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EVALUATION OF THE 1984 TENNESSEE VALLEY AUTHORITY'S ENERGY CONSERVATION TRAINING COURSE (INDUSTRIAL AND UTILITY)

FINAL REPORT

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Hagler, Bailly & Company and Reliance Energy Services, Inc. were retained by the U.S. Agency for International Development (AID) to evaluate the content and effectiveness of the 1984 session of the Energy Conservation Training Course prepared and presented by the Tennessee Valley Authority (TVA) for the Institute of International Education (IIE). IIE is AID's contractor for the Conventional Energy Training Project (CETP), of which the TVA course is a part.

The course trains representatives from AID countries in energy conservation in the industrial and utility sectors. The aim of the course is to cultivate participants' ability to initiate, develop, and monitor corporate energy demand management and conservation programs by "sharing the TVA experience."

The objectives of the evaluation were:

1. To evaluate the technical content of the course material

2. To evaluate the presentations of the course material

3. To determine how well the material and the presentations met the course objectives

4. To review the changes made to the course content and presentation in response to last year's review comments by NUS Corporation

5. To suggest changes that would make the course more effective.

The evaluation was performed in two parts. The first part consisted of an on-site review during the last 2 weeks of the course presentation in Tennessee. It included a review of course materials, attendance at classroom sessions and field trips, and discussions and interviews with involved TVA personnel, course administrators, mentors, and participants. The second part was a detailed review of the course materials from both this year's and last year's course. A formal evaluation questionnaire was distributed to the participants a week before the course end and was subsequently analyzed by Hagler, Bailly & Company.

The evaluation team consisted of Messrs. Streicher, Williams, Kowalski, and Lopp.

Alain Streicher, a vice president of Hagler, Bailly & Company, was the evaluation coordinator. He attended the course at TVA between July 24 and July 27, interviewed participants, organizers, sponsors, and mentors, and reviewed course materials of Sessions 101 through 105.

James Williams, a vice president of Hagler, Bailly & Company, attended the course between July 22 and July 24 and interviewed participants and organizers and reviewed course materials of Sessions 95 through 100.

Robert Kowalski, a senior consultant to Hagler, Bailly & Company, reviewed the 1983 course materials and the 1984 material from Sessions 1 through 29 and Sessions 67 through 94.

Max Lopp, a managing consultant to Reliance Energy Services (subcontractor to Hagler, Bailly & Company), attended the course between July 17 and July 24, reviewed course materials from Sessions 30 through 66, and interviewed instructors, organizers, and numerous participants (11).

Based on the review of course materials, the on-site evaluation, the observation of classroom sessions, and the interviews with participants, it is apparent that the 1984 course was a success. The program was carefully prepared and presented to meet the objectives of AID and the CETP. The course was well received by the participants, who felt that they were exposed to significant practical information that can be applied directly in their home countries. Participants also declared that they now feel confident to initiate energy conservation activities in their own countries. The course reference material is of particular value to them, since it provides a single source of basic data and information for future use and review.

Several areas were identified for potential modification to improve the overall effectiveness of the program. These areas are:

1. Field work. Almost all participants would have welcomed more field work (i.e., more plant visits, more exposure to people actually

conducting energy conservation programs and more energy auditing work in industrial plants).

2. **Course structure.** Participants and evaluators agree that the course sequence should be modified to improve its effectiveness. It is suggested that early in the course a session on the world energy situation and representative energy conservation programs in developing countries be given to provide a context. Sessions on energy-using equipment should immediately follow sessions on fundamentals instead of being presented later in the course, after sessions on auditing techniques. It is critical that participants be familiar with energy-using equipment before they discuss energy conservation opportunities and audits.

3. **Evaluation of participants.** The grading and ranking of participants was probably the part of the course about which the participants felt most negative. They contended that such a system does not accurately measure the effectiveness of the course and distracts them from more important matters. Recognizing the obligation of AID, IIE, and TVA to provide participants' employers with some sort of performance measure, a more flexible evaluation system should be used, based primarily on homework and the development of action plans.

Introduction

Hagler, Bailly & Company and Reliance Energy Services were retained by the U.S. Agency for International Development (AID) to evaluate an 8-week energy conservation training course ("Energy Conservation Training Program") conducted by the Tennessee Valley Authority (TVA) for the Institute of International Education (IIE), AID's contractor for the Conventional Energy Training Program (CETP).

The general objective of the course is to train representatives from AID countries to effectively plan, implement, and monitor energy conservation programs in their own enterprises.

The aim, more specifically, was that upon successful completion of the course, the participants would:*

1. Have an understanding of energy management philosophy in both utility and industrial applications

2. Be able to make an economic analysis of energy alternatives using contemporary life-cycle costing techniques

*Excerpt from the 1983 NUS evaluation report.

3. Understand the application of both conventional and alternative energy systems

4. Be able to conduct a systematic energy audit of basic facilities

5. Be able to apply an engineering approach to planning and implementating an energy management program.

To determine how effectively the 1984 course met the above-mentioned objectives, a four-member team from Hagler, Bailly & Company and its subcontractor, Reliance Energy Services, carried out a 4-week assignment. The team spent 2 weeks on-site and 2 weeks off-site, evaluating course materials and presentations and analyzing course evaluation questionnaires.

The report on the team's findings is organized into two chapters. Chapter 1, which discusses the major results of the evaluation, is divided into three parts. The first part presents the results of the on-site evaluation; the second part presents the findings of the review of the course materials used for the 1983 and the 1984 courses; and the third part presents Hagler, Bailly's analysis of the evaluation carried out by the participants themselves, using the questionnaire presented in Appendix A. Chapter 2 presents the team's recommendations for the 1985 course.

ON-SITE EVALUATION

Three team members successively attended the two last weeks of the course between July 17 and July 27 and conducted extensive discussions with sponsors, organizers, instructors, participants, and mentors. The findings of this on-site evaluation are presented along four dimensions: course organization, course content and structure, presentations, and reactions of participants.

Course Organization

The course was managed by Mr. Roger Sparry of TVA, who coordinated the activities of the divisions and support groups within and outside TVA that developed and presented the course materials. Under Mr. Sparry, responsibility for the day-to-day operation of the program was divided into two areas: logistics and classroom sessions. Responsibility for these areas was assigned on a full-time basis. Logistics was assigned to Ms. B. J. Wright of TVA, who was responsible for housing, transportation, recreational excursions, and support of field assignments. This effort was accomplished in a professional and effective manner. Experience gained in earlier courses presented by TVA has been applied to ensure smooth operation. One positive change from earlier programs was the use of University of

Tennessee/Chattanooga (UTC) on-campus housing for the course participants.

The Course Facilitator, UTC Professor J. M. Evans, coordinated and supervised classroom activities and the quality of course materials and presentation. His activities included reviewing course materials with respect to format and content, as well as providing feedback on the actual presentation of the material. He also developed and reviewed problem sets and simulation problems used in the evaluation of participants. Professor Evans' role was critical to the proper operation of the course. His presence ensured that individual sessions stayed on track; he also provided continuity for the course, in which roughly 50 instructors were involved. Much of the credit for the success or failure of any program of this nature goes to the individual in this position. It is the general opinion of the evaluation team that the Course Facilitator carried out his duties in an outstanding manner, with professionalism and presence.

