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TRAINING IN WATER AND WASTEWATER OPERATION AND MAINTENANCE: SOURCES OF TRAINING MATERIALS

WASH FIELD REPORT NO. 118

MARCH 1984

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TRAINING IN WATER AND WASTEWATER
OPERATION AND MAINTENANCE:
SOURCES OF TRAINING MATERIALS

Prepared for Near East Bureau
Agency for International Development
Under OTD 160

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Chapter 1

INTRODUCTION

1.1 Background: Efforts Leading to this Study

The Near East Bureau in the Agency for International Development (AID) requested the Water and Sanitation for Health Project (WASH) to study the organizations and institutions that offer training and educational programs in the water supply and wastewater treatment sector to determine which organizations and institutions could provide the most effective educational services to participants from Near Eastern countries. The results of that study are published under the title "Training in Water and Wastewater, Institutional Programs: Long-Term, Short-Term and Study Tours" (WASH Field Report No. 117). This is a parallel effort to identify sources of relevant written training materials. It is designed to complement the "Training Programs" effort (but may be used independently). This handbook is designed primarily for use by training officers, human resource development officers, and persons with responsibility for managing or conducting on-site training programs in water and wastewater operations and maintenance.

1.2 Scope of Study

This study of training materials deals only with water and wastewater operations and maintenance. Only those materials that fall under the definition of training materials were considered. This definition is described below under 1.3. As in the "Training Programs" document this study focuses on urban water and wastewater training needs.

Due to resource limitations and the turnover in training materials, this study is limited to identification of sources or publishers of training materials. Each source can provide up-dated catalogues and descriptions of materials. The sources do not include listings for system design, finance, and management. These areas are usually provided by universities as traditional programs in the water and wastewater field, although there are other institutions which provide such materials. As such, "training materials" (as defined by this study) do not exist in these areas.

The sources of this study are not exhaustive. Undoubtedly, other sources of high quality training materials in the water/wastewater sector exist. The list of sources in this document is intended as a starting point that will be added to in the future.

1.3 Definition of Training Materials

Training materials, as defined in this study, are those written materials which provide a description of learning activities and guidelines for performing them. In this instance, they consist of prescribed information and skill areas within the water supply and wastewater treatment field. Examples of such materials are:

Course Outlines. These are detailed guidelines for trainers/instructors that include learning objectives, technical content, learning activities for trainees, listings of instructional resources (textbooks films, slides, job aids, and other printed materials), and methods of evaluating the learning.

Trainer Manuals. Manuals include all the guidelines and materials necessary for a trainer/instructor to deliver a course, workshop, or training session on a particular topic. Generally included in a trainer manual are:

- o course objectives
- o course delivery guidelines which contain detailed instructions for the trainer on what to present to the student and how
- o student learning activities
- o instructional aids, usually printed materials
- o evaluation methods.

Trainer manuals usually contain all the written resources an instructor needs to conduct an entire course.

Trainer Modules. This term is used to describe the guidelines and materials that a trainer/instructor requires to deliver a training session on a particular topic. Included are:

- o objectives
- o specific directions for the trainer on what to present and how
- o student learning activities
- o instructional aids
- o evaluation methods.

Training modules contain the same things as a trainer manual. However modules are usually shorter than manuals. While a manual is for an entire course, a module might be for a specific topic within that

activities and guidelines for performing them. In this instance, they consist of prescribed information and skill areas within the water supply and wastewater treatment field. Examples of such materials are:

Course Outlines. These are detailed guidelines for trainers/instructors that include learning objectives, technical content, learning activities for trainees, listings of instructional resources (textbooks films, slides, job aids, and other printed materials), and methods of evaluating the learning.

Trainer Manuals. Manuals include all the guidelines and materials necessary for a trainer/instructor to deliver a course, workshop, or training session on a particular topic. Generally included in a trainer manual are:

- o course objectives
- o course delivery guidelines which contain detailed instructions for the trainer on what to present to the student and how
- o student learning activities
- o instructional aids, usually printed materials
- o evaluation methods.

Trainer manuals usually contain all the written resources an instructor needs to conduct an entire course.

Trainer Modules. This term is used to describe the guidelines and materials that a trainer/instructor requires to deliver a training session on a particular topic. Included are:

- o objectives
- o specific directions for the trainer on what to present and how
- o student learning activities
- o instructional aids
- o evaluation methods.

Training modules contain the same things as a trainer manual. However modules are usually shorter than manuals. While a manual is for an entire course, a module might be for a specific topic within that

course. A manual is usually composed of a series of modules.

Correspondence Courses. These are detailed guidelines for the student to use in learning certain specified information and skills. Courses include:

- o learning objectives
- o technical content
- o student learning activities
- o learning aids
- o methods of evaluation.

