

PN-ABT-225

PSN. 91416

WASH Field Report No. 447

**WASTEWATER TREATMENT PLANT
O&M AUDIT TRAINING
AT GABROVO AND VELIKO TARNOVO, BULGARIA**

Prepared for the Europe Bureau,
U.S. Agency for International Development
under WASH Task No. 537

by

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October 1994

**Water and Sanitation for Health Project
Contract No. DPE-5973-Z-00-8081-00, Project No. 936-5973
is sponsored by the Bureau for Global Programs, Field Support, and Research
Office of Health, Population, and Nutrition
U.S. Agency for International Development
Washington, DC 20523**

RELATED WASH REPORT

Water Quality Pre-Investment Studies in the Yantra Basin in Bulgaria. WASH Field Report No. 408. August 1993. Prepared by Max Clark, David Laredo, and William Hogrewe.

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Three related publications are available:

*Wastewater Treatment Plant Operation and Maintenance Audit Training:
Gabrovo and Veliko Tamovo, Bulgaria*

*Comprehensive Performance Evaluation of the Gabrovo, Bulgaria Wastewater
Treatment Plant*

*Comprehensive Performance Evaluation of the Veliko Tamovo, Bulgaria
Wastewater Treatment Plant*

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ACKNOWLEDGMENTS

The WASH team received the cooperation and support of people in the municipalities of Gabrovo and Veliko Tarnovo and in the Ministry of Environment in Sofia. Thanks are given to the persons listed below and to the many others who assisted with the studies.

The team wishes to thank those in USAID and WASH Project staff who gave their energies and assistance, especially James Taft (ENI/DR/ENR), John Austin (G/H/CD), Craig Hafner, and Jonathan Darling.

The team extends its appreciation to: Deputy Minister Branimir Natov and Dr. Ilya Natchkov of the Ministry of Environment; WaterEngineering Ltd; and the participants of the training program listed below. Without their help, interest, and enthusiasm the mission would not have been as successful as it was.

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ACRONYMS & UNITS

BOD ₅	5-Day biochemical oxygen demand
BuK	Regional semi-autonomous water company
CCP	Composite correction program
COD	Chemical oxygen demand
CPE	Comprehensive performance evaluation
DO	Dissolved oxygen
gm/L	Gram per liter
H ₂ S	Hydrogen sulfide
IWTP	Industrial wastewater treatment plant
L/S	Liters per second
M ³	Cubic meter
M ³ /Hr	Cubic meters per hour
M ³ /Day	Cubic meters per day
mg/L	Milligrams per liter
MLSS	Mixed liquor suspended solids
MoE	Ministry of the Environment - Bulgaria
NH ₄ ⁺	Ammonium
NIS	Newly Independent States; former Soviet Union
NO ₃ ⁻	Nitrate
O&G	Oil and grease
O&M	Operations and maintenance
pH	Measurement of the hydroxyl ion
POTW	Publicly owned treatment work
RAS	Return activated sludge
SDB	Sludge drying beds

SRT	Solids retention time
SSV	30-minute settled sludge volume
SVI	Solids volume index
TKN	Total kjeldahl nitrogen
TPM	Team planning meeting
TSS	Total suspended solids
USEPA	United States Environmental Protection Agency
USAID	United States Agency for International Development
WAS	Waste (excess) activated sludge
WASH	Water and Sanitation for Health Project
WWTP	Wastewater treatment plant (municipal)

EXECUTIVE SUMMARY

This report describes the comprehensive performance evaluation (CPE) training conducted in May 1994 at the Gabrovo and Veliko Tarnovo Municipal Wastewater Treatment Plants (WWTP) in Bulgaria. The purpose of the training was to present the participants with a methodology for evaluating the performance of wastewater treatment facilities and to set priorities for future activities. Pre-investment studies conducted by WASH in Bulgaria in 1993 established the need for the CPE training.

A prototype training protocol for carrying out wastewater treatment plant audits was developed for potential use in Eastern Europe. Wastewater treatment plants of a similar nature and with similar problems are common in Central and Eastern Europe and the former Soviet Union; therefore, there is a potential for future use of this training protocol.

The CPE training program was developed through a series of team planning and review meetings and work sessions in which overall course objectives, logistics, and a detailed syllabus were developed. The workshop was designed primarily for delivery to regulatory personnel and secondarily to other individuals—including design engineers, operations and maintenance supervisors, and administrative decision makers—who are responsible for evaluating the performance of wastewater treatment plants.

The training course was arranged to be carried out over a period of two weeks (nine training days). Week #1 consisted of five days at the Gabrovo WWTP. During this time the main concepts of the CPE were introduced by the instructional team. Week #2 consisted of four days at the Veliko Tarnovo WWTP. The course participants assumed the leadership role in these sessions.

Because the main objective of the workshop was to train the individuals on how to conduct a CPE, and because of the strict limitations on time, it was determined that a complete and detailed CPE of each facility could not be accomplished. The solution to this problem was to develop a plan of action for the Ministry of the Environment (MoE) officials to use to complete the CPEs at Gabrovo and Veliko Tarnovo. The information and conclusions generated as part of the training exercise would become the foundation for a complete CPE at each plant.

Twelve individuals participated in the workshop. Of these, three represented the Bulgarian MoE, three represented the Yantra River Basin Inspectorate, five represented the wastewater treatment facilities, and one represented Vodokanal Engineering. These twelve individuals were trained to conduct a CPE at wastewater treatment plants, and they demonstrated their abilities to the training team during the exercise at Veliko Tarnovo by assuming leadership roles in conducting the CPE. Among the other accomplishments of the training were the following results:

- CPEs were developed for the Gabrovo WWTP and the Veliko Tarnovo WWTP, and representatives of MoE agreed on an action plan to complete the CPEs at both plants.
- Institutional relations between regulatory, design, and operating agencies were strengthened.
- Reference materials were provided to MoE and WWTPs.
- The CPE methodology was well received and most probably will be used elsewhere in Bulgaria.
- The training design was field-tested, and suggestions for improvement were made.

Several minor changes to the training design are recommended in an accompanying working paper, the most important of which is to allow for more time to conduct the training and complete the audit. The recommended changes will probably be made as part of the next implementation of this training, which has many potential applications at wastewater treatment facilities in Central and Eastern Europe and the former Soviet Union.