One unique aspect of this course and a companion TVA/CETP course is the Mentor Program established by TVA, which seeks to team a course participant with a former or current TVA employee to help participants adjust to life in the United States. The program has been universally well received by the course participants, who not only endorse it but encourage its use in future programs.

Course Content and Structure

The course was divided into seven training modules, which are listed in Exhibit 1.a. Compared with the 1983 course, this year's course devoted more time to energy conservation in industry than in utilities, and included considerably more material on management concepts and human relations (Module III). Nevertheless, informal discussions with participants indicated that the course still relied too much on utility material. Moreover, although about 25 percent of the course was devoted to auditing and field assignments, many participants would have preferred more time in the field and less in the classroom.

Experience gained in the 1983 course led to significant improvements in the present course material, resulting in a generally well-organized, well-presented, and more compact course. A major contribution to improved structuring and control of the instruction was a lead sheet for each session that defined its objectives and key ideas and summarized its content. Changes to the lead sheet included improved indexing, two-sided pages, and inclusion of reference material that was previously provided as loose handouts. The changes alleviated the problem of shipping the course material home (a major concern of the 1983 participants) and greatly enhanced its usefulness as a permanent reference work for the participants.

The sequence of the modules should be changed, with technical modules VI and VII (which describe energy-consuming equipment and conservation opportunities) preceding the energy auditing and field work. This

Exhibit 1.a

Time Allocation Matrix

Training module	Time spent (hours)					
	Formal instruction	Practical applications	Problem solving	Case studies	Supplemental training	Total
I. Introductory meetings and preliminary information	9	--	--	--	--	9
II. Review of engineering fundamentals	11	--	2	--	3	16
III. Energy management philosophy and concepts	16	--	2	3	--	21
IV. Energy auditing techniques	35	7	2	--	7	51
V. Field assignments	6	42	--	--	--	48
VI. Energy conservation opportunities in industry	24	--	--	7	--	31
VII. Energy conservation opportunities in utilities	13	--	4	--	6	23
Total	**114**	**49**	**10**	**10**	**16**	**199**

SOURCE: Tennessee Valley Authority.

change would facilitate understanding of the application of auditing methods.

The evaluation team had two observations on course content. First, the sessions on waste heat recovery did not meet participant expectations. Second, in the sessions on power generation and transmission, many of the illustrations applied to large electric utilities and had limited value for small utilities. Moreover, the data and discussions centered on coal-fired power plants; there was little instruction on gas, oil, diesel, hydro, and other non-coal systems, which are more common in developing countries.

Presentations

Most speakers were practicing engineers from the TVA engineering and support staffs; consequently, they were knowledgeable and had hands-on experience in the energy field. Although most lacked teaching experience, the presentations observed were well thought out and prepared. Of the 90 technical sessions presented, only 5 were presented by people not associated with TVA. Many of the speakers were serving as instructors for only the first or second time.

Some sessions were presented by professors and affiliates from various branches of the University of Tennessee and by individuals who prepare and present seminar material professionally. These sessions tended to be somewhat more polished and relaxed.

Nonetheless, course participants benefit from having practicing engineers, rather than academicians, as speakers. The major advantages are the close, day-to-day experience with real-world operating situations that is lacking, or not current, with many full-time professors or instructors. Since one of the main goals is to provide the participants with experience and data in a real-world environment, contact with practicing engineers far outweighs the minor drawbacks resulting from their lack of teaching experience.

Quality was sometimes influenced by the limited preparation time allowed the speakers. They were given only 3 hours of paid preparation time per session, which is inadequate for a first presentation. A presentation lasts 1-1/2 to 2 hours on the average.

Visual aids were used intensively (and quite appropriately) in presenting the course material, although the speakers did not always use them to full advantage. The use of a combination of overhead projectors, slides, and blackboard media to emphasize the information being presented was very effective. However, the use of these media could be improved in two ways:

- Avoid the use of dense tables in slides or overhead projections, as they are not easily read. All tables are presented in the text and can be reviewed more readily by reference than by use of a projector. Graphic representations of tables are recommended.

- Revise the set-up for the use of the overhead projector. The projector was not square to the

screen, which resulted in a skewed projection that was often difficult to read or interpret.

Some training of speakers in the use of visual aids would be beneficial. On the whole, however, speakers stayed close to the lesson plans and covered the topics thoroughly, although more technical details and practical rules-of-thumb could have been provided in some sessions (e.g., Sessions 95 through 100).

In regard to interaction with the participants, the speakers were generally informative and helpful in responding to questions. They tended to go out of their way to provide supplemental information requested by their audience. There were no major communication problems between the speakers and the participants. Some repetition and discussion of questions took place to ensure that the speaker understood what was being asked, but such discussion was primarily the result of interpretation of particular words rather than a lack of understanding on the part of either the speakers or the participants.

Classes were conducted in a relaxed atmosphere that encouraged dialogue between the speakers and participants. Any tendency to stray too far from the topic under discussion was held in check by the Course Facilitator, who was present almost all the time; on his suggestion, the discussion returned to the main topic.

Reactions of Participants

Comments in this section are a summary of the reactions of the course participants obtained on-site from both formal and informal interviews. The evaluators interviewed 16 of 31 course participants and received brief verbal comments from several others. This section does not deal with the results of the formal evaluation conducted with a questionnaire, which is presented later in this chapter.

Overall, the course was very highly rated by the participants, and most agreed that it was comprehensive and well-prepared. Most of the participants interviewed preferred speakers with practical experience to academicians, despite the less professional teaching style of the former. The speakers with relevant work experience were perceived to be more credible and practical. Overall, the participants felt that the speakers were well prepared and competent in their respective subject areas.

A few participants, mostly from government and academic sectors, favored expanding the scope of the training beyond company-level industrial energy conservation and mentioned topics such as an overview of the world energy situation, national energy policy development, and transportation energy management. A majority of participants also suggested that more time be devoted to the practical aspects of energy management/conservation and less time to theory. They felt that the unnecessary repetition of course material absorbed time that could have been devoted more profitably to practical applications.

Most of the participants' comments related to the course format and sequence. The major suggestion concerned modification of the sequence of the sessions so that the hardware-related information preceded the sessions on auditing (as discussed earlier in this chapter). Participants also requested **more field work and an improvement in the organization and structure of the field assignments**.

Although participants recognized the need for some method of evaluating themselves, they **generally objected to the testing and ranking method employed**. In their opinion, this method tested their ability to respond to English language problems under a time constraint, rather than testing their comprehension of the subject matter. (This point is discussed further in Chapter 2.)

Specific course changes suggested by participants are detailed below:

- Add an overview of the world energy situation to establish the context of the course. This information should be presented as introductory material to focus the participants' attention on the near- and long-term nature of the world energy situation, the near- and long-term benefits of energy conservation, and to provide some direction when discussing alternative fuels.

- Devote more time to practical aspects and benefits of energy management/conservation and less to theory. Some participants noted that many

speakers repeated fundamentals and concepts already presented in other sessions or in the review section, which decreased the amount of time available to present and discuss practical application and conservation opportunities. This problem represents one of coordination, best handled by the Course Facilitator by reviewing each presentation with the instructor when it is in the development stage.

- Add sessions on HVAC and the application of heat pumps. Several participants expressed a desire to have some discussion of HVAC fundamentals and conservation opportunities. This information may have limited application in developing countries, but it could possibly be presented in a supplementary session outside normal class hours. Of more general interest might be a session on the fundamentals and applications -- commercial and industrial -- of heat pumps. While this technology is still emerging, to some extent, it has many potential applications in developing countries.

