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A SYSTEMS ANALYSIS OF WATER QUALITY SURVEY DESIGN. APPENDIX VI.--ETC(U)

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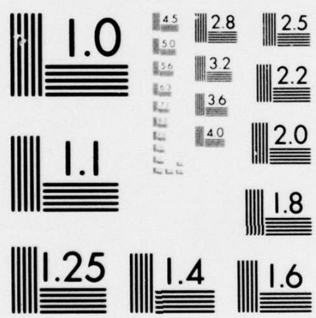


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# A SYSTEMS ANALYSIS OF WATER QUALITY SURVEY DESIGN,

~~FINAL REPORT~~

APPENDIX VI.

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# A SYSTEMS ANALYSIS OF WATER QUALITY SURVEY DESIGN

Automated Instrument Programmer's Manual
APPENDIX VI

Author: Thomas L. Drake

August 1975

Supported by

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This is the final report of a three year project titled, "A Systems Analysis of Water Quality Survey Design."

In this project a study was made of water quality surveys conducted by the United States Army Environmental Hygiene Agency (AEHA). Mainly data and reports from studies of Army Ammunition Plants (AAP) were used.

The focus of this project was the development of computer aided procedures which would assure efficient use of manpower and equipment and assure that the measurements taken give a reasonalbe representation of the system. Planning the

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) survey, conducting the survey and reporting on the survey were included in the study.

The site modeling program models the manufacturing processes which contribute pollutants to the system, models the sewer system, and models the treatment system including acid or caustic neutralization, settling ponds, and domestic treatment. The inputs to the model are the production levels of the manufacturing processes and the outputs are the predicted pollutant measurement values at each possible measure point in the system.

The resource matching program accepts data defining proposed measurements and matches these against the available time, manpower, and equipment. The output lists the pollutant to be measured at each measure point, the total commitment of time for each analyst and for each piece of equipment. Note is made of any overcommitment of manpower or equipment.

The model refinement or updating program accepts measurements taken during a preliminary survey or during a regular survey and computes suggested new parameters for the process models.

The indicator model program evaluates the performance of sanitary treatment facilities.

The program uses design data, data from the operating log and/or data generated during the survey and computes key operational characteristics. Comparing these with desirable values as cited in design books and manuals will give the survey planner insight into the operation of the system and suggest the need for more survey measurements or the need for changes in operation.

A system was developed for automatic instrumentation of pH, conductivity, and other parameters which use strip charp recordings. Interface hardware was selected and purchased and interface software was developed for direct connection to a digital computer.

A data handling system was developed for use during and after the survey. A PDP8-OS/8 and peripheral equipment was purchased. Software was developed to perform data handling functions and to direct the user in application of the software. The program accepts raw data from the analytical chemist and performs data conversions, transcriptions, and data logging functions. Output is available in several forms as may be needed for various reports during and at the end of the survey.

Recommendations are: the survey planner should obtain sufficient data in a proliminary survey to model and analyze the site; measurements should be automated to the maximum extent possible; data handling should be delegated to the computer when the operations are well defined and repetitive. The programs, software and hardware included here will assist the survey planner in following these recommendations and design a more effective survey.

## TABLE OF CONTENTS

INTRODUCTION....................................................1

FISHER SCIENTIFIC DIGITAL pH/Ion METER..........................4

YELLOW SPRINGS MODEL 33 S-C-T METER.............................6

TALOS DIGITIZER SYSTEM..........................................8

# INTRODUCTION

A Fisher Scientific Accumet Model 52Ø Digital pH/Ion meter, a Yellow Springs Model 33 S-C-T meter, a Talos 5148 graphic tables, and a Digital Equipment Corporation RTØ2-BA data entry terminal are interfaced to the data handling system via a Digital Equipment Corporation PDM-7Ø programmable data mover. Figures 1 and 2 are block diagrams showing the connections between this instrumentation, the PDM-7Ø programmable data mover, and the data handling system. The manuals, supplied with each component accurately describes the operation of this component. Each component can operate in a stand-alone mode independent of the data handling system or under the control of the data handling system.

The chapters within this manual describe the data which is transferred between this instrumentation and the PDM-7Ø. Included in each chapter is the PDM-7Ø program for transferring this instrument data via the PDM-7Ø program and the program INPUT within the data handling system.