The training team also observed the need for operations and maintenance-related training and the WWTP staffs' desire for such knowledge. Unfortunately there is very little training available to operations and maintenance (O&M) personnel in Bulgaria, and there is no institutionalized operator training program. Many problems identified during the CPEs at both Gabrovo and Veliko Tarnovo could be reduced through good process control programs. Skill development for O&M staff personnel in Bulgaria would have a substantial impact on WWTP performance. This training could include the following assistance from USAID:

- Encouragement of the Bulgarian MoE to support training of WWTP O&M staff.
- Assistance with the development of a national operator training program.
- Conducting a "training-of-trainers" course for selected Bulgarians who have strong technical skills and experience in WWTP O&M.
- Providing packaged training programs and reference materials for the development and delivery of operator training.
- Promoting the implementation of an operator certification program and networking by operators through professional associations.

Details of the audits are in separate documents and may be requested from the Environmental Health Project. Please reference this field report in your request. The major factors that limit the performance of the treatment process at Gabrovo are lack of funding, the absence of any alternative source of electrical power, poor aeration equipment, equipment damage from grit and fibers, inability to control activated sludge process, and untreated overflows in wet weather. The recommendations for Gabrovo are as follows:

- Funding and budgeting practices should be reviewed and modified.
- A second electrical feeder should be run to the plant.
- The blowers should be upgraded.
- The preliminary treatment facilities should be evaluated. Industrial discharges should be monitored for the presence of offending material.
- Process control instrumentation should be purchased and process control improved.
- Priority should be given to the completion of the anaerobic digesters to increase overall plant capacity.

At Veliko Tarnovo the major problems are lack of funding, inadequate sludge processing capacity, and lack of control and monitoring of the activated sludge process. The recommendations for Veliko Tarnovo are as follows:

- Funding and budgeting practices should be reviewed and modified to assure the availability of funds for operation, maintenance, replacement parts, and capital improvements.
- Priority should be given to the completion of the anaerobic digesters and the development of an interim solution to the lack of sludge dewatering capacity.
- Ownership of all components of the plant should be resolved.
- Staff should be increased.
- Process control instrumentation should be purchased and process control improved.
- Industrial discharges should be monitored for the presence of offending material.

Chapter 1

INTRODUCTION

1.1 Background

The town of Gabrovo is located on the upper reaches of the Yantra river in Bulgaria. The population is approximately 80,000, 51 percent of whom have access to sewerage. Gabrovo has a municipal wastewater treatment plant (WWTP) with an activated sludge process. More than 30 percent of the wastewater flow and a very large portion of the organic loading to the treatment plant are from industries. The major industrial dischargers include tanning, food processing, textiles, and metal finishing. The U.S. Agency for International Development (USAID) is currently funding an equipment replacement project at the municipal WWTP to make it more reliable and energy efficient. However, additional improvements in operation and maintenance (O&M) are needed to improve the performance and increase the reliability of the WWTP which, in turn, will reduce pollution of the Yantra river. These improvements can be realized by evaluating the current O&M practices at the municipal WWTP and the industrial wastewater pretreatment plants in conjunction with waste minimization at the industries.

Veliko Tarnovo, located downstream from Gabrovo, has a population of almost 70,000, with 93 percent sewerage coverage. The municipal WWTP uses an activated sludge process; however, a large portion of the raw wastewater bypasses the plant and runs into the river without treatment. A very small portion of the wastewater flow comes from industry. Improvements to the sludge handling train are currently being funded by USAID. These changes will allow use of the plant at full capacity and eliminate the need to bypass some of the flow. Additional improvements in O&M are needed to assure the effectiveness of the changes in progress. These changes will drastically reduce the flow of untreated sewage to the Yantra river.

The purpose of this task is to train Ministry of Environment (MoE) personnel in evaluating O&M practices at municipal WWTPs and to undertake O&M audits at the towns of Gabrovo and Veliko Tarnovo. The work in Gabrovo will include the evaluation of the need for an industrial wastewater pretreatment program. In addition a prototype training protocol for carrying out audits will be developed for potential use in Eastern Europe. Wastewater treatment plants of this type are common in Central and Eastern Europe and the former Soviet Union; therefore, there is a potential for future use of this training protocol.

1.2 Objectives

The objectives of this task include:

- 1) training of MoE personnel to perform audits of municipal WWTPs and including industrial pretreatment facilities;**
- 2) O&M audits of two municipal WWTPs;**
- 3) development of a prototype audit training program;**
- 4) recommendations for municipal WWTP process control and rehabilitation projects which may be funded locally.**

Chapter 2

PREPARATION OF THE WORKSHOP

2.1 Background

The objectives of this task were to develop a training program that would transfer the skills necessary to conduct systematic evaluations of a wastewater treatment plants, and to provide a formal training methodology that could be refined and applied in other countries in Eastern Europe and the NIS countries.

The comprehensive performance evaluation (CPE) training program, along with the individual and team assignments, was developed through a series of team planning and review meetings. First, overall objectives and general course logistics for the training course were developed. It was then determined that the United States Environmental Protection Agency (USEPA) standard procedure for conducting comprehensive performance evaluations would be used as the model for the Bulgaria training program. Based on the USEPA-CPE format, the course was divided into 28 modules, and a syllabus was developed for each course module. Each syllabus included specific learning objectives, the instructional strategy for achievement of each learning objective, resources required, and the estimated time required to implement each strategy. The syllabus package led to the development of a block calendar (agenda) for the training course and a list of required resources, including handout packages, flip charts, overhead transparencies, and various instructional aids. The Water and Sanitation for Health (WASH) Project, with assistance from a contractor in Bulgaria (WaterEngineering, Ltd.), developed and translated the course materials, as well as arranged logistics for the training course.

The following is a breakdown of activities that resulted in the development of the CPE training course.

2.2 Workshop Overview and Objectives

2.2.1 Overview

The primary target audience for the workshop was regulatory personnel; the secondary target was individuals responsible for evaluating the performance of wastewater treatment plants (i.e., design engineers, operations and maintenance supervisors, and administrative decision makers). The training course was designed for a two-week period (nine training days), using the standard USEPA format for conducting comprehensive performance evaluations.

Week #1 consisted of five days at the Gabrovo WWTP. During this session the concept of the CPE was introduced, and the course participants were guided by the instructional team through an abbreviated CPE of the Gabrovo WWTP. **Week #2** consisted of four days at the Veliko Tarnovo WWTP. The course participants assumed the leadership role in conducting an abbreviated CPE for the Veliko Tarnovo WWTP. The instructional team provided guidance and suggestions where necessary to follow the course agenda.