- Provide an overview of policies and programs that have been developed and/or implemented in other countries to encourage energy conservation. The actual request was a session on policy development, but this could be impractical, owing to the widely varying social and economic conditions in the countries of the various participants. A reasonable alternative would be a discussion of actions taken in other

countries that stressed the need to consider all local socioeconomic factors.

Overall, the content of the program was very highly rated by the participants. Comments such as "I feel I have gained several years of experience through this program" were prevalent. The participants reacted differently to the various sections of the course, depending on their positions as practicing engineers, managers, government employees, or academicians, but all agreed that the course was extremely comprehensive and well prepared.

In the following paragraphs, we summarize the reaction of participants in three critical areas: evaluation, speakers, and field work.

Evaluations. While the participants universally recognized the need for some method of evaluating the effectiveness of the instruction, they generally objected to the testing and ranking method currently being employed. Comments were not restricted to those at the bottom of the ranking, as the interview sample was carefully selected to include those ranked at the top, middle, and bottom of the ranking. The feeling is that the participants are professionals, attending this course out of a desire to learn, and that the current approach tests their ability to respond to English language problems under a time constraint rather than their comprehension of the subject matter.

The evaluation team agrees that this type of ranking/evaluation is likely to be counterproductive, as it places undue emphasis on the participants' ability to

take a test rather than on the participants' ability to apply what has been presented in the sessions. There are a number of alternative methods that could be used; they are discussed later in this report.

Speakers. The course participants had few comments about the speakers. The reaction was that they were generally well prepared and competent in their respective subject areas.

Field work. All the course participants were sent on week-long field assignments to provide firsthand experience in the practical application of the conservation techniques presented in the course. The participants were given the opportunity to select assignment at either a TVA central generation station or a TVA field office, depending on their interest in either utility or industrial/commercial conservation.

The various field locations selected for these assignments were provided in advance with outlines of the course to familiarize the local TVA staff with the type of information and instruction given to the participants. At each location, the TVA staff were asked to involve the participants in the day-to-day operation of the site.

For the participants assigned to the field offices, such involvement entailed site visits to various client locations to collect data and conduct a site energy audit or review work already accomplished. In the offices, participants were actively involved in data analysis and interpretation and in developing recommendations. Areas of analysis covered during the field

work included lighting, HVAC, building envelope, and alternative energy feasibility studies. A total of 16 course participants were assigned to 6 field offices (Southeastern - 2; Appalachian - 3; Alabama - 2; Central - 2; Western - 5; Mississippi - 2).

In the generating plant locations, participants were encouraged to involve themselves in day-to-day plant operations to see how TVA's ongoing programs contribute to improving plant efficiency. Typical programs presented to the course participants included TVA's heat rate and reliability improvement programs and review of the impact of environmental controls on plant efficiency. Of particular interest to course participants was the opportunity to meet with plant management in open forums to discuss plant operating practice and common problems.

A total of 13 course participants were assigned to two central plant locations: Allen (6 participants) and Colbert (7 participants).

Two of the course participants were UTC students who were unable to participate in the field assignments owing to conflicting schedules of their university classroom work.

Reactions of the participants to the field work varied as a function of their individual interests and assignments. All participants felt that the assignments were valuable, but many felt that greater benefit could be derived <u>if the field assignments were better structured</u>. The one universal complaint was the time lost because the field work was scheduled for the week of

the July 4th holiday. The 1-day break presented many problems to TVA because of plant shutdowns and vacation schedules. While the evaluation team is aware of why the field visits were scheduled as they were (i.e., delays in starting the course), care should be taken to ensure that this situation does not occur again.

Other reactions indicated a variety of levels of preparation on the part of the selected TVA sites. To ensure the greatest benefit to all participants, guidelines should be provided to the selected field offices and plant sites indicating the level of participation required and providing a better structure for the field assignments. Participants also indicated a desire to be exposed to more than one location during the field period to broaden the contact and experience gained. Some individuals also indicated a desire to split the field assignment into sessions at both a power plant and a field office.

Field assignments are valuable to the participants, but more attention must be paid to organizing and structuring these assignments so that all participants can reap the greatest benefit.

Additional informal comments on the course were offered by the participants in their final reports to IIE. These comments are summarized in Appendix B.

REVIEW OF COURSE MATERIALS

The 1984 course materials cover 105 sessions grouped into 7 major modules and presented in 7 bound volumes,

each of about 500 pages, double-sided. The seven modules are:

1. Introductory meetings and preliminary information (Sessions 1-5)

2. Review of basic engineering fundamentals (Sessions 6-13)

3. Energy management philosophy and concepts (Sessions 14-29)

4. Energy auditing techniques (Sessions 30-66)

5. Field assignments (Sessions 67-70)

6. Energy conservation opportunities in industries (Sessions 71-94)

7. Energy conservation opportunities in utilities (Sessions 95-105).

The detailed course schedule is presented in Appendix C.

Since presentation of the course last year, the format of the course reference materials has been significantly restructured. Significant changes from last year's volumes are:

- Revision of index and volume tabbing to conform to the session numbers, thus improving the ease of reference.

- Introduction of lead sheets for each section defining the objectives, key ideas, and summary of each session. This approach clearly focuses the participants' attention so that the most information can be derived from both independent reading and the classroom sessions. This format is also an aid to speakers in preparing their classroom presentations.

- Inclusion in the manuals of additional tables and reference material that were loose handouts in the 1983 course. Last year, the amount of loose handout material almost equaled the 11-volume preprinted course material and, in many cases, represented much duplicate effort. For this year's course, the material was sorted and relevant material included in the course manuals.

- Using double-sided text in the volumes instead of single-sided. Even with the inclusion of much additional material, the total number of course books was reduced from 11 to 7. This change represents a significant reduction in volume and weight to be handled and shipped home by course participants.

In general, the course materials were well organized and presented. One note of caution, however, should be introduced. Some of the material came from sources outside TVA and did not reproduce well. Care must be taken to ensure the high quality of the copied materials included in the course materials.

A good feature was the inclusion of appendices containing current articles and publications from a variety of sources on subjects relevant to each particular session. This approach allows replacement of outdated information with current articles without having to re-edit sections related to basic theory or concept.

In the following paragraphs, detailed findings of the review of course materials are presented along three dimensions: content, structure, and relevance to LDCs.

Content

The content of the course reference material was reviewed to determine its usefulness in achieving the goals of the program -- namely, to train managers and professionals from developing countries in energy conservation techniques. The first step was to review last year's manuals and the comments made by NUS Corporation, which evaluated the 1983 session. The suggestions made by NUS for maintaining course quality have generally been implemented.

In the second phase of the technical review, TVA's response to NUS' comments on improving course quality were examined as they apply to the sections under review. The following comments are the result of this evaluation:

- The use of case studies was increased, but needs to be examined further. The studies used should be carefully selected for consistency with the material being taught and for

relevance to the situations found in developing countries. For example, the case studies used in Session 34 on pre-audit investigations included much material that would not be readily available in most actual cases in developing countries (and even in the United States).

- The types of instruments demonstrated in the 1984 course were more consistent with those that might actually be used in a developing country. Also, a partial list of equipment suppliers was included as part of the reference material this year.

