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APPLICATIONS OF COMPUTERIZED DIGITAL DATA ACQUISITION SYSTEMS

A Mobile Process Control Laboratory

A Solution
to a Measurement Problem for:
SHELL DEVELOPMENT COMPANY
Emeryville, California

THE APPLICATION

Shell Development Company is constantly seeking advanced techniques for obtaining optimum product yields from its petroleum refineries and chemical plants located throughout the United States.

A typical distillation column for separating products from crude oil is shown on the front page. The crude is separated into a number of products including gasoline, kerosene (jet fuel), various light and heavy gas oils such as used for fuel oils and lubricating oils, and pitch.

The column shown is a two-stage unit. The large column in the center is the main fractionating column, operating at around 50 psig. The crude is heated (in a furnace similar to the one shown on the left) to a temperature of around 650°F and fed into the main column near the bottom. There is a temperature gradient in the column with the highest temperature at the bottom and the lowest at the top. Since the different components of the crude have different boiling temperatures, they will condense out of the rising vapor at different levels onto trays. The products are then drawn off through the large pipes shown on the side of the column.

The heavy ends from the bottom of the main column are reheated in the heater to the right and fed to a smaller vacuum column (at right) operating at approximately 15 mm of mercury for further separation. Other columns (not shown) further separate the lighter products such as propane and butane.

The complete distillation process is controlled by a fully automatic system, requiring only two or three operators (who also have other duties). The function of the automatic control system is to maintain steady state conditions to obtain the desired yield proportions of the various products. Total output of a column of this size is in the order of 54,000 barrels/day.

THE MEASUREMENT PROBLEM

Prior to use of the present mobile measurement system (as described below) data were recorded at the various sites and subsequently analyzed on a computer at the Emeryville, California R&D headquarters of Shell Development Company. This led to long delays in obtaining useful new information, and also did not permit experimentation in the closed-loop mode. These factors made on-site evaluation of advanced control techniques somewhat slower and less efficient than desired. To enable on-site evaluation *Shell wanted a transportable system that could measure a number of process parameters, provide moderate data reduction, and be able to operate closed-loop control systems.*

COVER:
A Typical Two-Stage Distillation Column for Separating Products from Crude Oil.

THE SOLUTION

Shell selected the HP computerized data acquisition system shown in the block diagram to perform on-site analysis. The HP system is installed in the trailer shown in the photo, along with an analog computer and other instrumentation to form a mobile process control laboratory. An HP system was chosen because the HP 2116B Computer was easier to interface with existing Shell equipment than any competitive computer, and sophisticated I/O software was available. Also, the HP system met most of the environmental requirements for a mobile system of this nature.

SYSTEM OPERATION

The data acquisition system measures pressures, temperatures, flows, and levels, and will monitor any process variable in a plant. These parameters are sensed by transducers providing pneumatic outputs or electrical currents (typically 4-20 mA). The signals are transmitted to the trailer and there converted (through transducers or resistors) to voltage signals in the 0-10V range. The trailer is typically located from 200 to 1000 feet from the process.