Because the main objective of the workshop was to train the individuals in how to conduct a CPE, and because of the strict limitations on time, it was determined that a complete and detailed CPE of each facility was not possible. The solution was to develop a plan of action for MoE officials to use in completing the CPEs at Gabrovo and Veliko Tarnovo. The information and conclusions generated as part of the training exercise would become the foundation for a complete CPE at each plant.

The training workshop was divided into several modules, mirroring the USEPA standard procedure for conducting CPEs at wastewater treatment facilities. The module titles are as follows:

Facility #1 CPE - Gabrovo WWTP:

- I. Introductions/Logistics/Course Overview**
- II. Overview of CPE/CCP Process**
- III. Implementation of the CPE - Gabrovo WWTP**
 - A. Initial Activities**
 - B. Data Collection**
 - 1. Kick-off Meeting**
 - 2. Plant Tour**
 - 3. Detailed Data Gathering**
 - C. Evaluation of Major Unit Process**
 - D. Evaluation of Performance Limiting Factors (PLF)**
 - E. Performance Evaluation**
 - F. Presentation to POTW Administrators and Staff**
 - G. CPE Report**
 - H. CPE Results**
- IV. Wrap-up of Gabrovo CPE**
- V. Planning for Veliko Tarnovo WWTP CPE**

Facility #2 CPE - Veliko Tarnovo WWTP:

- I. Introductions/Logistics/Course Overview**
- II. Planning for Veliko Tarnovo CPE**
- III. Implementation of the CPE - V.T. WWTP**
 - A. Initial Activities**
 - B. Data Collection**
 - 1. Kick-off Meeting**
 - 2. Plant Tour**
 - 3. Detailed Data Gathering**
 - C. Evaluation of Major Unit Process**
 - D. Evaluation of Performance Limiting Factors (PLF)**
 - E. Performance Evaluation**
 - F. Presentation to POTW Administrators and Staff**
 - G. CPE Report**
 - H. CPE Results**
- IV. Wrap-up of Veliko Tarnovo CPE**
- V. Program Evaluation and Closing**

2.2.2 Objectives

The overall objectives for the training course were determined during a team planning meeting. These objectives are as follows:

OVERALL COURSE OBJECTIVES:

At the end of this course the participant will be capable of effectively and systematically designing and conducting a comprehensive performance evaluation (CPE) at a wastewater treatment plant (WWTP). This CPE includes:

- 1) Identifying ineffective WWTP unit processes based on limitations in design, operations, and maintenance.**
- 2) Identifying and prioritizing factors which limit WWTP performance in administration, design, operations, maintenance, and performance.**
- 3) Conveying results of the CPE to MoE and WWTP ownership/management for action.**

2.3 Team Planning Meeting

In the preparations for this task a team planning meeting (TPM) approach was used. The TPM is an organized process used by WASH to prepare teams to better perform a task through a concentrated effort to define and plan for the work. The planning covers two areas: task functions - what is to be done; and team building - how team members can form an effective team. The objectives of the TPM are to review background; identify the clients and their stake; develop an approach for working with the clients; define team and individual scopes of work; agree on objectives and outcomes; develop a work plan; agree on how the team will work together and on the roles of the team leader; and complete all logistical arrangements.

2.4 Workshop Syllabus

In order to establish detailed instructional guidelines and to identify resources required, a standard training syllabus was developed for each module of the workshop. The first step in developing the syllabus was to prepare an overall learning objective for the CPE module. The next step was to prepare several specific learning objectives in order to accomplish the overall objective of the CPE module. For each learning objective, an instructional strategy was selected. The selection of each strategy was based upon the most appropriate method for transferring the knowledge. Among the strategies used were lectures, guided discussions, group exercises, and role play. Instructional resources were identified after a review of each strategy. An estimated delivery time was determined for each strategy. Because of the time required for language translation, a multiplier of two (2) was used for each estimate of delivery time. After time estimates were totaled and required adjustments were made, each module was positioned within the block calendar. Each syllabus is included in the "working paper" that accompanies this report.

2.5 Workshop Agenda

Following development of a complete syllabus package the workshop agenda was prepared. The factors that were considered during preparation of the agenda were the total number of days available for training delivery and the estimated delivery time from each workshop module syllabus. Each module was situated in the agenda in logical order along with sessions at the beginning and end of each day for review of logistics and past and future activities, and a morning and afternoon break. A complete course agenda is included in Section 3.2 of this report.

2.6 Training Resources

Instructors:

A team leader and two instructors were assigned to participate in delivery of the training. Leadership and support roles for delivery of each module were divided between the instructors. The team leader provided logistical support, support with training resources, technical input during the exercises, and an ongoing evaluation of the delivery of each module.

Training Facilities:

- **Week #1: Conference room at Gabrovo WWTP**
- **Week #2: Conference room at Veliko Tarnovo WWTP**
- **Both rooms listed above were suitable for 12 students. Tables were arranged in a "U shape" to promote interaction between the participants.**

Instructional Media:

- **CPE guidance manual: English and Bulgarian**
- **Flip charts: English (8-1/2 X 11), Bulgarian (Std. flip chart)**
- **Overhead transparencies: English (hard copy), Bulgarian (acetate)**
- **Physical facilities at Gabrovo WWTP and Veliko Tarnovo WWTP**

Translations:

There were two translators for the workshop. While one translated the lecture and discussion, the other prepared media for upcoming sessions or provided back-up with technical terms. Both interpreters participated in the group exercises.

2.7 Logistical Arrangements

The following logistical assignments were made for the workshop:

WaterEngineering, Ltd., Sofia, Bulgaria:

- **translation and duplication of handout materials**
- **selection of and contracting with interpreters**
- **arrangement of intercity travel and lodging for the WASH team**

Bulgarian MoE and Yantra River Basin Inspectorate:

- selection of course participants
- selection of plants to be used in exercise

Regional semi-autonomous water company (BuK) in Gabrovo and Veliko Tarnovo:

- meeting rooms and facilities

Chapter 3

IMPLEMENTATION OF THE WORKSHOP

3.1 Workshop Objectives and Strategies

3.1.1 CPE Program Task Objectives

The CPE modules for the workshop, along with a general objective for each module, are listed below.

A. INITIAL ACTIVITIES

Determine magnitude of field work and make on-site activities more productive by gathering basic data on the plant.

B. DATA COLLECTION

Collect information about administration, design, operations, maintenance and performance.