Finally, the content of the individual sessions dealing with energy audits from this year's course were reviewed. The significant items from this review are:

- Some sessions are incorrectly identified in the course outline. For example, Session 47 -- "Identifying Improved Operating and Maintenance Procedures" -- is actually a presentation on developing a planned preventive maintenance program.

- Several of the sessions contain repetitive material and should be combined. Specifically, Sessions 47 and 49 should be rewritten to provide separate coverage of preventive maintenance programs and the identification of low-cost/no-cost (operating and maintenance) saving measures. Also, Sessions 35 and 40 (on data collection) could be combined into a single session on primary energy data collection.

- Session 34 on pre-audit investigations requires the development, before a site visit, of plans and analysis often possible only after at least some of the site work has been accomplished. In developing this section of the course, consideration should be given to the age of many operations in developing countries and the probable lack of documentation (e.g., drawings, mechanical specifications). Development of process flow worksheets or submetering plans, for example, requires information in the form of up-to-date drawings that probably will not be available. Even in developed countries such as the United States and Canada, experience has shown that this type of information is often unavailable.

Structure

In addition to evaluating the technical content and presentation of the course material, the overall program structure was also reviewed. The purpose of reviewing the structure was to ensure that the material is presented in an orderly and logical progression from theory to practice.

While all the relevant program elements are in place, the sequence in which they are presented does not lead the participants in logical steps from the conception of an energy management program through the audit, analysis, and implementation phases. The early sessions on fundamentals are correctly placed. However, Section 53 -- "Systematic Approach to Energy Usage" --

should be presented at the end of the fundamental section following the session on statistics, as this session deals with the application of the fundamentals presented in the statistics section. This section also offers an ideal opportunity to focus the attention of the participants on the need to be aware of entire systems and their interactions rather than discrete components. It is critical to introduce this concept early in the program, as much of the subsequent course material deals with discrete components or equipment rather than entire systems.

The part of the course requiring the most restructuring is the section starting with Session 26 and continuing through Session 59. Under the current structure, control and follow-up techniques are presented prior to the sessions on establishing a need for an energy management program, defining parameters, and actual program development. After a discussion of planning (Sessions 14 through 17), organizing (Sessions 18 through 21), and directing (Sessions 22 through 25) an energy management program, the course should then proceed in an orderly sequence through a discussion of audits, concepts, audit steps, evaluation of conservation opportunities, financing, and risk analysis. A proposed course sequence will be outlined in Chapter 2.

Relevance to LDCs and Participants

More effort could have been made to relate course material to the particular conditions and requirements of developing countries, using an outside qualified advisor, if necessary.

The practical value of the course could be enhanced by the addition of more energy conservation opportunity (ECO) areas that apply to LDCs and more field work in plants that are of direct interest to participants. Course planners might reduce the time spent on less essential subjects and plan course materials to avoid repetition.

An overview and introduction to the world energy situation would provide a perspective for the participants and increase their awareness of potential benefits. A summary of measures taken and programs developed in selected LDCs would also be beneficial at the end of the course.

Finally, an explanation of AID's centrally funded Energy Conservation Services Program (ECSP) and various Mission-funded energy conservation projects would acquaint participants with assistance that is available to support their energy conservation efforts in their own countries.

FORMAL EVALUATION OF COURSE BY PARTICIPANTS

In addition to the informal reactions of participants gathered during the on-site evaluation, a formal evaluation was conducted using a detailed questionnaire (see Appendix A). The course evaluation in the questionnaire called for two types of responses. Questions A-D required a subjective choice of one of four rating levels, while Questions E-T required a narrative response, sometimes as short as "yes" or "no." Responses were mostly anonymous, as names were not required.

The responses to Questions A-D were interpreted by means of an estimate of the mean of the data distribution curve -- i.e., the concentration of responses. To reduce data to a manageable proportion, only the curves that were skewed to the left or right of average ("good" technical content or "high" usefulness) were highlighted. Consequently, the results (presented in Exhibit 1.b) constitute an exception report, focusing on deviations from normal or expected responses. The comments below refer to this exhibit; session numbers appear in parentheses.

Course Rating

The following sessions received top ratings, both in technical content and usefulness:

- Tour of Combustion Engineering Facility (46)
- Simulation Session III (50)
- Presentation of Final Energy Audit Report (59)
- Lighting Systems (71-73)
- Electric Motors (75-77).

The lowest ratings, both in technical content and usefulness, were given to:

- Waste Heat Recovery
- Case Study -- Waste Heat Recovery.

Five of the six sessions that had excellent technical content also had very high usefulness. More than twice as many sessions were judged to have very high

ibit 1.b

Energy Conservation Training Course: Exception
lysis of Course Evaluation Questionnaire --
stion D: Technical Content and Usefulness

ession	Excellent technical content
14-16	Planning for Energy Management
46	Tour of Combustion Engineering Facility (very high usefulness)
50	Simulation Session III (very high usefulness)
59	Presentation of Final Energy Audit Report (very high usefulness)
71-73	Lighting Systems (very high usefulness)
75-77	Electric Motors (very high usefulness)
	Fair technical content
29-30	Problem Review II: Energy Management Philosophy and Concepts
32	Case Study: Pumps, Compressors, Fans
61-62	Simulation and Problems III: Energy Auditing (divided opinion on usefulness)
	Fair to poor technical content
91-93	Waste Heat Recovery (medium-low usefulness)
94	Case Study: Waste Heat Recovery (medium-low usefulness)
	Very high usefulness
4	Management Commitment to Energy Conservation
25	Role Playing Exercises
38	Energy Audit Objectives and Plans
39	Pre-Energy Audit Investigations
40	Collection of Energy Consumption Data
42-44	Audit Data Analysis
50, 54	Simulation Sessions II, III, IV
46	Tour of Combustion Engineering Facility
59	Presentation of Final Energy Audit Report
64	Discussion and Critique of Project Presentations
67	EU and DR District Field Assignments
71-73	Lighting Systems
79-81	Pumps, Compressors, Fans

ibit 1.b (continued)

Energy Conservation Training Course: Exception
lysis of Course Evaluation Questionnaire --
stion D: Technical Content and Usefulness

ession	Medium usefulness
12	Problems/Exercises in Engineering Fundamentals
13	Tour of Chattanooga State Technical Community College
21	Case Study and Discussion of Energy Management
2-33	TVA Energy Auditing Programs
65	Review Problem Set III: Energy Auditing
69	Submission of Internship Reports/Discussion of Field Assignments
90	Case Study: Boilers and Steam Distribution Systems
99	Management Development Program
	Medium-low usefulness
1-93	Waste Heat Recovery
94	Case Study: Waste Heat Recovery
	Divided opinion on usefulness
58	Simulation Session V
61-62	Simulation and Problems III: Energy Auditing
66	Safety in the Workplace

JRCE: Hagler, Bailly & Company.

usefulness as were judged to have excellent technical content.

There were relatively few unfavorable ratings, and in the case of the following three sessions there was a divided opinion as to their usefulness:

- Simulation Session V (53)
- Simulation and Problems III -- Energy Auditing (61-62)
- Safety in the Workplace (66).

The lack of consensus in these cases may arise from the different affiliations of the participants, which were:

Utility	17
Industry	8
Academic	4
Government	2
Total	31

Since high ratings exceeded low ratings by far, it appears that participants were satisfied with the course as a whole. This conclusion is borne out by the ratings of Questions A-C (based on a scale of 1-4, low to high):

A: Overall evaluation -- 3.1
B: Usefulness -- 3.7
C: Difficulty -- 2.0.

