Cahners

30 YEARS

Pollution Engineering

April 1999

The Source for Water, Air and Waste Information

Opening the Door to Efficient NO_x Removal 32

Consultants Add Non-Traditional Services to Remain Competitive 38

Control Hazardous Waste Site Operations with Interactive Telemetry 42

Visit our web-exclusive columns at www.pollutionengineering.com

Interactive Telemetry

Controls Remedial Operations at Hazardous Waste Site

Off-site control reduces operating costs and project duration.

by David A. Pass and Charles Mamane

Interactive telemetry (IT) combines hardware and software to give a user remote access to, and control of, mechanical equipment and processes. IT makes it possible to get information from field equipment, diagnose problems and operate those systems without being onsite.

Essential elements of an IT system include a programmable logic controller (PLC) connected to sensors, motor controllers or other electrical signals, a modem or Internet connection and software at the office that can communicate with the field PLC.

The project

An IT solution was selected for a chemical company that had experienced an accidental release of approximately 28,000 gallons of chloroform at a former Freon manufacturing facility. Selected remedial technologies included air sparging with 23 vertical and six horizontal wells, vacuum extraction using four horizontal wells, carbon adsorption using on-site steam regeneration and air stripping of recovered liquids with permitted discharge to a National Pollution Discharge Elimination System (NPDES) facility.

The area under remediation was surrounded by a network of five point-of-compliance (POC) monitoring wells, each equipped with chloroform sensors. If a POC well sensed chloroform above a set-point threshold, it would signal the closest air sparge wells to reduce injection pressure and flow. The air sparge systems were interlocked with the vacuum blower so if the blower were not operating, the air sparge systems would not operate. The remedial systems were designed to include a PLC that could be accessed and operated with software.

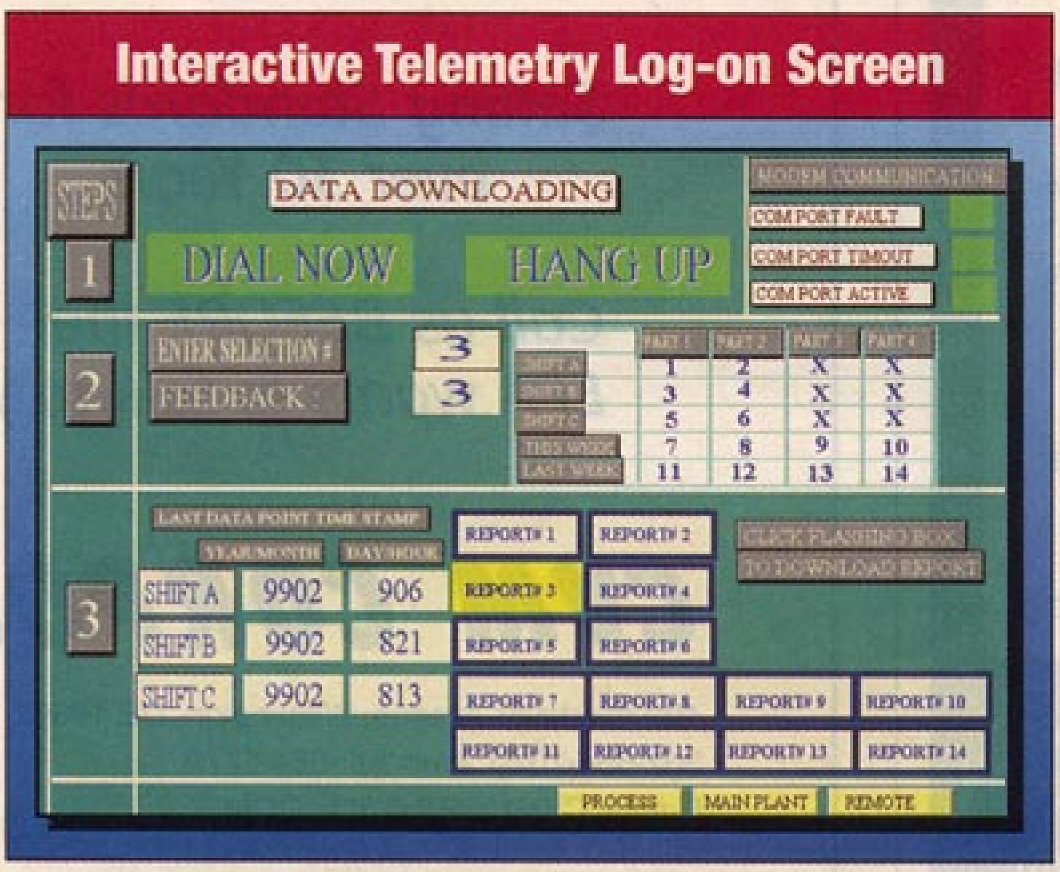

Figure 1. The log-on screen allows the operator, from a remote location, to pull up reports, print out logs and switch to other monitoring screens.

The advantages

The benefits of incorporating interactive telemetry control into the process design include:

- Providing safeguards against overpressurizing sparged air into the aquifer.
- Optimizing vacuum pressure and flow, controlling NPDES discharges, and analyzing and logging recovered vapors and fugitive emissions with an on-site gas chromatograph.
- Diagnosing mechanical failures.
- Providing remote alarming and data logging.
- Increasing operational time while reducing on-site labor costs.