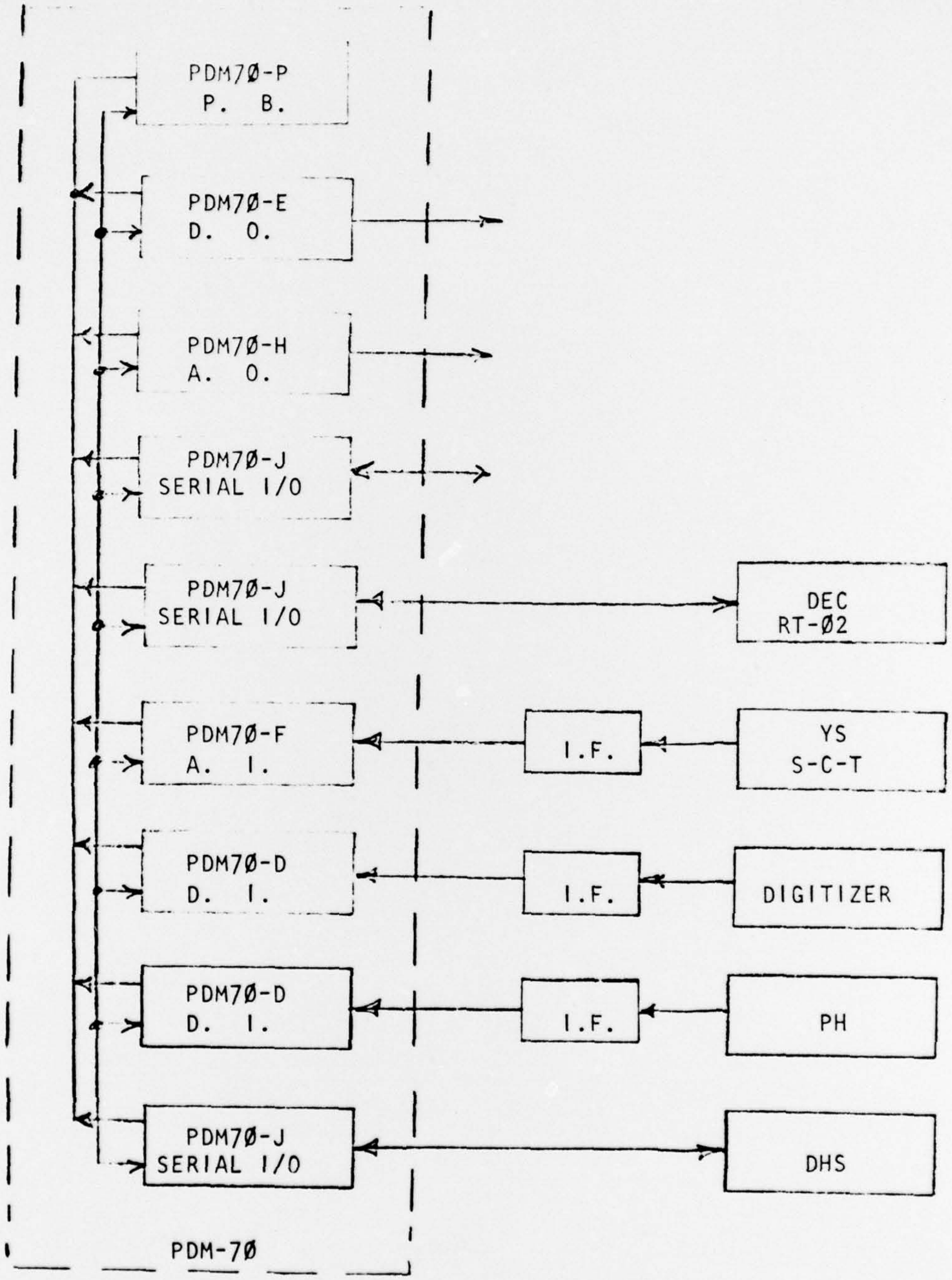


FIGURE 1 BLOCK DIAGRAM OF AUTOMATED INSTRUMENTATION

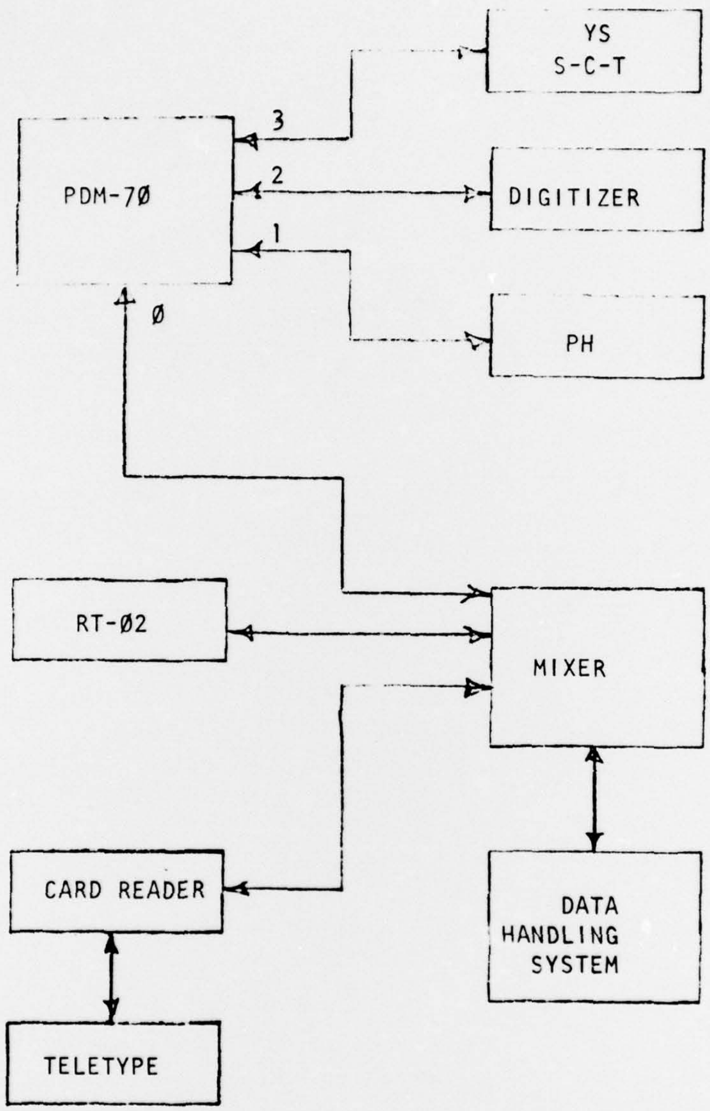


FIGURE 2 DATA HANDLING SYSTEM - AUTOMATED INSTRUMENTATION INTERCONNECTIONS

## FISHER SCIENTIFIC DIGITAL PH/ION METER

A Fisher Scientific Accumet Model 52Ø Digital pH/Ion meter is interfaced to the PDM7Ø-D 8-digit BCD input module. This interface is mounted on the back of the pH meter with a 25-foot cable connecting this interface with the PDM7Ø-D. A lighted push button on this interface will trigger the PDM7Ø-D module, when pressed, and cause the present meter reading to be transferred to the PDM7Ø-D. This interface has no effect on the operation of this pH/Ion meter.

Each meter reading consists of 5 decimal digits with these 5 digits being interfaced to the PDM7Ø-D. Therefore, a front panel meter reading of 7.452 and 12.345 will respectively be interpreted by the PDM-7Ø as Ø7452 and 12345. Note that the decimal point is dropped and 5 digits are always transferred.

The connections between the PDM7Ø-D and the pH/Ion meter are as follows:

| PDM7Ø-D | pH/Ion Meter |
|---|---|
| DØ | $1Ø^{Ø}$ Digit |