Narrative Questions

In contrast to the participants' informal verbal comments, the written comments revealed few unexpected opinions. Replies to yes/no questions were almost unanimous in every case, and criticisms or suggestions were broadly distributed, without a consensus. The following summary of responses follows the questionnaire in sequence and identifying letter.

E. **Most Difficult Session.** The most difficult sessions were those dealing with engineering fundamentals. Also mentioned were transmission and distribution losses, economic analysis, and systematic approach to energy use.

F. **Sessions to Improve or Expand.** The sessions on waste heat recovery, ECOs, and heat rate improvement should be improved or expanded.

G. **Additional Information Desired.** A great variety of technical information was requested. Only two respondents wanted information on alternative energy sources.

H. **Additional Subjects to Cover.** Three subjects were of greatest interest: hydro, air conditioning, and insulation.*

*Nuclear energy was also mentioned many times by participants, but this topic does not fall within the scope of activities conducted by AID, since AID is explicitly prohibited by law from conducting training in the nuclear field.

I. Usefulness of Written Course Materials. Almost all respondents said they were extremely useful.

J. Sufficient Time for Questions and Answers. Seven respondents felt that there was insufficient time for questions and answers on some sessions.

K. Problem with Course Schedule. There were no significant problems, aside from the Fourth of July plant shutdown.

L. Course Structure and Lecture Coordination. Repetition of subjects and illogical sequence of topics were mentioned frequently.

M. Plans to Initiate an Energy Conservation Program. Most respondents will initiate programs or contribute to existing programs.

N. Confidence in Ability to Initiate and Conduct an Energy Conservation Program in Own Organization. Most of the respondents were confident of their ability.

O. Priorities. A broad range of priorities was given, but organizing, training, auditing, boilers, and lighting were often mentioned.

P. Who Will Perform Energy Audits? Twelve respondents said they would perform audits. Five others did not respond, and five said the matter is to be decided.

Q. **Method of Training Auditors.** Courses and seminars were mentioned most frequently.

R. **Availability of Audit Equipment in Home Country.** Most have equipment and can import more.

S. **Course Accommodations.** High cost and deficient cleaning were the most common complaints.

T. **Other Comments.** Seven respondents wanted more emphasis on the practical side, and four wanted more outside plant visits. Three mentioned a need for more qualified instructors.

1,8

Based on the findings presented in Chapter 1, the evaluation team has developed a set of recommendations for the 1985 course. These recommendations are presented along three dimensions: course structure, course content, and evaluation of participants.

Course Structure

The order in which the course material is presented should be changed. Prior to discussing audit techniques and ECOs, participants should be exposed to both the engineering fundamentals and hardware sessions. Using the session numbers from the current program, an alternative ordering of sessions is indicated in Exhibit 2.a.

The participants indicated that such a sequence would be more logical and might eliminate some of the confusion encountered during the discussion of audit techniques and the field assignments. In addition to the general course restructuring recommended above, other modifications are discussed below.

The material in Sessions 15 through 47 dealing with the audit process should be restructured into a sequence that more closely follows the actual sequence of events in the audit process. Sessions 15 through 25 should be presented in the same order.

Exhibit 2.a

Proposed Sequence of Sessions for 1985

1.	Introductory sessions:	1-3, with a Session 3a dealing with world energy situation and experience in energy conservation programs
2.	Fundamentals:	4-11, 53 (relocated here), 12-13
3.	Equipment/ECOs:	71-98, 100
4.	Management:	14-24, 99
5.	Audit program:	38, 31, 39, 35, 40, 42, 34, 36, 37, 41, 43, 44, 47-52, 55-57, 26, 27, 28
6.	Alternate energy:	102-105

SOURCE: Hagler, Bailly & Company.

After Session 25, the following sequence is suggested:

Current session number	Session title
38	Energy Audit Objectives and Plans
31	Energy Audit Terms and Concepts
39	Pre-Audit Investigations
35	Acquisition of Primary Electric Metering Data
40	Collection of Energy Consumption Data
42	Collecting Other Technical Data Needed for Energy Analysis
34	Pre-Audit Analysis of Existing Energy Data
36	Sub-Metering Techniques for Data Acquisition
37	Use of Portable Energy Audit Meters
41	Simulation Session I
43	Calculating Energy Balances and Efficiencies
44	Review of Actual Audit Data

Sessions 47 to 52 would follow the above in sequence. Session 28, "Methods of Analyzing Data" (a presentation on risk analysis), should be presented next. Sessions 26 and 27 on managing and controlling an energy management program would be covered after Session 28.

Session 53, "Systematic Approach to Energy Usage," should be presented following Session 11 on statistics. This session is a discussion of systems engineering, a natural outgrowth of statistics, and introduces the

concept of the interrelationship of discrete components in a facility or complex. Understanding this relationship is critical to the successful development and implementation of an energy management program.

Sessions 55, 56, and 57 should be given in sequence following Session 52. The various simulation sessions can be scheduled as at present, affording an opportunity for all participants to work with a set of audit instruments.

Course Content

While the overall content of the course text and presentations is excellent, some additional material should be included.

First, **an overview of and introduction to the world energy situation**, both physical and political, would provide a context for the benefits derived from conservation programs. The overview should be followed by a brief summary of the steps taken and programs established in selected developing countries and developed nations, encouraging conservation and management of energy resources. At the end of the course, it might be appropriate to hold a session describing the additional in-country services available through AID/Washington and AID Missions overseas to support, encourage, and enhance a country's ability to develop and implement an effective energy management program.

The structure and content of the materials dealing with energy audits should be reviewed and restructured to

provide a more effective presentation of the audit process. Wherever possible, sessions containing significant quantities of duplicate material should be combined to avoid unnecessary repetition. As noted in the NUS review, the subject of preventive maintenance should be stressed. This subject deserves to be covered separately as well as stressed throughout the course wherever applicable. In addition, the benefits of proper operation of equipment and services should be identified as a means of achieving energy and cost savings at little or no cost, and the role of controls should be emphasized.

The course contains no discussion of diesel-driven equipment. Because TVA does not feel that it has the internal resources to develop these materials, an outside source should be sought to prepare them. A series of discussions on diesel equipment is as important as the sessions developed for this course on gas turbines.

To respond to the needs of a limited number of participants, several sessions of optional material could be developed, including HVAC, materials handling and transportation, policy development (e.g., energy demand management planning, incentives for conservation), and other subjects not of general interest but of significant value to those interested or involved in the given areas. These sessions could be presented outside class hours for the benefit of interested participants.

Other recommendations follow:

- Consideration should be given to using metric units in course material to the greatest extent

possible, since most participants' countries use the metric system.

- Insofar as possible, the structure of each session should follow a standard format that includes:

  - presentation of subject

  - discussion of relevance to the LDC context

  - case study based on an industry or equipment that is relevant to LDCs.

- The exercises using the calculator (Session 6) should include a problem in financial justification of an ECO. Also, the session should cover the use of computer programs to assist energy auditors. A number of such programs for hand-held calculators are available at a modest cost, and can be applied to a variety of thermodynamic calculations, power factor correction, and life-cycle costing.

- Consideration should be given to more field work, more complexity, and a stronger industrial orientation.

- A practical session on project management should be added to the course. The session should include the use of personal computers and commercially available software for project management.