C. DATA COLLECTION

- Kick-off Meeting with key WWTP personnel:
 - Explain and gain support for the CPE
 - Coordinate and establish the schedule
 - Initiate the administrative evaluation
- Plant Tour:
 - Familiarize the evaluator with the physical plant
 - Conduct preliminary assessment of design and operational flexibility
 - Provide initial basis for discussions during evaluation phase.
- Detailed Data Gathering:
 - Collect all data necessary to assess the performance potential of the existing facilities

D. EVALUATION OF MAJOR UNIT PROCESSES

Determine the general applicability of a Composite Correctional Program (CCP) to improve performance by evaluating each major unit process and selecting a rating for the plant of type 1, type 2 or type 3.

E. EVALUATION OF PERFORMANCE LIMITING FACTORS (PLFs)

Identify and prioritize the factors that most accurately describe the causes of limited performance

F. PERFORMANCE EVALUATION

- Establish or verify the magnitude of the performance problem.
- Project the level of improvement that can be expected from a CCP.

G. PRESENTATION TO WWTP STAFF AND ADMINISTRATORS

Inform WWTP personnel of preliminary CPE results.

H. CPE REPORT

Summarize the CPE findings and recommendations in writing. The purpose of this report is to communicate this information to the decision makers.

I. CPE RESULTS

Determine if WWTP personnel have selected and approach and implemented activities to achieve the required performance.

3.1.2 Implementation Strategies

For every learning objective in the syllabus of each CPE module, a specific instructional strategy was selected during the planning stages and implemented during the workshop. The strategies consisted of lectures, guided discussions, group exercises, and role play. Every effort was made to actively involve the participants in the workshop; therefore lectures were kept to a minimum, and a majority of time was spent on group exercises and guided discussions. The basic strategy was for the instructional team to lead the participants through the CPE at Gabrovo, and at Veliko Tarnovo the participants would assume the leadership role of conducting the CPE, with input from the instructors as necessary.

During delivery of each workshop module, the lead instructor guided the class activities. The back-up instructor, depending upon need, assisted during group exercises, provided support with instructional media, offered comments about the topics being discussed in

class, and gathered data from the plant which would be useful in future presentations. The team leader assisted with group exercises, recorded actual delivery times, conducted an ongoing evaluation of the training delivery, and provided media support and comments. Each day after the workshop, the team leader conducted a meeting with the other two team members to discuss accomplishments, problems, required action or adjustments to the workshop, and the program for the following day.

The training specialist, in addition to training delivery and support, was responsible for making sure that the agenda was followed and for making the adjustments necessary to ensure the accomplishment of the learning objectives.

Two interpreters were used during the CPE training. During lectures, guided discussions, and role play sessions, one interpreter would translate the lecture content, while the other interpreter either provided back-up to the lead interpreter with technical terms or worked outside the classroom preparing flip charts. During group exercises, both interpreters assisted as instructors and group members discussed issues.

3.2 Workshop Agenda

The workshop schedule was modified slightly at the beginning of the course in order to accommodate the participants. Although the training had been scheduled to run from 8:00 AM to 5:00 PM, it was changed on-site to 9:00 AM to 6:00 PM. Hourly five-minute breaks were added to the fifteen-minute AM and PM breaks.

During the training, certain course modules required more time than was originally planned. Adjustments to the schedule were made to allow adequate time for important topics to be covered in sufficient detail. Also, before the training at Veliko Tarnovo began, the agenda was modified to include the "lessons learned" in Gabrovo. The modifications to time allotments, as well as recommendations for future training activities, are discussed in the working paper that accompanies this report.

Block Calendar - Gabrovo CPE Training

BEST AVAILABLE DOCUMENT

Monday 16	Tuesday 17	Wednesday 18	Thursday 19	Friday 20
9:00 - 11:00 I. Introductions/Logistics/ Course Overview	9:00 - 9:15 Work Plan	9:00 - 9:15 Work Plan	9:00 - 9:15 Work Plan	9:00 - 9:15 Work Plan
11:00 - 11:15 Break	9:15 - 10:45 III. Implementation of the CPE - Gabrovo WWTP B. Data Collection 2. Plant Tour	9:15 - 11:00 III. Implementation of the CPE - Gabrovo WWTP B. Data Collection: 3. Detailed Data Gathering	9:15 - 11:00 III. Implementation of the CPE - Gabrovo WWTP D. Evaluation of Performance Limiting Factors (PLF)	9:15 - 11:15 III. Implementation of the CPE - Gabrovo WWTP F. Presentation to POTW Administrators and Staff
11:15 - 12:45 II. Overview of CPE/CCP Process	10:45 - 11:00 Break	11:00 - 11:15 Break	11:00 - 11:15 Break	11:15 - 11:30 Break
	11:00 - 12:45 III.B.2. Plant Tour (continued)	11:15 - 1:15 III.B.3. Detailed Data Gathering (continued)	11:15 - 1:00 III.D. Evaluation of Performance Limiting Factors (PLF) (continued)	11:30 - 12:30 III. Implementation of the CPE - Gabrovo WWTP G. CPE Report
				12:30 - 12:45 III.H III. Implementation of the CPE - Gabrovo WWTP H. CPE Results
12:45 - 1:45 LUNCH	12:45 - 1:45 LUNCH	1:15 - 2:15 LUNCH	1:00 - 2:00 LUNCH	12:45 - 1:45 LUNCH
1:45 - 3:00 III. Implementation of the CPE - Gabrovo WWTP A. Initial Activities	1:45 - 3:15 III.B.2. Plant Tour (continued)	2:15 - 3:45 III. Implementation of the CPE - Gabrovo WWTP C. Evaluation of Major Unit Process	2:00 - 3:15 III. Implementation of the CPE - Gabrovo WWTP E. Performance Evaluation	1:45 - 3:30 IV. Wrap-up of Gabrovo CPE
3:00 - 3:15 Break	3:15 - 3:30 Break	3:45 - 4:00 Break	3:15 - 3:30 Break	3:30 - 3:45 Break
3:15 - 4:00 III.A. Initial Activities (continued)	3:30 - 4:30 III.B.2. Plant Tour (continued)	4:00 - 5:45 III.C. Evaluation of Major Unit Process (continued)	3:30 - 5:00 III. Implementation of the CPE - Gabrovo WWTP F. Presentation to POTW Administrators and Staff	3:45 - 6:00 V. Planning for Veliko Tarnovo WWTP CPE
4:00 - 5:45 III. Implementation of the CPE - Gabrovo WWTP B. Data Collection 1. Kick-off Meeting	4:30 - 5:45 III. Implementation of the CPE - Gabrovo WWTP B. Data Collection 3. Detailed Data Gathering	5:45 - 6:00 Work Plan	5:00 - 5:15 Work Plan	
5:45 - 6:00 Work Plan	5:45 - 6:00 Work Plan	6:00 - 6:30 Team Meeting	5:15 - 5:45 Team Meeting	
6:00 - 6:30 Team Meeting	6:00 - 6:30 Team Meeting			