Materials Not Included

In general, training materials which provide instructional guidelines such as learning objectives, trainer instructions on what to present and how, and methods of evaluation are included. Materials of an informational nature, such as text books or reference manuals, are not included in this presentation. Nor are those materials which must be produced on site included, such as pamphlets, job aids, slides, or drawings.

1.4 Job Functions Approach

In the companion study on training institutions, the reference system used for identifying training resources was based upon a "job functions approach." This approach identified the skills and knowledge required to plan, design, build, operate and maintain both water and wastewater facilities. The operations and maintenance functional definitions from this effort are reproduced in this document in complete form in Appendix A. A summary of these is provided at the beginning of Chapter 2 and recapitulated (as an indexing device) next to the listing of the corresponding source of training materials.

1.5 Research Methodology

A survey was conducted with selected sector experts and experienced AID staff to identify sources and publishers whose training materials were considered to be among the best. Another valuable source for training materials was the work done in 1979 by the Joint Training Coordinating Committee of the American Water Works Association, Association of Boards of Certification, Federation of

Associations on the Canadian Environment, and the Water Pollution Control Federation*.

Identified sources of training materials were surveyed and contacted by phone. For many sources, in addition to telephone interviews, copies of their training materials were obtained and evaluated. The following criteria were used in the evaluation process:

- o Technical content: Did the materials provide suitable, detailed technical instructions and presentation? Was the technical presentation clear and correct?
- o Training objectives: Did the materials list training objectives which were clear and specific?
- o Practical approach: Did the training design incorporate an appropriate mix of theory and practice, including applied exercises and instructions for "hands-on" practice (as opposed to a preponderance of lecture material)?
- o Adaptability: Could the training materials be easily adapted for use in development projects?
- o Evaluation: Did the training materials include an evaluation component?

Organizations which provide materials that meet the above criteria and fall within the definition outlined in 1.3. above were selected. They are presented in Chapter 2 and referenced consistent with job functions.

*Water and Wastewater Training Materials Evaluation: Matrix Project Step 1 Report, March 1979. Joint Training Coordinating Committee of the American Waterworks Association, Association of Boards of Certification, Federation of Associations on the Canadian Environment and Water Pollution Control Federation.

Chapter 2

SOURCES OF TRAINING MATERIALS

The sources listed in this chapter have produced materials which meet the criteria defined in 1.5 above and are recommended by this study.

2.1 Job Functions Summary: Operations and Maintenance

The sources of training materials in this document are referenced by three separate functional areas within the overall job requirements for operations and maintenance. These functional areas comprise the technical, financial, and managerial requirements for both water and wastewater systems in operations and maintenance (for a detailed analysis, see Appendices A and B). These job functions are summarized as follows:

- o Technical: For each component of a water or wastewater system the operator is required to perform normal and abnormal operational procedures, preventive and corrective maintenance, and laboratory and system control procedures.
- o Economic/Financial: Prepare annual budgets, recommend financing for improvements and expansion, and manage day-to-day financial activities.
- o Management: Recruit O&M staff, manage resources and train staff, manage all day-to-day O&M activities, project future needs, and maintain operational ability of the plant.

2.2 Sources of Training Materials: Use of Indexing System

The following is a tabular presentation of the sources of training materials indexed by the above listed job functions under water and wastewater systems operation and maintenance. To use the indexing system, first locate the job function required in the left column. In the column on the right is a list of sources. Then refer to the Index of Sources (section 2.3, pp. 10 through 12) to locate the types of materials provided and details for ordering.

RECOMMENDED TRAINING MATERIAL SOURCES

| JOB FUNCTIONS | TRAINING MATERIAL SOURCES |
|--|--|
| <u>Water System Operation and Maintenance</u> | |
| A. <u>Technical</u> : For each process perform normal and abnormal operation procedures, preventive and corrective maintenance procedures, and laboratory and system control procedures. | California State University Linn-Benton Community College International Reference Center for Community Water Supply and Sanitation Industrial Training Corporation Environmental Protection Agency Instructional Resource Center Federated Association on Canadian Environment American Water Works Association West Virginia Vocational Curriculum Laboratory |

RECOMMENDED TRAINING MATERIAL SOURCES

JOB FUNCTIONS

TRAINING MATERIAL SOURCES

Operation and Maintenance

B. Financial: Prepare annual budgets, recommend financing for improvements and expansion, manage day-to-day financial activities.

Michigan State University - Executive Programs

C. Management: Recruit O&M staff, manage resources, prepare periodic reports, manage all O&M day-to-day activities, project future needs and maintain operational ability of plant.