| D1 | $1Ø^{1}$ Digit |
| D2 | $1Ø^{2}$ Digit |
| D3 | $1Ø^{3}$ Digit |
| D4 | $1Ø^{4}$ Digit |
| D5 | FUNCTION |
| D6 | Unused |
| D7 | Unused |

The function code, when enabled, is coded as follows:

| D5 VALUE | FUNCTION |
|---|---|
| 1 | -MV |
| 2 | +MV |
| 4 | pH |

In addition, the value of D4 is either Ø or 1.

The PDM7ØD module for the pH/Ion meter is designated as device member 1. When used in conjunction with the program INPUT, it is operated in mode 3 with the serial interface (device Ø) as the destination of data. The PDM-7Ø program is as follows:

STX
DC1
1
SOH
3
DC2
Ø
DC3
ETX

The PDM7Ø Programmable Data Mover User's/Maintenance Manual provides complete programming details.

## YELLOW SPRINGS MODEL 33 S-C-T METER

A Yellow Springs Model 33 S-C-T meter is interfaced to the PDM7Ø-F analog input module. Channel Ø of the PDM7Ø-F received an analog signal proportional to the S-C-T meter reading. Channel 1 of the PDM7Ø-F receives an analog signal which is coded to indicate instrument function. This S-C-T meter was slightly modified internally to accomplish this interface. A lighted push button was added to this instrument to trigger the PDM7Ø-F.