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Block Calendar - Veliko Tarnovo CPE Training

Wednesday 25	Thursday 26	Friday 27	Saturday 28
9:00 - 10:00 I. Introductions/Logistics/ Course Overview	9:00 - 9:15 Work Plan	9:00 - 9:15 Work Plan	9:00 - 9:15 Work Plan
10:00 - 11:00 II. Planning for Veliko Tarnovo WWTP CPE	9:15 - 10:45 III. Implementation of the CPE - Veliko Tarnovo WWTP B. Data Collection 2. Plant Tour	9:15 - 11:15 III. Implementation of the CPE - Veliko Tarnovo WWTP C. Evaluation of Major Unit Process	9:15 - 11:00 III. Implementation of CPE - Veliko Tarnovo WWTP F. Presentation to POTW Administrators and Staff
11:00 - 11:15 Break	10:45 - 11:00 Break	11:15 - 11:30 Break	11:00 - 11:15 Break
11:15 - 12:15 III. Implementation of the CPE - Veliko Tarnovo WWTP A. Initial Activities	11:00 - 1:00 III. Implementation of the CPE - Veliko Tarnovo WWTP B. Data Collection 3. Detailed Data Gathering	11:30 - 12:45 III.C. Evaluation of Major Unit Process (continued)	11:15 - 1:00 III.F. Presentation to POTW Administrators and Staff (continued)
12:15 - 1:15 III. Implementation of the CPE - Veliko Tarnovo WWTP B. Data Collection 1. Kick-off Meeting			
1:15 - 2:15 LUNCH	1:00 - 2:00 LUNCH	12:45 - 1:45 LUNCH	1:00 - 2:00 LUNCH
2:15 - 3:45 III. Implementation of the CPE - Veliko Tarnovo WWTP B. Data Collection 2. Plant Tour	2:00 - 3:15 III.B.3. Detailed Data Gathering (continued)	1:45 - 4:15 III. Implementation of the CPE - Veliko Tarnovo WWTP D. Evaluation of Performance Limiting Factors (PLF)	2:00 - 2:30 III. Implementation of the CPE - Veliko Tarnovo WWTP G. CPE Report
3:45 - 4:00 Break	3:15 - 3:30 Break	4:15 - 4:30 Break	2:30 - 3:00 III. Implementation of the CPE - Veliko Tarnovo WWTP H. CPE Results
4:00 - 5:45 III.B.2. Plant Tour (continued)	3:30 - 5:45 III.B.3. Detailed Data Gathering (continued)		3:00 - 3:15 Break
		4:30 - 6:15 III. Implementation of the CPE - Veliko Tarnovo WWTP E. Performance Evaluation	3:15 - 5:00 IV. Wrap-up of Veliko Tarnovo CPE
5:45 - 6:00 Work Plan	5:45 - 6:00 Work Plan	6:15 - 6:30 Work Plan	5:00 - 6:00 V. Program Evaluation and Closing
6:00 - 6:30 Team Meeting	6:00 - 6:30 Team Meeting.	6:30 - 7:00 Team Meeting	6:30 Bus Back to Sofia

BEST AVAILABLE DOCUMENT

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Chapter 4

WORKSHOP RESULTS

4.1 Workshop Participants

Twelve individuals participated in the workshop. Of these, three represented the Bulgarian Ministry of the Environment, three represented the Yantra River Basin Inspectorate, five represented the wastewater treatment facilities, and one represented Vodokanal Engineering.

The participants in the workshop represented a cross section of backgrounds and responsibilities. Among these experts were engineers, biologists, chemists, technical and administrative specialists. Their responsibilities included regulatory policy and enforcement, technical troubleshooting, laboratory operation, as well as plant design, management, operation and maintenance.

This diversity of skills added to the dynamics of the workshop. While there were "spirited" discussions during the group exercises, the net result was that potential WWTP performance problems were collectively identified, prioritized, and evaluated from a variety of perspectives. This successful collaboration reinforced the participants' awareness of the need to involve experts from many different backgrounds to produce a "comprehensive" plant evaluation.

4.2 Achievements

Training goals accomplished:

The overall goal of training individuals to conduct a comprehensive performance evaluation was accomplished. Twelve individuals were trained to conduct CPEs at wastewater treatment plants. They demonstrated their abilities to the training team during the exercise at Veliko Tarnovo when they assumed the leadership role in conducting the CPE.

CPEs and action plans (for completion) prepared along with action plan:

CPEs were developed for the Gabrovo WWTP and the Veliko Tarnovo WWTP. Information about the CPEs is included in Chapter 5. An action plan to complete the CPEs at both plants was agreed upon by representatives of MoE.

Institutional relations strengthened:

Prior to this workshop the participants had little or no opportunity to work as a team or interact with the other individuals who shared an interest in improving WWTP performance. This workshop provided the course participants with new technical skills, an experience of the value of teamwork in problem solving, and an increased appreciation for other people's responsibilities.

Reference materials provided to MoE and WWTPs:

Textbooks and guidance manuals were provided to the MoE, Gabrovo WWTP, and Veliko Tamovo WWTP for reference. These materials cover inspection, operations, maintenance, and troubleshooting of wastewater facilities.

Institutionalized CPE methodology for Bulgaria:

The MoE will implement the CPE approach as a standard procedure for conducting performance evaluations of wastewater plants in Bulgaria.

Training workshop field tested:

During the training, an ongoing evaluation was carried out. Observations and recommendations for improvements to the program were made. This information is presented in the working paper that accompanies this report.

4.3 Key Decisions and Support

Achieving this task would not have been possible were it not for several key decisions made during the workshop, as well as for the support provided by many individuals. The following is a summary of the key decisions and support:

Key Decisions:

The adequacy of translations was vital to the success of the program. Translators were needed for the course material (textbooks, handouts, flip charts and overheads) and the in-class presentations. At the beginning of the workshop in Gabrovo, one of the two translators had to be replaced because of poor performance.

