficult to promote energy efficiency and introduce energy management into everyday practice.

The workforce in Uganda has adequate level of theoretical knowledge. What is lacking, however, is the practical experience in how to carry out energy audits, identification and design of energy cost reducing measures and how to plan and carry out implementation of these.

Besides, it should be noted that according to our opinion, the participants in Uganda were less aware of importance and potentials of energy conservation and less

familiar with basic techniques and instrumentation for energy auditing. A reason for that could be that Uganda was less exposed to technical assistance in energy field before. To our knowledge there were no similar projects previously carried out in Uganda, while in Ethiopia and Tanzania similar projects were supported by the World Bank before. Consequently, the interest of participants, although very high in all the countries, was particularly strong in Uganda after reaching the initial results on potential savings from the practical exercises, which were a real revelation for them. Even more, the participants form the Uganda Breweries, which was the case study factory, spent extra hours over weekend to get more in depth in the analysis of the factory energy consumption. Therefore, we firmly believe that additional assistance in energy conservation field in Uganda is both, very much in need and to reach keen and eager to learn audience.

It is not to say that the other countries do not need the assistance any more, but that the positive impact of the pervious assistance can be recognised, which is only encouraging to continue with further efforts to put energy conservation on the every day agenda of both, policy makers and industrialists.

The environmental auditing, which was briefly introduced, also raised considerable interest, which indicates that the needs for training and assistance in this area have to be assessed.

According to the participants remarks, the other problems are

-lack of the support from top management,
-lack of awareness on energy conservation potentials,
-missing or out of order instrumentation in the factories which is necessary to monitor and control energy consumption,
-lack of continuous energy consumption analysis and monitoring,
-lack of information on and availability of energy efficient technologies,
-need for additional training on preparation of financial proposals for energy conservation projects.

Regarding the workshop itself, the main remark was that the time was somewhat short for the ambitious programme prepared, and that the residential course would be probably more effective in achieving the training objectives. However, participants were pleased with the emphasize on the practical work, and some of the skills practiced were revelation for some of them.

To address the problems recognised, more workshops should be held but as a residential in other regions of Uganda, and focused on particular industrial branch. This way it would be possible to go more in depth into related technologies and emphasise relevant practical aspects for the selected industrial branch.

Pilot energy conservation projects should be carried out in close co-operation with the staff of selected industrial plants and local counterpart - MINISTRY OF NATURAL RESOURCES, which could continue the work in the future.

Another essential part is to increase the awareness of these questions among top management so that the companies really pay attention to energy conservation

To summarised, the following is recommended:

-to screen the needs for training on energy conservation and environmental problems in the countries for different target groups such as operators, engineers, managers, trainers, policy makers, financial people, etc.

-to prepare and held seminars for top management on financial aspects of energy conservation opportunities,
-additional workshops on energy auditing for specific industrial sectors in other regions of Uganda,
-implementation of energy conservation projects in selected factories,
-training on use of UNIDO's ENERCOST software package.

5. ACKNOWLEDGEMENT

It is our pleasant duty to thanks to staff of MINISTRY OF NATURAL RESOURCES, Kampala, and local UNIDO office in Uganda, who all did their best to facilitate successful workshops implementation. The staff of Uganda Brewery were also instrumental in providing opportunities for practical training.

Finally, participants motivation and hard working approach were crucial for the Workshop success.

ATTACHMENTS

NATIONAL WORKSHOP ON ENERGY AUDITING TECHNIQUES

LIST OF PARTICIPANTS

1. Mr. J. NDIBWAMI, (Cheif Engineer), NYTIL.
2. Mr. G. MATOVU, (Electrical Engineer) Uganda Breweries Ltd.
3. Mr. K. KAPS (Project Engineer) Uganda Breweries Ltd., Group Leader
4. Mr. G.MABWEIJANO (Mechanical Engineer) BAT, Group Leader
5. Mr. RUBAIJANIZA (Electrical Supervisor) Crown Bottlers Ltd, Group Leader
6. Mr. P.J.K.MUKUNYA (Principal Commercial Engineer) Uganda Electricity Board.
7. Dr. J.K.D. HIGENYI (Associate Professor) Makerere University, Faculty of Technology.
8. Mr. A.h SEBBIT (Lecturer), Makerere University, Faculty of Technology.
9. Mr. M.KAKURU (Principal Commercial Engineer), Ministry of Trade & Industry.
10. Mr. A. BUYUNGO (Mechanical Engineer) Min. of Natural Resources.
11. Mr. S.OPEJO (Mechanical Engineer) Ministry of Natural Resources.
12. Mr. J. MABIRIZI (Mechanical Engineer) Ministry of Natural Resources.
13. Mr. M.S. WAMBOGA (Commissioner Energy Conservation) Ministry of Natural Resources.
14. Mr. G.W.KAYONDO (Engineer, Energy Consultant) Ministry of Natural Resources.
15. Mr. G.M. KIMULI (Research Officer) Ministry of Natural Resources.
16. Mr. W.M. WAKOOLI (Energy Statistician) Ministry of Natural Resources.

MEASURING INSTRUMENTS FOR THE ENERGY AUDIT TRAINING COURSE

2 pcs	Electronic thermometer, Testoterm
2 pcs	Silicon paste
1 pcs	Infrared non-contact thermometer
1 pcs	Solomat humidity meter
1 pcs	Testovent 490 air velocity meter
1 pcs	Prandtl tube
1 pcs	Micromanometer, electronic, digital
1 pcs	Stop clock with 100 mm dial
1 pcs	Bestobell steam leak detector
1 pcs	Electrical energy analyzer
2 pcs	Clamp-on Mulimeter MX 1200
1 pcs	Combustion efficiency analyzer Neotronics
1 pcs	Lux Meter
2 pcs	Notebook Computer, 4 MB RAM, 80 MB hard disc with Windows 3.1, MS Word 2.0, MS Excel 4.0
2 pcs	Portable CANON Bubble Jet printer (BJ-10)
2 set	diskettes 3.5" and ribons

WORKPLAN FOR THE PRACTICAL ENERGY AUDITING

IN THE UGANDA BREWERY

ENERGY SYSTEMS	GROUPS		
	1	2	3
1. STEAM	THURSDAY 9^{00}	THURSDAY 10^{30}	FRIDAY 9^{00}
2. COMPRESSED AIR	FRIDAY 9^{00}	THURSDAY 9^{00}	THURSDAY 10^{30}
3. REFRIGERATION	FRIDAY 10^{30}	FRIDAY 9^{00}	THURSDAY 9^{00}
4. ELECTRICAL	THURSDAY 10^{30}	FRIDAY 10^{30}	MONDAY 9^{00}
5. WATER	MONDAY 9^{00}	MONDAY 9^{00}	FRIDAY 10^{30}
6. OTHERS			