Michigan State University - Executive Programs

RECOMMENDED TRAINING MATERIAL SOURCES

| JOB FUNCTIONS | TRAINING MATERIAL SOURCES |
|--|--|
| <u>Wastewater System Operation and Maintenance</u> | |
| A. <u>Technical</u> : For each process perform normal and abnormal operation procedures, preventive and corrective maintenance procedures, and laboratory and system control procedures. | Water Pollution Control Federation Environmental Protection Agency Instructional Resources Center Industrial Training Corporation International Reference Center for Community Water Supply and Sanitation Linn-Benton Community College California State University - Sacramento |

RECOMMENDED TRAINING MATERIAL SOURCES

JOB FUNCTIONS

TRAINING MATERIAL SOURCES

Operation and Maintenance

- B. Financial: Prepare annual budgets, recommend financing for improvements and expansion, manage day-to-day financial activities. Michigan State University - Executive Programs
- C. Management: Recruit O&M staff, manage resources, prepare periodic reports, manage all O&M day-to-day activities, project future needs and maintain operational ability of plant. Michigan State University - Executive Programs

2.3 Index to Sources: Address and Contact Person

Following is a list of the sources identified in the previous chart. Addresses, names and phone numbers of contact persons are provided. A brief indication of the types of material available is given.

American Water Works Association

6666 W. Quincy Avenue
Denver, Colorado 80235
(303) 794-7711

Contact: David Preston, Executive Director

Materials focus on the process units and process control in a water treatment plant.

Water Treatment Plant Operation

California State University - Sacramento
6000 J Street
Sacramento, California
(916) 454-6142

Contact: Ken Kerri

Materials focus on the process units and process control in a water or wastewater treatment plant.

Environmental Protection Agency

Instructional Resource Center
1200 Chambers Road, Third Floor
Columbus, Ohio 43212
(614) 422-6717

Contact: Dr. Robert Howe

A wide variety of training materials (manuals, films, audio-visuals) relating to water/wastewater operation and maintenance is available.

Federated Association on Canadian Environment (F.A.C.E.)

190 Somerset Street, West -- Suite 206
Ottawa, Ontario K2P 0J4
(613) 230-7575

Contact: David Simpson

Materials focus on process units and process control in a water treatment plant.

Industrial Training Corporation
14616 Southlawn Lane -- Box 6009
Rockville, Maryland 20850
(301) 279-2527
Contact: Monique Eidell

Materials focus on the support systems; for example, skill training in pumps, motors, pipefitting, etc., in a water/wastewater treatment plant.

International Reference Center for Community Water Supply and Sanitation
P. O. Box 5500, 2280HM
Rijswijk, Netherlands
(070) 949322
Contact: E.F. Hofkes

A wide variety of training materials in water/wastewater for developing countries is available.

Linn-Benton Community College
Water/Wastewater Technology
6500 S.W. Pacific Blvd.
Albany, Oregon 97321
(503) 928-2361
Contact: E.E. Arasmith

Materials focus on both process units and process control (i.e. sedimentation) and support systems; i.e. pumps, motors, etc., in a water/wastewater treatment plant.

Executive Programs - Michigan State University
Self-Study Coordination
Room 7, Olds Hall
East Lansing, Michigan 48824
(517) 353-8711
Contact: Linda Farrell

Materials focus on supervision and management of personnel and some financial job functions.

National Environmental Training Association
970 Millpond Road
Valparaiso, Indiana 46383
(219) 465-1744
Contact: Christine Walter

Some materials focus on support systems; i.e., skill training of pumps, motors, etc. Other materials focus on

process units and control; i.e. chlorination or sedimentation of a water/wastewater treatment plant.

Water Pollution Control Federation

2626 Pennsylvania Avenue, N.W.

Washington, D.C. 20037

(202) 337-2500

Contact: James Suddreth

Materials focus on process units and controls; i.e., aeration, or sedimentation of a wastewater treatment plant.

West Virginia Vocational Curriculum Laboratory

Cedar Rapids Conference Center

Ripley, West Virginia 25271

(304) 372-8673

Contact: Mary Sue Skeen

Some materials focus on support systems, skill training in pumps, motors; others focus on process units and controls; i.e., chlorination in a water treatment plant.

The following are sources for more information on training materials in water/wastewater:

1. Instructional Resources Information System (IRIS) is a computerized compilation of abstracts of print and non-print materials related to water quality and water resources education. IRIS contains over 7000 entries from government and non-government sources. The system is accessible through major computer networks such as Bibliographic Retrieval Services (BRS), Dialog, or CompuServe. IRIS can be computer searched for specific subjects or authors. It is also a part of the Instructional Resources Center of EPA.
2. It is expected that in 1984 the National Environmental Training Association (NETA) will have completed an updated training material evaluation similar to the one done in 1979 by the Joint Training Coordinating Committee.