During the workshops, decisions were made about time allotments and implementation strategies for specific modules. The varied reasons for these decisions involved logistical changes, make-up of the groups, physical facilities available at the plant, and time actually required for completion of a module. The training team collectively discussed and agreed upon all changes. All decisions that resulted in a modification to the syllabus are presented in the working paper.

Support:

Logistics were arranged prior to the course by MoE and the Yantra River Inspectorate. Transportation, meals, and training facilities were provided by the Gabrovo WWTP and Veliko Tarnovo WWTP. Transportation between cities, hotel arrangements, and translations were arranged by WaterEngineering, Ltd., who served as the local contractor to WASH. The most significant support was provided by the individual course participants, who actively and enthusiastically took part in all aspects of this training exercise.

4.4 Presentation Delivery - Time Required

Specific recommendations regarding time allotted to each module are included in the working paper which accompanies this report. In general, the delivery of presentations went according to design with the exception of Gabrovo modules III.D (Evaluation of Performance Limiting Factors) and III.C (Performance Evaluation). Because of the amount of group discussion, which was essential to achieve the learning objectives, these modules required more time than was originally planned. This schedule change required a decrease in the delivery time for the modules that followed III.D and III.E. Also, because of transportation problems for most of the course participants, the Friday session in Gabrovo had to be shortened by three hours. Reading was assigned to cover the material that was not presented in class.

In order to overcome the minor difficulties experienced in Gabrovo, the agenda was adjusted for the Veliko Tarnovo workshop and transportation was arranged by all participants to allow seven hours of training on the final day.

Overall, the time was sufficient to achieve the goals of the training; however as discussed previously, the actual CPE yielded only preliminary results. If training and a complete audit are to be the goals of a future task, more time will be required. Recommendations regarding this issue can be found in section 5.3.1 of this report and in the working paper.

4.5 Summary of Evaluations by Participants

At the conclusion of the workshop an evaluation form (Appendix D) was provided to each participant. Three of the twelve participants attended only the session in Gabrovo and therefore were unable to complete an evaluation. Appendix D contains a summary of the participant evaluations, showing the number of participants answering in each category and indicating to what degree the workshop succeeded in improving their ability to perform a WWTP audit.

Although the participants found most of the aspects of the training to be useful, some regretted the inadequate time for the interpretation and evaluation of the audit results and the repetitive explanations of detailed data gathering. A general need for more time and more group activities was expressed.

4.6 Agreements Concerning Follow-up CPE Activities

Discussions were held with the MoE personnel during the training, and it was agreed that they would complete the audits at the two plants. However, because of the very busy schedules at the ministry, a formal request would be made to the Deputy Minister to give priority to completing the audits.

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

5.1.1 Training

The most significant conclusion is that the training workshop was a success. The general strategy—using plant #1 for introducing the CPE approach and guiding the class through a CPE and then plant #2 for having the class assume the leadership role in the CPE—worked out extremely well. This approach allowed the training team to evaluate and refine the procedures employed by the workshop participants. Bulgaria now has twelve individuals who are capable of conducting a CPE using the "team" approach. They also possess the support materials (guidance and troubleshooting manuals) that can be used to maintain uniformity in the audit as well as to encourage institutionalization of the CPE procedure.

The time available for preparation and delivery in Bulgaria was a limiting factor. The preparatory tasks, prior to delivery of the training workshop, and the workshop content itself are in need of refining and polishing, based on the results of this field test.

5.1.2 Audit

It was very useful to have an actual plant with actual problems to use as an example in the training. However, the participants' close connection to the plants and the existence of very complex process problems sometimes diverted attention from the evaluation methodology.

The results of the audits are in separate documents and may be requested from the Environmental Health Project. Please reference this field report in your request.

5.2 Problems Identified

5.2.1 Training

The problems encountered were related to time available for in-country preparation and for delivery of each CPE module. Although the learning objectives were achieved, the time restrictions cut down on the detail of some presentations and limited the completeness of the actual CPE.

5.3 Recommendations

5.3.1 Training

The CPE training program, that has now been field tested in Bulgaria, should be revised and developed into a formal training program to implement in other countries. A working paper has been prepared that describes in detail the observations made during field testing and recommendations for improvements. The working paper should be used as a guide for revising the training program.

During this task the training team observed the need for O&M-related training and the desire for such knowledge among the WWTP staff members. Unfortunately there is very little training available for O&M personnel in Bulgaria, and there is no institutionalized operator training program. Many problems that were identified during the CPEs at Gabrovo and Veliko Tarnovo could be reduced through good process control programs. Skill development for O&M staff personnel in Bulgaria would have a substantial impact on WWTP performance. Such skill development could include the following assistance from USAID:

- Encouragement of the Bulgarian MoE to support training of WWTP O&M staff.
- Assistance with the development of a national operator training program.
- Conducting a "training-of-trainers" course for selected Bulgarians who have strong technical skills and experience in WWTP O&M.
- Providing packaged training programs and reference materials for development and delivery of operator training.
- Promoting the implementation of an operator certification program and networking by operators through professional associations.

5.3.2 Audit

The evaluation of an actual WWTP is very useful and should be incorporated in future training programs. More time should be allotted to assure that a complete audit and report are completed as a part of the training. The instructors should perform a preliminary visit and audit on the plant before the participants arrive. This initial audit would allow the trainers a chance to identify good examples as well as possible pitfalls. In addition, the instructors should continually evaluate and direct discussions to avoid useless arguments.

Appendix A

SCOPE OF WORK

Bulgaria: Operations and Maintenance Audit Training

Background

The town of Gabrovo is located on the upper reaches of the Yantra river in Bulgaria. The population is approximately 80,000 with 51% served with sewerage. Gabrovo has a municipal wastewater treatment plant (WWTP) incorporating an activated sludge process. Over 30% of the wastewater flow and a very large portion of the organic loading to the treatment plant is from industries. The major industrial dischargers include tanning, food processing, textiles, and metal finishing. USAID is currently funding an equipment replacement project at the municipal WWTP to make it more reliable and energy efficient. However, additional improvements in operation and maintenance (O&M) are needed in order to improve the performance and increase the reliability. This in turn will reduce pollution to the Yantra river. These improvements can be realized by evaluating the current O&M practices at the municipal WWTP and the industrial wastewater pretreatment plants in conjunction with waste minimization at the industries.