Evaluation

The present method of evaluating student proficiency in the course was found by the participants, almost without exception, to be distasteful. If it is necessary to rank the participants, a more effective and fair method must be found. As an alternative to the present method of using the problem sets and simulations, the following is suggested:

- Give homework assignments at the end of each session to provide immediate positive reinforcement of the material presented. This work should require approximately one to one-and-a-half hours to complete and would be turned in the next morning to the Course Facilitator, who would review and "grade the work (i.e., excellent, acceptable, or not acceptable). The first half-hour of each day's session could be devoted to handing out solutions to the previous night's problems and discussing them with participants.

- Develop case studies or simulations for either individuals or teams at each of the logical break points in the course structure. A total of up to four such case studies could be developed, although three would be adequate.

- Begin development of the individual energy conservation action plans earlier in the course and review them for application of the principles taught in the course. The development of

these plans could be considered equivalent to a final examination.

Implementation of an evaluation system of this nature depends on the presence of an able Course Facilitator. It will fall to this individual to conduct the daily review sessions and develop and review the case studies. However, the potential benefit is worth the effort, as this type of approach permits a direct assessment of an individual's ability to apply the concepts presented rather than a determination of theoretical understanding and English language proficiency.

A follow-up evaluation of course participants is highly recommended at least 12 months after the end of the course. Various AID officers and contractors could spend a few hours with former course participants when visiting their countries.

Appendix A

TVA ENERGY CONSERVATION TRAINING COURSE

June 4-July 27, 1984 **Chattanooga, Tennessee**

Course Evaluation Questionnaire

Please give each question careful consideration. Your suggestions are welcomed and, to the extent possible, will be incorporated in future training courses on related subjects. Please return the completed questionnaire by Friday, July 27, to Alain Streicher, Vice President of Hagler, Bailly & Company, who will attend the course between Wednesday, July 25, and Friday, July 27.

A. How would you evaluate the overall course? Excellent _____ Good _____ Fair _____ Poor _____

B. How useful overall do you think this course will be to you? Extremely useful _____ Useful _____ Not useful _____

C. How would you characterize the course? Very difficult _____ Difficult _____ Average _____ Easy _____

D. How would you evaluate the various sessions, both in terms of their technical content and their usefulness to you?

Session number	Main topic	Technical content				Usefulness to you			
		Excellent	Good	Fair	Poor	Very high	High	Medium	Low
1	TVA orientation								
2	Course introduction and overview								
3	Orientation to U.S. customs and traditions								
4	Management commitment to energy conservation								
5	Philosophy of energy efficiency in electric utility operations and maintenance								
6-8	Review of energy conservation concepts and techniques								
9	Electrical energy analysis techniques								
10	Fluid and thermal energy analysis techniques								
11	Basic statistical analysis techniques								
12	Problems/exercises in engineering fundamentals								
13	Lunch and tour of Chattanooga State Technical Community College								
14-16	Planning for energy management								
17	Case study and discussion of energy management								
18-20	Organization and staffing for energy management								

TVA ENERGY CONSERVATION TRAINING COURSE

June 4–July 27, 1984 Chattanooga, Tennessee

Course Evaluation Questionnaire
Page Two

D. How would you evaluate the various sessions, both in terms of their technical content and their usefulness to you? (continued)

Session number	Main topic	Technical content				Usefulness to you			
		Excellent	Good	Fair	Poor	Very high	High	Medium	Low
21	Case study and discussion of energy management								
22-24	Directing the energy management program								
25	Role playing exercises								
26-28	Controlling energy use								
29-30	Problem review								
31	Energy audit terms and concepts								
32-33	TVA energy auditing programs								
34-37	Acquisition of data								
38	Energy audit objectives and plans								
39	Pre-energy audit investigations								
40	Collection of energy consumption data								
41	Simulation session I								
42-44	Audit data analysis								
45*	Simulation session II -- group 1 to UTC boiler								
46	Tour of combustion engineering facility								
47-49	Identifying low-cost options								
50*	Simulation session III -- group 2 to UTC boiler								
51-52	Identifying capital-intensive measures								
53*	Systematic approach to energy usage								
54	Simulation session IV -- group 3 to UTC boiler								

*Fill out questions only when related to your group.

June 4-July 27, 1984 Chattanooga, Tennessee

Course Evaluation Questionnaire
Page Three

D. How would you evaluate the various sessions, both in terms of their technical content and their usefulness to you? (continued)

Session number	Main topic	Technical content				Usefulness to you			
		Excellent	Good	Fair	Poor	Very high	High	Medium	Low
55	Tracking energy consumption								
56-57	Data analysis								
58*	Simulation session IV -- group 4 to UTC boiler								
59	Presentation of final energy audit report								
60	Energy audit follow-up procedures								
61-62	Simulation and problems								
63	Presentation of participants' energy audit projects								
64	Discussion and critique of project presentations								
65	Review problem set III								
66	Safety in the workplace								
67	EU & DR district location field assignment								
68	Fossil-fired plant field assignment								
69	Submission of internship reports and small group discussion of field assignments								
70	Entire group discussion of field assignments								
71-73	Lighting systems								
74	Case study								
75-77	Electric motors								
78	Case study								
79-81	Pumps, compressors, and fans								
82	Case study								

*Fill out questions only when related to your group.

TVA ENERGY CONSERVATION TRAINING COURSE

June 4–July 27, 1984 **Chattanooga, Tennessee**

Course Evaluation Questionnaire
Page Four

D. How would you evaluate the various sessions, both in terms of their technical content and their usefulness to you? (continued)

Session number	Main topic	Technical content				Usefulness to you			
		Excellent	Good	Fair	Poor	Very high	High	Medium	Low
83-85	Internal combustion engines								
86	Case study								
87-89	Boilers and steam distribution systems								
90	Case study								
91-93	Waste heat recovery								
94	Case study								
95	Introduction to fossil plant system and fundamentals of operation								
96	Heat rate improvement program								
97	Availability improvement program								
98	Data collection and analysis								
99	Management development program								
100	Transmission and distribution system losses								
101	Problem set IV								
102	Biomass								
103	Cogeneration								
104	Solar applications								
105	Review problem set IV								

TVA ENERGY CONSERVATION TRAINING COURSE

June 4-July 27, 1984 Chattanooga, Tennessee

Course Evaluation Questionnaire
Page Five

E. Which sessions were the most difficult?

F. Which sessions should be improved or expanded?

G. What additional information would you like to receive on the topics covered?

H. What additional subject(s) would you have liked to cover during the course?

TVA ENERGY CONSERVATION TRAINING COURSE

June 4-July 27, 1984 · Chattanooga, Tennessee

Course Evaluation Questionnaire
Page Six

I. How useful will the written course materials be to you?

J. Was there enough time for questions and answers?

K. Did you have any problems with the course schedule?

L. Was the course structure logical and the lectures properly coordinated?

TVA ENERGY CONSERVATION TRAINING COURSE

June 4-July 27, 1984 **Chattanooga, Tennessee**

Course Evaluation Questionnaire
Page Seven

M. Do you plan to initia e an e ergy conservation program in your organization?

N. Do you feel confident now to initiate and conduct such a program in your organization?

O. What will be your priorities?

P. Who will perform the energy audits?

Course Evaluation Questionnaire
Page Eight

Q. How will the auditors be trained?

R. Is the energy audit equipment and instrumentation used in the course or its equivalent available in your country? If not, how would you overcome this problem?