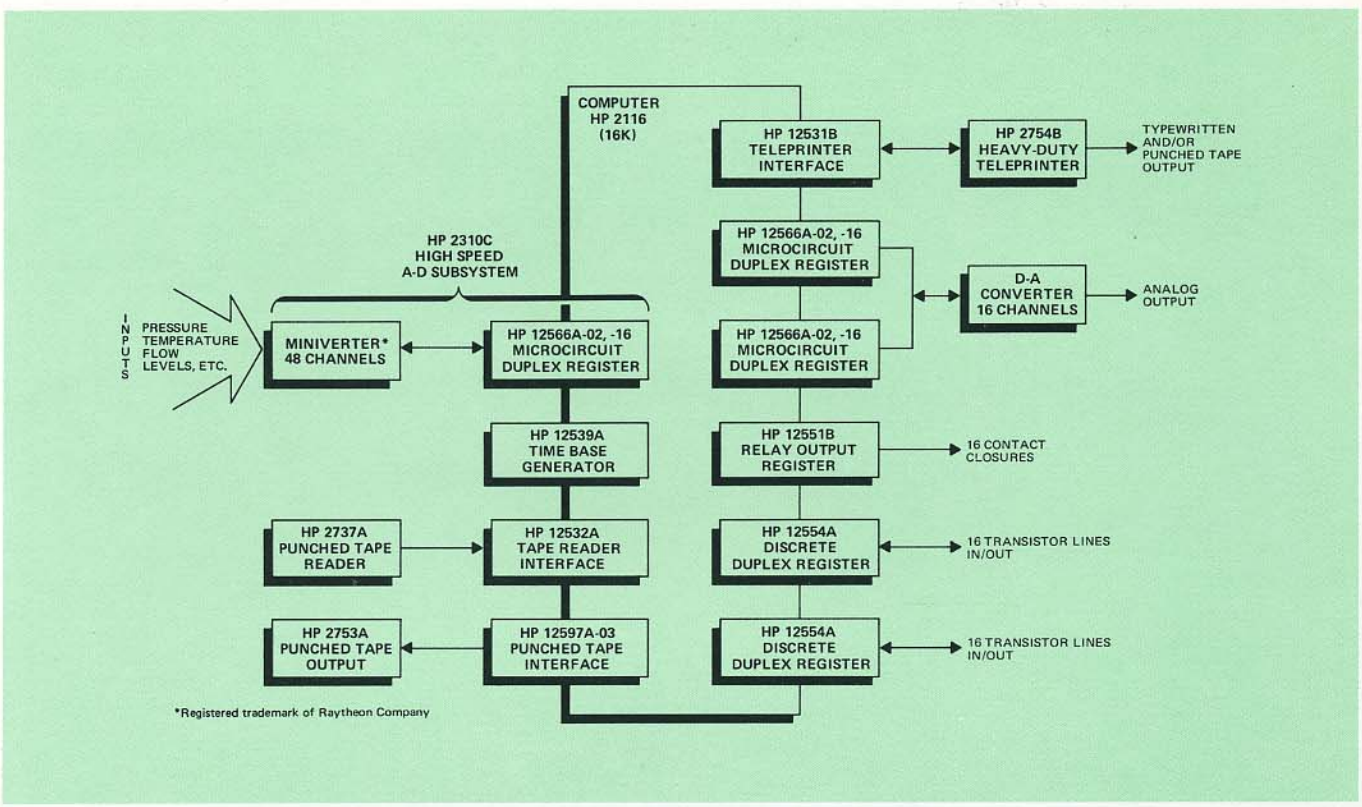
The measurements are converted to engineering units, including on-line zero offset correction and linearization as necessary, and printed out on the teleprinter in the desired format. The data may also be punched on tape for later in-depth analysis at the company's central computer.

For closed-loop operation, the system generates analog or digital signals to control process variables. The analog computer system in the trailer can be used to develop any control scheme desired, and the mobile lab can take complete control of a number of control loops.

There is now some movement in refineries and chemical plants to *continuous monitoring of all the various processes by data acquisition systems,* with real time data reduction to provide a profile of process performance. Also, multiprogramming executives may be used to schedule individual real-time data logging systems and permit in-depth analysis as required, besides batch data processing in the background, and general purpose laboratory studies.

BENEFIT OF COMPUTERIZED DATA ACQUISITION

The increased versatility offered by the HP system now allows computations and operations previously impossible. In many cases the results obtained with the mobile lab system may lead to installation of a permanent device, either digital or analog or hybrid, committed to a single control task. The incentive for this effort is mainly economic – to increase efficiency – though in some cases a reduction in pollution is a direct goal.



Computerized Data Acquisition System for On-Site Process Analysis Block Diagram

Mobile Process Control Laboratory Houses Computerized Data Acquisition System and Related Instrumentation

For more information, call your local HP Sales Office or East (201) 265-5000 • Midwest (312) 677-0400 • South (404) 436-6181
West (213) 877-1282. Or, write: Hewlett-Packard, 1501 Page Mill Road, Palo Alto, California 94303. In Europe, 1217 Meyrin-Geneva, Switzerland

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