Veliko Tarnovo is located downstream from Gabrovo. The population of Veliko Tarnovo is near 70,000 with 93 percent sewerage coverage. There is a municipal WWTP utilizing an activated sludge process; however, a large portion of the raw wastewater is bypassed around the plant and into the river without treatment. A very small portion of the wastewater flow comes from industry. Improvements to the sludge handling train are currently being funded by USAID. These changes will allow use of the plant at full capacity and eliminate the need to bypass some of the flow. Additional improvements in O&M are needed to assure the effectiveness of the changes in progress. These changes will drastically reduce the flow of untreated sewage to the Yantra river.

The purpose of this task is to train Ministry of Environment personnel in methods for the evaluation of operation and maintenance practices at municipal WWTPs and to undertake O&M audits at the towns of Gabrovo and Veliko Tarnovo. The work in Gabrovo will include the evaluation of the need for an industrial wastewater pretreatment program. In addition a prototype training protocol for carrying out audits will be developed for potential use in Eastern Europe. Wastewater treatment plants of this type are common in Central and Eastern Europe and the NIS countries; therefore, there is a potential for future use of this training protocol.

Objectives

The objectives of this task include:

- 1) training of MoE personnel to perform audits of municipal WWTPs including industrial pretreatment facilities;
- 2) O&M audits of two municipal WWTPs;
- 3) development of a prototype audit training program;
- 4) recommendations for municipal WWTP process control and rehabilitation projects which may be funded locally.

Tasks

1. O&M specialist and trainer will review background material.
2. O&M specialist and trainer will draft prototype training program for audits.
3. O&M specialist and trainer will participate in a team planning meeting at the WASH operations center.
4. O&M specialist and trainer will travel to Bulgaria and finalize the training design and conduct the training and detailed O&M audit in Gabrovo with 5 to 10 trainees from the national Ministry of Environment and the local inspectorate. The audit will be divided into sections with instruction and discussion of each section followed by on-the-job training at the Gabrovo plant. The training and audit will include an evaluation of existing industrial wastewater pretreatment and the need for waste minimization activities. Activities involved in the audit will include:
 - a) review of reports, operating data, and as-built drawings and plans;
 - b) discussions with design, operation, and regulatory personnel to define characteristics and identify problems with plant operation; and
 - c) visit to the WWTP to examine the facilities and observe operation and maintenance schedules and implementation techniques;
 - d) visit to industries to evaluate pretreatment facilities; and
 - e) on-the-job training for the Bulgarian trainees;
5. The Bulgarian trainees, with assistance from the WASH consultants, will develop an audit work plan and perform the audit for Veliko Tarnovo.
6. The WASH consultants and trainees will debrief MoE and USAID/Sofia staff.
7. Based on the above tasks, the O&M specialist and trainer will prepare: (1) a Field Report including a brief summary of the activities performed in the task and the resulting observations and conclusions. The summary should include a discussion of

benefits that can be obtained through changes in O&M practices. Low cost rehabilitation expenditures that could be funded by the municipalities should also be described. (2) a draft of a prototype Training Program.

Team Leader

An integral part of the training team will be a team leader with the following responsibilities:

1. Liaison/introduction of other team members to national and municipal government as well as local USAID officials.
2. Coordinate all administrative and logistics activities with government and a local subcontractor, including facilities, materials and equipment.
3. Supervise interpreters; assure payment for interpreters and local subcontractors.
4. Provide technical and training back-up to O&M auditors.
5. Assure consistency with the overall WASH program in Bulgaria.
6. Review final product.

Personnel

The consultants for this activity will be:

- a WWTP O&M specialist
- a training specialist with background in wastewater treatment plant operations, maintenance, and training program development.
- a team leader with recent experience in Gabrovo and Veliko Tarnovo, and full knowledge of the complete program of activities being undertaken by WASH in the region.

A local firm will provide a qualified Bulgarian interpreter who is experienced in environmental engineering or science. Document translation and reproduction services will also be required, as will transportation and training facilities.

Deliverables

1. A Field Report as outlined in task 7 above.
2. A prototype training program for conducting audits.

Level of Effort

O&M specialist	30 days
training specialist	30 days
local engineer/interpreter	24 days
team leader	15 days

Work Plan

Proposed Dates

team planning meeting	4 May to 5 May
develop training materials	6 May to 12 May
consultants to Bulgaria	13 May
training and Gabrovo audit	16 May to 20 May
Veliko Tarnovo audit	23 May to 27 May
report writing	30 May to 3 June

Appendix B

PARTICIPANT LIST

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Appendix C

WORKSHOP NORMS

Improving Treatment Plant Performance is the Goal

- **Sharing responsibility for learning**
- **Participating actively in all session activities**
- **Starting and ending sessions on time**
- **Respecting the view/positions of other participants**
- **Helping one another**
- **Asking questions as they arise**
- **No smoking in the classroom**
- **DO NOT TOUCH ANY OF THE PLANT EQUIPMENT**

Appendix D

PARTICIPANT EVALUATION FORM

Workshop Evaluation Form and Results

Part 1: Goal Attainment

1. Identify the importance of the different aspects of a WWTP audit (i.e., general, administrative, design, operations, maintenance and performance).

0	0	0	9
Very little	Somewhat	Well	Very well

2. Determine the purpose of an audit.

0	0	2	7
Very little	Somewhat	Very well	Well

3. Collect information on each aspect of an audit.

0	0	2	7
Very little	Somewhat	Well	Very well

4. Analyze information to determine the performance-limiting factors.

0	0	4	5
Very little	Somewhat	Well	Very Well

5. Select appropriate values in weighing the performance evaluation.

0	1	5	3
Very Little	Somewhat	Well	Very Well

6. Develop an action plan to carry out an audit.

0	2	4	3
Very Little	Somewhat	Well	Very Well

7. Use data collecting methods.

0	1	2	6
Very Little	Somewhat	Well	Very Well

8. Prepare for a successful audit program based on procedures learned in the workshop.

0	1	3	5
Very Little	Somewhat	Well	Very Well

9. Develop a presentation to report results of a WWTP audit.

0	1	4	4
Very Little	Somewhat	Well	Very Well

These results indicate a generally successful training. The areas that seem to need improvement are:

- the determination and especially the ranking of performance-limiting factors (questions 4 and 5);
- general planning of audits (questions 6 and 8);
- use of data collection methods (question 7);
- reporting of results (question 9).