S. Were the course accommodations satisfactory? If not, please detail and make suggestions for future courses.

T. Please make any additional general comments that you feel could benefit the course.

TVA ENERGY CONSERVATION TRAINING COURSE

June 4-July 27, 1984 Chattanooga, Tennessee

Course Evaluation Questionnaire
Page Nine

OPTIONAL

If you wish, you may give your name and the organization you represent.

Name of participant _____

_____

Name of organization _____

_____

Nature of business/production or activity of the organization _____

_____

L. N. Thakur, Works Manager, Sugar Mill, Nepal

- Wanted to see how ECOs are implemented in U.S. industry
- Wanted internship in U.S. refinery
- A few instructors were not up to the mark (pumps, compressors, waste heat recovery, setting energy goals, systematic approach to energy use)
- More time is needed on some subjects; should extend training period 2 weeks

Jagat Narayan Nayak, Electricity Department, Nepal

- Some trainers were not sufficiently experienced (waste heat recovery, systematic approach to energy management)
- Wants field trips centering on biomass, cogeneration, and solar energy

Peterson Kimani, Food Processing, Kenya

- There was a lot of material from a utility's point of view
- Suggests more attention on energy end-use and less on generating

Hamed Sheikh Ragab Tamini, Utility, Jordan

- Suggests less economic/management content, more technical content

D. R. Bhattarai, Department of Electricity, Nepal

- Stress energy (fossil) savings, rather than dollar savings
- Wants hydropower training

Mingsak Tangtrakul, Energy Conservation Center, Bangkok, Thailand

- It would have been better to discuss newer technologies

Jose Luis Moita da Cruz, Consultant, Lisbon, Portugal

- Received the course material (engineering fundamentals) only 3 days before departing for the United States; should send material 2-4 months before the course begins
- Would like TV set in apartment
- Suggests organized sports and social activities during "empty" weekends

Jorge Mendes Ribeiro, Refinery, Portugal

- Try to increase active participation of the students in some sessions; for example, the trainer could ask questions requiring short answers by the class

U Myo Myint, Instructor, Rangoon, Burma

- Would like to have a higher level energy technology if available

Rafael A. Martinez Bautista, Utility, Dominican Republic

- Time limited the development of some sessions, and in other sessions it was more than enough; a better time distribution should be studied
- Suggests better planning of field assignments

Samuel T. Powers, National Power Authority, Sierra Leone

- Time was limited; should consider a longer course
- Wants more demonstrations and case studies from other industrial sectors

Nelson Chavez, Utility, Dominican Republic

- Should expand instruments session, including practice in their selection

James O. Omondi, Brewery, Nairobi, Kenya

- Questions validity of the rating system -- i.e., rating with regard to the highs and lows and the standard deviation (no independent performance standard)
- Expected more coverage of energy alternatives; is interested in photovoltaic systems

Errol L. Thame, Utility, Jamaica

- Field trip to the Allen coal-fired steam plant was very useful; would like to participate in the district office field trips as well to observe energy audits at other locations

Appendix C

ENERGY CONSERVATION TRAINING PROGRAM OUTLINE
(Industrial and Utility)

Day	Schedule Location	Main Topic	Morning Sessions 8:30-9:50	Morning Sessions 10:10-11:30	Afternoon Sessions 1:00-2:50	Afternoon Sessions 3:10-4:30
INTRODUCTORY MEETINGS AND PRELIMINARY INFORMATION						
Mon 6/4	Krystal Building Room 205	PARTICIPANT ORIENTATION	Breakfast and Welcoming Session (Meet in Read House lobby - 8:30 a.m.)		1. *TVA Orientation	2. *Course Introduction and Overview
Tue 6/5	Krystal Building Room 205		3. *Orientation to United States customs and traditions		(3. cont)	
Wed 6/6	a.m. Krystal Building 205 p.m. UTC Raccoon Mountain Room		8:45 a.m. - Banking activities 10:15 and 11:15 a.m. TVA van will depart from the Chesthut Street side of the Read House to move participants into UTC housing		4. Management Commitment to Energy Conservation	5. Philosophy of Energy Efficiency in Electric Utility Operation and Maintenance 5:30 UTC University Center: Reception and Banquet
REVIEW OF BASIC ENGINEERING FUNDAMENTALS						
Thur 6/7	Raccoon Mountain Room	REVIEW OF ENERGY CONSERVATION CONCEPTS AND TECHNIQUES	6. Use of Calculator	7. Basic Terminology and Units	8. Standard Economic Evaluation Procedures	(8. cont)
Fri 6/8	Raccoon Mountain Room		9. Electrical Energy Analysis Techniques	(9. cont)	10. Fluid and Thermal Energy Analysis Techniques	(10. cont)

Morning Breaks = 9:50-10:10
Lunch = 11:30-1:00
Afternoon Breaks = 2:50-3:10

Appendix C (continued)

ENERGY CONSERVATION TRAINING PROGRAM OUTLINE
(Industrial and Utility)

Day	Schedule Location	Main Topic	Morning Sessions 8:30-9:50	Morning Sessions 10:10-11:30	Afternoon Sessions 1:00-2:50	Afternoon Sessions 3:10-4:30
Sat 6/9			10.00 a.m. - Sightseeing trip to Lookout Mountain			
Sun 6/10						
Mon 6/11	UTC Signal Mountian Room		11. Basic Statistical Analysis Techniques	12. Problems/ Exercises in Engineering Fundamentals - Problems Set I	13. Noon - Lunch and tour of Chattanooga State Technical Community College	

ENERGY MANAGEMENT PHILOSOPHY AND CONCEPTS

Tue 6/12	UTC Arena 445	PLANNING FOR ENERGY MANAGE-MENT	14.	Setting Energy Goals	15.	Establishing Energy Standards	16.	Establishing Policies and Procedures For Energy	17.	Case Study and Discussion of Energy Management
Wed 6/13	Signal Mountain Room	ORGANIZATION AND STAFFING FOR ENERGY MANAGEMENT	18.	Organizational Concepts for Energy Management	19.	Selecting the Energy Management Team	20.	Defining Tasks and Responsi-bilities of the Energy Management Team	21.	Case Study and Discussion of Energy Management
Thur 6/14	Arena 445	DIRECTING THE ENERGY MANAGE-MENT PROGRAM	22.	Motivation Concepts	23.	Communication and Relation-ship Techniq-ues	24.	Training Applications	25.	Role Playing Exercises

Appendix C (continued)

ENERGY CONSERVATION TRAINING PROGRAM OUTLINE
(Industrial and Utility)

Day	Schedule Location	Main Topic	Morning Sessions 8:30-9:50	10:10-11:30	Afternoon Sessions 1:00-2:50	3:10-4:30
Fri 6/15	Signal Mountain Room	CONTROLLING ENERGY USE	26. Data Acquisition Techniques	27. Control Chart Techniques	28. Methods of Analyzing Data	29. Problem Set II
Sat 6/16			Trip to Opryland in Nashville			
Sun 6/17			Visit the Grand Ole Opry in Nashville			

ENERGY AUDITING TECHNIQUES

Mon 6/18	Raccoon Mountain Room	INTRODUCTION TO ENERGY AUDITING	30. Review Problem Set II	31. Energy Audit Terms and Concepts	32. Internal, TVA Energy and Auditing Programs	33. External, TVA Energy Auditing Programs
Tues 6/19	Raccoon Mountain Room	ACQUISITION OF DATA	34. Pre-Audit Analysis of Existing Energy Data	35. Acquisition of Primary Electrical Metering Data	36. Sub-Metering Techniques for Data Acquisition	37. Use of Portable Energy Audit Meters with Demonstrations
Wed 6/20	Raccoon Mountain Room	STEPS IN CONDUCTING AN ENERGY AUDIT	38. Energy Audit Objectives and Plans	39. Pre-Energy Audit Investigations	40. Collection of Energy Consumption Data	41. Simulation Session I
Thur 6/21	Arena 445		42. Collecting Other Technical Data Needed For Energy Analysis	43. Calculating Energy Balances and Efficiencies	44. Review of Actual Energy Audit Data	45. Simulation Session II - Group 1 to UTC Boiler
Fri 6/22			46. Tour of Combustion Engineering Facility (9:00 a.m.-4:30 p.m.)			