An extra wafer was added to the function switch to code the switch position as an analog voltage as follows:

| Function | PDM-7Ø Measurement (approx.) |
|---|---|
| Cond. x1 | 2.Ø |
| Cond. x1Ø | 1.6 |
| Cond. x1ØØØ | 1.2 |
| Salinity | .8 |
| Temperature | .4 |
| Red Line | Ø |

The interfact within the S-C-T meter converts the meter reading to a Ø to 1.2 volt analog signal. The power for this interface is supplied by the PDM-7Ø. This interface has no effect on the operation of this S-C-T meter.

The PDM-7Ø would normally be programmed to transfer this channel Ø and channel 1 analog information to the serial interface (device Ø) as follows:

```
STX
DC1          /Transfer Channel Ø
3
SOH
4
DC2
Ø
S1
SPACE
DC3
```

```
DC1        /Transfer Channel 1
 3
SOH
 1
DC2
 Ø
SI
SPACE
DC3
ETX
```

Each time the button is pressed, this PDM-7Ø program sends 18 characters via the serial interface to the computer. A typical character string is as follows:

3ØL + Ø457␣31L + 1594␣

3 = address of module
Ø = channel Ø
L = 1.2 volt full scale
+Ø457 = .457 volt data
Space = delimeter
3 = address of module
1 = channel 1
L = 1.2 volt full scale
+1594 = 1.594 volt data
Space = delimeter

## DIGITIZER/PDM-70 OPERATION

Interface with the Talos Digitizer System is accomplished with a single 50 pin connector located at the rear of the Conversion Unit. The X, Y, Margin, and Curser Switch Code information is interfaced to a PDM70-D 8-digit input option card within the PDM-70. The signals and connector pin assignments for both the Talos Digitizer and the PDM-70 are described in their respective manuals.

The interface, fabricated by Clemson University, connects the X, Y, Margin, and Curser Switch Code information from the digitizer to the PDM70-D option card via a 25 foot multiconductor cable. Each signal from the digitizer is buffered with a bus driver before being connected to this cable so as to eliminate any cable loading effects on the digitizer. The lamp on this interface box, connected to the digitizer, is on whenever the PDM-70 is ready to receive information from the digitizer. In addition, the presence of this interface has no effect on the operation of the digitizer.

When the PDM70-D is programmed for mode 3 operation, the PDM70-D converts the 32-bits received from the digitizer for each coordinate into 8 characters. Four bits of information are coded into each ASCII character as follows:

| Information | ASCII Character |
|---|---|
| 0000 | 0 |
| 0001 | 1 |
| 0010 | 2 |
| 0011 | 3 |
| 0100 | 4 |
| 0101 | 5 |
| 0110 | 6 |
| 0111 | 7 |
| 1000 | 8 |
| 1001 | 9 |

| Information | ASCII Character |
|---|---|
| 1010 | : |
| 1011 | ; |
| 1100 | < |
| 1101 | = |
| 1110 | > |
| 1111 | ? |

The character string generated by the PDM70-D is as follows:

$$C_7\ C_6\ C_5\ C_4\ C_3\ C_2\ C_1\ C_0$$

The digitizer information is coded into this character string as follows:

$C_7 = Y_1$ + Curser Switch Code

$C_6 = Y_2$

$C_5 = Y_3$

$C_4 = Y_4$

$C_3 = X_1$ + Margin

$C_2 = X_2$

$C_1 = X_3$

$C_0 = X_4$

The ranges of the X and Y coordinates are

$$0 \leq Y_1\ Y_2\ Y_3\ Y_4 < 1400$$

$$0 \leq X_1\ X_2\ X_3\ X_4 \leq 1400$$

where

$Y_1 = 0, 1$

$Y_2 = 0, 1, 2, \ldots, 9$

$Y_3 = 0, 1, 2, \ldots, 9$

$Y_4 = 0, 1, 2, \ldots, 9$

$X_1 = 0, 1$

$X_2 = 0, 1, 2, \ldots, 9$

$X_3 = 0, 1, 2, \ldots, 9$

$X_4 = 0, 1, 2, \ldots, 9$

The character $C_7$ is coded as follows:

000 $Y_1$ = White Curser Switch + $Y_1$

010 $Y_1$ = Yellow Curser Switch + $Y_1$

100 $Y_1$ = Black Curser Switch + $Y_1$

110 $Y_1$ = Red Curser Switch + $Y_1$

110 $Y_1$ = Pen

The character $C_3$ is coded as follows:

00 M $X_1$

The M bit represents the margin bit and is 1 whenever a margin violation is present.