The second part of the evaluation form asked for a narrative answer to the following questions:

RESULTS OF THE PARTICIPANT EVALUATION

PART II: Success Analysis of the Workshop

1. Which workshop goals most closely met your learning needs?

- The methodology; the data collection; the maintenance; the inspection of the facilities; finding the weak points and their reasons for their existence; evaluation of the project's sections; the exercises to determine factors according to importance.
- Classification of the factors limiting the work; the evaluation of the collected data, and presentation of administrative decisions.
- The determination and classification of the factors limiting the plant for waste water treatment exploitation.
- The improvement of the plant's operation, methodology for annual output evaluation for waste water equipment.
- Defining the inefficient processes of the various parts of the plant for waste water treatment as a result of the design specifications, implementation and maintenance of the system.
- Becoming acquainted with the detailed methodology for evaluation.
- Determination of inefficient processes in various parts of the plant; determination and classification of factors in relation to their importance being connected with administration, use and maintenance; recommendations.
- This is a new methodology we got acquainted with for the first time. All issues in the discussion are relevant to our needs.

2. What was the most helpful aspect of the workshop structure?

- Everything mentioned above: the methodology, the exercises, the report, and the evaluation.
- The entire methodology of the process evaluation and the systematizing of the evaluation results.
- Accomplishing knowledge for profound analysis regarding productivity.
- Evaluation of the equipment's operations.
- The team work and discussions; the data collection system; the way they are systematized; the process evaluation.

- Everything was helpful.
- The classification of the plant's operation information and being absolutely objective in evaluation. The information is directly dependent on the plant's real operation.
- The way redundant operation factors were classified and the recommendations which make their elimination possible. The implementation of a methodology which is applicable for any waste water equipment.
- A pragmatic program.

3. What did the trainers do that was most helpful for you?

- The terminology explanations and the way the audience becomes aware to what extent reasons are subjective or objective. The assistance in shaping the team's opinions and orientations.
- The lectures were given in a systematic way and with a certain directness. They indicate the lecturer's professional background and experience in those evaluations.
- With a systematic approach in an easily understandable format they presented the methodology for the accomplishment of CPE and CPP.
- The way the sessions were organized and conducted.
- The efforts they put in explaining the methodology.
- I was given the chance in a transparent and simple way to realize the restricting factors and the ability to differentiate them and to determine the reasons (administrative, operational etc.) for their emergence.
- The efforts to overcome some essential differences in the way the methodology is applied. The real state of the plants under evaluation.
 - We were presented with a brief and exact methodology for evaluation of the Waste Water Equipment;
 - We were given the opportunity and therefore, we asked if some of the restricting factors could be determined. Some factors for some unknown reason have been neglected;
 - We were given directions being asked at the same time to find them ourselves and the ways we can eliminate or at least limit the restricting factors.
 - The work was constructive.
- The lecturers were giving presentations that could easily be visualized. When asked questions they gave detailed answers. They attempted to become participants in solving our quite complex problems.

4. What problems arose that were overcome well in your opinion?

- All problems. Restricting factors are evaluated at the end and recommendations concerning those factors and designing operations are made.
- All problems in relation to the final report's edition and the preparation of the operation plans.
- Problems concerning the sediment.
- The problem of the biological basins and the drying fields.
 - The data collection.
 - The determination of all restriction factors in relation to the plant operations.
- All problems have been solved with the assistance of the lecturers.
- Working teams formation. The maximum usage of the participants individual capabilities.
- It is my opinion that the best solutions available were recommended. What is left to do is to implement these in practice.
- The most crucial problems of both plants. It is a pity at the moment everything is just on paper! The key issue is financing!

5. Which workshop goals did not meet your learning needs? Which learning needs were not met by the workshop?

- All goals respond to my needs.
- The systematics and the logistics of the process themselves are of great importance for every phase of the analytical process. Perhaps we could have used more time for the evaluation and the interpretation of the established results.
- The numerous and frequently repeated explanations in relation to data collection. However, I did not fully comprehend how this training is conducted in the United States.
- All needs were met.
- The results delivered from the UAP to the Ministry of Environment to the waste water treatment plant (an instruction manual). I would like to learn more about the technologic control and the way documentation is kept about the waste water equipment.

6. What part of the workshop structure was least helpful to you? Why? How could it be improved?

- There was no such part.
- I will mention it again that we lost a lot of time for data collection. To me their interpretation is more important and their usage in the future goals formation and the working out of the preparation plans.
- All parts of the seminar were useful enough.
- The interface was limited strictly to the plants chief manager. I did not have the foggiest idea what a person from the laboratory thinks as well as the power engineer and/or the operators. The list for contacts should be a longer one.
- The time for rethinking the material is not adequate. A longer term and smaller amount of material per day are desirable.
- Everything was helpful.
- A more precise preliminary selection of the investigated plants is recommended. The total opportunities of the methodology will be manifested when all water and sediment facilities are in operation.
- There was no such part.
- The structure is good, but the time for its realization is not enough. It could be two days longer.

7. What did the trainers do that was least helpful to you? Why? How could it be improved?

- Everything was helpful.
- Everything was helpful. Everything about the lectures had a good preparation and was well scheduled.
- Everything was helpful.
- I think that there is a need for the seminar system to be improved.
- All their activities to a lesser or greater extent were helpful. I cannot give a full account of their work, simply because I do not have them.
- Everything was helpful.
- Everything was helpful! We got acquainted with a new methodology and we now comprehend it the way it was presented. When we adopt it to our condition, or to be exact - when we apply it - we will understand whether it has any shortcomings.

8. What other suggestions would you care to make to improve this workshop?

- More time for contacts between the groups, so the experience accomplished during the group training sessions can be shared.
- During the first week when we were attending the lectures the time was too limited for us to conduct the exercises. This created certain tension and confusion.
- More information about the operation processes control.
- Improvement in the interactions between the lecturer and the audience is necessary.
 - More time is needed.
 - Elaborations of the final report.
- The number of practical training exercises must be increased. And they should be done in more detail. Perhaps more time for learning is required.
- I would give the seminar an excellent mark, but if possible more should be incorporated into the schedule.

9. Other comments:

- I consider the seminar very helpful. I also consider it a good training exercise. All this makes me think about the real work ahead when elaborating on a real evaluation and the time it will take. The same concerns are shared by the people and the team which would have to accomplish all that.
- Just my gratitude to EPA and to the lecturers for their efforts in the Republic of Bulgaria.
- We would like to have specific instructions for laboratory work and the way processes can be controlled in practice.