Appendix C (continued)

ENERGY CONSERVATION TRAINING PROGRAM OUTLINE
(Industrial and Utility)

Day	Schedule Location	Main Topic	Morning Sessions 8:30-9:50	Morning Sessions 10:10-11:30	Afternoon Sessions 1:00-2:50	Afternoon Sessions 3:10-4:30
Sat 6/23						
Sun 6/24	Cookout for trainees, instructors, mentors, steering committee, and families Chattanooga Employees' Recreation Association					
Mon 6/25	Raccoon Mountain Room		47. Identifying Improved Operating and Maintenance Procedures	48. Determining Process Maintainability	49. Identifying Low-Cost Energy Improvements	50. Simulation Session III - Group 2 to UTC Boiler
Tue 6/26	Raccoon Mountain Room	STEPS IN CONDUCTING AN ENERGY AUDIT (continued)	51. Identifying Capital Cost Energy Improvements	52. Capital Rationing Techniques	53. Systematic Approach to Energy Usage	54. Simulation Session IV - Group 3 to UTC Boiler
Wed 6/27	Raccoon Mountain Room		55. Tracking Energy Consumption	56. Statistical Analysis of Energy Audit Data	57. Analysis of Energy Conservation Opportunities Using UTC Data	58. Simulation Session V - Group 4 to UTC Boiler
Thur 6/28	Raccoon Mountain Room		59. Presentation of Final Energy Audit Report	60. Energy Audit Follow-Up Procedures	61. Simulation Session VI	62. Problem Set III
Fri 6/29	Raccoon Mountain Room		63. Presentation of Participants' Energy Audit Projects	64. Discussion and Critique of Project Presentations	65. Review Problem Set III	66. Safety in the Workplace

Appendix C (continued)

ENERGY CONSERVATION TRAINING PROGRAM OUTLINE
(Industrial and Utility)

Day	Schedule Location	Main Topic	Morning Sessions 8:30-9:50	Morning Sessions 10:10-11:30	Afternoon Sessions 1:00-2:50	Afternoon Sessions 3:10-4:30
Sat 6/30						
Sun 7/1			Students Travel to Internship Assignments			
			FIELD ASSIGNMENTS*			
Mon 7/2		FIELD ASSIGNMENTS	Field Assignments will begin on 7/2/84 and end on 7/10/84. Participants may select one of two alternatives for a field assignment: (Each participant will prepare a written report on his/her field experience.) Wednesday, July 4, will be observed as the Fourth of July National Holiday.			
Tue 7/3						
Wed 7/4			67. (1) EU&DR District Location Field Assignment			
Thur 7/5			68. (2) Fossil-Fired Plant Field Assignment			
Fri 7/6						
Sat 7/7						
Sun 7/8						
Mon 7/9						

*Daily schedule to be determined by field assignment supervisor.

Appendix C (continued)

ENERGY CONSERVATION TRAINING PROGRAM OUTLINE
(Industrial and Utility)

Day	Schedule Location	Main Topic	Morning Sessions 8:30-9:50	Morning Sessions 10:10-11:30	Afternoon Sessions 1:00-2:50	Afternoon Sessions 3:10-4:30
Tue 7/10						
Wed 7/11			Participants Return from Field Assignments			
Thur 7/12	Raccoon Mountain Room		69. Submission of Internship Reports and Small Group Discussion of Field Assignments	(69. Cont'd)	70. Entire Group Discussion of Field Assignments	(70. cont'd)
		ENERGY CONSERVATION OPPORTUNITIES (ECOs) IN INDUSTRIES				
Fri 7/13	Raccoon Mountain Room	LIGHTING SYSTEMS	71. Lighting Concepts	72. Techniques for Lighting ECOs	73. Application of ECOs in Lighting	74. Case Study
Sat 7/14						
Sun 7/15						
Mon 7/16	Raccoon Mountain Room	ELECTRIC MOTORS	75. Electric Motor Concepts	76. Techniques for Electric Motor ECOs	77. Application of ECOs in Electric Motors	78. Case Study
Tue 7/17	Arena 445	PUMPS, COMPRESSORS, AND FANS	79. Pumps, Compressors, and Fans Concepts	80. Techniques for Pumps, Compressors, and Fans ECOs	81. Application of ECOs in Pumps, Compressors, and Fans	82. Case Study
Wed 7/18	Arena 445	INTERNAL COMBUSTION TURBINES	83. Internal Combustion Turbine Concepts	84. Techniques for Internal Combustion Turbine ECOs	85. Application of ECOs in Internal Combustion Turbine.	86. Case Study

Appendix C (continued)

ENERGY CONSERVATION TRAINING PROGRAM OUTLINE
(Industrial and Utility)

Day	Schedule Location	Main Topic	Morning Sessions 8:30-9:50	Morning Sessions 10:10-11:30	Afternoon Sessions 1:00-2:50	Afternoon Sessions 3:10-4:30
Thur 7/19	Raccoon Mountain Room	BOILERS AND STEAM DISTRIBUTION SYSTEMS	87. Boiler and Steam Distribution System Concepts	88. Techniques for Boiler and Steam Distribution Systems ECOs	89. Application of ECOs in Boiler and Steam Distribution Systems	90. Case Study
Fri 7/20	Raccoon Mountain Room	WASTE HEAT RECOVERY	91. Waste Heat Recovery Concepts	92. Techniques for Waste Heat Recovery ECOs	93. Application of ECOs in Waste Heat Recovery Systems	94. Case Study
Sat 7/21	Trip to Muscle Shoals and Huntsville, Alabama Visit Alabama Space and Rocket Center					
Sun 7/22						
	ENERGY CONSERVATION OPPORTUNITIES IN UTILITIES					
Mon 7/23	Raccoon Mountain Room	POWER GENERATION AND TRANSMISSION	95. Introduction to Fossil Plant System and Fundamentals of Operation	96. Heat Rate Improvement Program	97. Availability Improvement Program	98. Data Collection and Analysis
Tue 7/24	Raccoon Mountain Room		99. Management Development Program	100. Transmission and Distribution System Losses	(100. cont'd)	101. Problem Set IV
Wed 7/25	Raccoon Mountain Room	ENERGY ALTERNATIVES	102. Biomass	103. Cogeneration	104. Solar Applications	
Thur 7/26	Raccoon Mountain Room	SUMMARY AND CONCLUSIONS	105. Review Problem Set IV	106. Review Course	(Transportation available to post office for mailing course materials)	
Fri 7/27	Read House Hotel	GRADUATION CEREMONIES, RETURN HOME	107. Graduation Ceremonies			