Appendix A

JOB FUNCTIONS

I. WATER SYSTEM OPERATION AND MAINTENANCE

A. Technical

1. Perform all or part of the following operational, start up and shut down procedures for the water system:
 - a. Follow operating procedures for each process and support system for the water supply, treatment and distribution facilities:
 - o Recognize indicators of normal and abnormal conditions
 - o Identify causes of abnormal conditions using proper troubleshooting techniques
 - o Perform necessary corrective actions
 - o Record reasons for taking corrective actions, including the consequences of not taking action
 - o Perform necessary calculations
 - o Record necessary information
 - o Use necessary tools/test equipment/reference manuals
 - o Conform to safety procedures
 - o Identify safety hazards
 - o Explain interaction with other support systems/equipment and the total water system
 - o Relate necessary information to others
2. Perform the following preventive maintenance procedures:
 - o Follow actions in accordance with schedule
 - o Recognize when corrective maintenance is indicated
 - o Identify and locate each part of the system requiring preventive maintenance
 - o Perform preventive maintenance actions
 - o Record reasons for taking these actions, including the consequences of not taking action

- o Record necessary information
- o Use necessary tools/test equipment/reference manuals
- o Conform to safety procedures
- o Identify safety hazards
- o Explain interaction with other support systems/equipment and the total treatment process
- o Relate necessary information to others

3. Perform the following corrective maintenance procedures:

- o Locate causes of malfunction using proper troubleshooting techniques
- o Perform corrective maintenance actions
- o Record reasons for taking these actions, including the consequences of not taking action
- o Record necessary information
- o Use necessary tools/test equipment/reference manuals
- o Conform to safety procedures
- o Identify safety hazards
- o Relate necessary information to others

IV. Operations and Maintenance (continued)

B. Financial

1. Perform the following normal financial operations for plant operation and maintenance:
 - o prepare annual budgets
 - o recommend financing for capital improvements and expansion
 - o maintain normal financial day-to-day cash management
 - o maintain financial accounting system for water treatment plant(s) (i.e., accounts payable, accounts receivable, payroll records, tax records, etc.)

IV. Operations and Maintenance (continued)

C. Management

1. Recruit and select staff required to operate and maintain water treatment system.

2. Manage human resources (i.e., orienting new employees, disciplining and motivating employees, encouraging professional development among staff, etc.).
3. Organize and implement a human resources development system that will allow for training of staff.
4. Maintain stock of supplies and materials necessary for operation of water treatment system.
5. Prepare periodic reports for appropriate government and/or private organizations.
6. Maintain daily operational controls.
7. Communicate effectively with community (i.e., responding to complaints, explaining operations to citizens, promoting treatment plant image).
8. Respond to/work with appropriate ministry officials.
9. Project future needs and plan for future expansion of system.
10. Maintain treatment plant (i.e., check physical plant for worn parts, replace worn parts, recommend capital improvements, etc.).

Appendix B

JOB FUNCTIONS

I. WASTEWATER SYSTEM OPERATION AND MAINTENANCE

A. Technical

1. Perform the following for each process unit (for process units see II. A):
 - a. normal operation procedures:
 - o master routine activities
 - o demonstrate safety procedures
 - b. abnormal operation procedures:
 - o recognize and correct abnormalities
 - o demonstrate safety procedures
 - c. preventive maintenance procedures:
 - o master routine activities
 - o demonstrate safety procedures
 - d. corrective maintenance procedures:
 - o recognize and repair malfunctions
 - o demonstrate safety procedures
 - e. laboratory control procedures:
 - o conduct sampling
 - o determine appropriate analyses
 - o conduct analyses
 - o evaluate results of analyses
 - o interpret results
 - o demonstrate safety procedures
 - f. system interaction procedures:

- o identify function of process units
- o identify effects of wastes
- o identify purpose of process units
- o recognize and deal with potential crises

IV. Operations and Maintenance (continued)

B. Financial

1. Perform the following normal fiscal functions for plant operation and maintenance:
 - o prepare annual budgets
 - o recommend financing for capital improvements and expansion
 - o manage normal financial day-to-day cash transactions
 - o maintain financial accounting system for wastewater treatment plant(s) (i.e., accounts payable, accounts receivable, payroll records, tax records, etc.).

IV. Operations and Maintenance (continued)

C. Management

1. Recruit and select staff to operate and maintain the wastewater treatment system.
2. Manage human resources (i.e., orienting new employees, disciplining and motivating employees, encouraging professional development among staff, etc.).
3. Organize and implement a human resources development system that will allow for training of staff.
4. Maintain stock of supplies and materials necessary for operation of the wastewater system.
5. Prepare periodic reports for organization.
6. Maintain daily operational controls.

7. Communicate effectively with community (i.e., responding to complaints, explaining operations to citizens, promoting treatment plant image).
8. Respond to/work with appropriate ministry officials.
9. Project future needs and plan for future expansion of system.
10. Maintain treatment plant and collection system (i.e., check physical plant for worn parts, replace worn parts, recommend capital improvements, etc.).