Assistance for Implementation of

OPTRAIN

The Computer Based Training Simulator
for
Wastewater Treatment Plant Operators

Executive Summary
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Prepared for:
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Executive Office of Environmental Affairs
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At CDM, Mr. Thomas F. Cheyer was the contract officer, and Mr. Robert P. Schreiber was the project manager. Mr. David E. Schafer, who is the primary author of the OPTRAIN computer program, was the project engineer. To Mr. Schafer goes the credit for most of the work that went into producing the the Step-by-Step User's manual and the program algorithm documentation for the operator training simulator.
EXECUTIVE SUMMARY

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1.0 BACKGROUND

Training wastewater treatment facility operators is a crucial function, given their responsibility for keeping a plant operational. When a problem occurs, a decision must usually be made quickly, and a newcomer may not have the experience to feel comfortable with his or her decision. More on-the-job training is needed, but this may be accomplished only at the expense of the facility's operation.

One training method that can eliminate this risk is to simulate the workings of a plant in such a way that an operator trainee can face an actual situation, but not fear that he or she might jeopardize the operational continuity of the treatment processes. To this end, CDM developed computer software for training wastewater treatment plant operators, labeling the end product OPTRAIN, for "Operator Training Simulator." This was accomplished under Research and Demonstration Contract Number 82-22 with DWPC.

CDM delivered and installed OPTRAIN at DWPC's training section in September, 1985. A complete description of the simulator and its use is provided in the OPTRAIN User's Manual, which was delivered with the simulator. This training device, which consists of a desk-top computer and a color video input/output screen, is the first of its kind for training wastewater treatment plant operators. OPTRAIN is designed to test an operator's knowledge of conceptual processes via simulation of plant conditions.

DWPC began testing operators' skills on OPTRAIN soon after the training simulator was installed. As expected, OPTRAIN proved to be a valuable tool in the overall training process. The heavy workload of the DWPC training staff, however, did not allow them to watch each student as he or she ran the simulator. A typical training session could last a full day.

To ease this situation, DWPC asked that CDM create a step-by-step student guide, so that the DWPC instructors could get a student started and then "walk away." DWPC and CDM signed Research and Demonstration Contract Number 87-04 for this purpose. Also included in this contract was the documentation of the OPTRAIN simulation algorithms, as well as a minor amount of general consultation on the use of OPTRAIN. The remainder of this executive summary describes the work performed and the results of this "OPTRAIN Assistance" contract.
A Step-by-Step User's Guide for OPTRAIN, the wastewater treatment plant operator training simulator, was developed as a supplement to the OPTRAIN User's Manual to familiarize both experienced and inexperienced operators alike with the OPTRAIN computer simulation package. As its name implies, the OPTRAIN User's Guide provides detailed step-by-step instructions to guide users through three independent training sessions. Each session is directed at running OPTRAIN's 10 MGD activated sludge plant. The overall objective of the sessions is to provide users with the necessary skills and experience to run any or all of OPTRAIN's plants including:

- 10 MGD Conventional Activated Sludge Plant
- 10 MGD Activated Sludge with Nitrification
- 1 MGD Extended Aeration
- 1 MGD Trickling Filter
- 1 MGD Rotating Biological Contactor

The Step-by-Step User's Guide was created through close cooperation between DWPC and CDM. DWPC personnel called on their experience in training operators and performing trouble-shooting for various plants throughout the Commonwealth. DWPC personnel has also run OPTRAIN themselves, to understand how the simulator works and to "test" their own skills, and they had observed several students running OPTRAIN. Such sessions and the insight gained by DWPC into how students responded to OPTRAIN proved invaluable in writing the step-by-step manual.

CDM chose a conversation style for this guide. This works well, as evidenced by the number of large software companies who use conversations in their user's guides.

An excerpt from the OPTRAIN guide demonstrates this style, and it neatly summarizes the purpose and contents of the guide:

"Your role is to serve as OPTRAIN's chief plant operator. You are responsible for making all process control decisions during the course of a simulation session. For example, you control the distribution of both liquid and solid waste streams to various treatment units by adjusting or setting valves and pumping rates. You are also responsible for adjusting chemical feed rates and mechanical aerator speeds, running dewatering equipment, supervising laboratory work and plant scheduling.

The Step-by-Step User's Guide will assist you with the above, as well as supply you with guidance in the use of micro-computer based training software."

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3.0 OPTRAIN ALGORITHM DOCUMENTATION

The second major task in the OPTRAIN Assistance contract was to provide documentation on the simulation algorithms used in OPTRAIN. The documentation was prepared as an addendum to the OPTRAIN Users Manual.

The addendum provides DWPC instructors with detailed reference material describing how OPTRAIN simulates each treatment plant via its individual process components. The addendum includes:

- A cross reference listing of the full plants and process modules in which each process component appears.
- Design sizes and specifications for components within each plant simulated.
- Documentation on OPTRAIN's influent characteristics and simulation options.
- Process variables affected by each unit process/unit operation.
- Equations, rules, and/or efficiency curves used to perform the simulation.
- Assumptions and/or limitations associated with the simulation algorithms.

In addition, it provides the instructor with background information on how DWPC and CDM designed the algorithms to provide students with a flexible and useful training package.
4.0 GENERAL ASSISTANCE

As part of its "OPTRAIN Assistance" contract with DWPC, CDM provided general assistance in the use of OPTRAIN. Several tasks were accomplished.

CDM converted OPTRAIN from an older version of Turbo Pascal to the newest version available in the spring of this year. This allowed for more efficient OPTRAIN simulation runs.

Similarly, CDM converted OPTRAIN from a flexible-disk-based program to a faster running hard-disk-based system. CDM first converted OPTRAIN to the Bernoulli Box hard disk drive at CDM, to test the conversion on a hard disk similar to the one purchased by DWPC in 1987. Then, CDM ported the converted software, on flexible disk, to DWPC and installed it on DWPC's Bernoulli drive. Both the Turbo Pascal and flexible-to-hard-disk conversions were made at the same time.

CDM also instituted a progress reporting system in which CDM submitted a formal progress report with each quarterly invoice. These reports included a section for describing briefly the tasks that were accomplished during the quarter, as well as sections for: listing deliverables due in the next period; estimating the "percent complete" versus the amount billed; and describing any changes in personnel at CDM or at DWPC.