The on-site PLC operates 112 digital input/output signals and 88 analog signals. Software was used to create a custom graphical interface that allows the user to interact visually with the remote operation.

Programming

The first step in implementing interactive telemetry is to develop the process logic and functions that will be controlled by the PLC for each mechanical system in the remedial operation. For the project under discussion, the PLC monitored and controlled five separate processes. These were a vacuum extraction system, a master compressor system, a groundwater treatment system, a field compressor system and a carbon adsorption system.

The logic developed was programmed into the PLC, with specific memory addresses assigned for each data point required. The graphical software then was configured to display the systems under control and the required operational capabilities. Each process point, or data field, in the graphical software was programmed to link to the correlating memory address in the PLC when connected via modem or the Internet. The software allows data to be transmitted seamlessly to spreadsheets and word processors through dynamic data exchange links.

Process graphics

The first graphical interface developed for this project was a log-on screen. See Figure 1. The screen provides graphical interactive push-buttons to dial and hang up from the remote-location PLC. A menu of data log reports is available. The user enters the number associated with the desired report into the designated field. The report button will flash yellow when the report is ready for downloading to the office computer. The user then pushes the flashing report button. This opens a spreadsheet and fills the report template cells with the updated, logged data.

Interactive Telemetry Log-on Screen

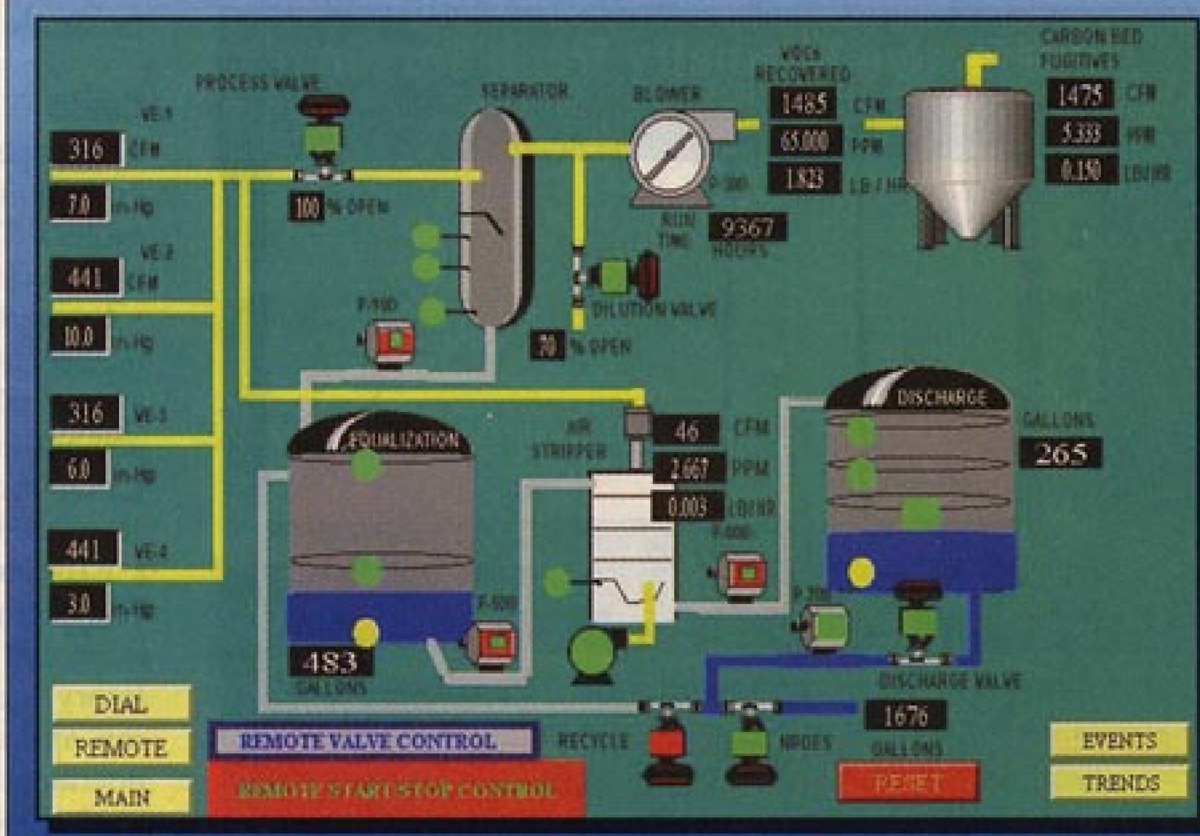

Figure 2. The process-control screen shows a graphical interface of real-time operations in the field.

The process screen, shown in Figure 2, is a graphical representation of the process flow diagram. Four incoming vacuum extraction pipes are shown on the left. Above each vacuum pipe inlet graphic, data boxes dynamically show the field pipe vacuum pressure (inches-mercury) and flow (cfm). The vacuum lines in the graphic turn yellow when the blower is operational and gray when it is off. The four vacuum pipes manifold into one, which is equipped with an interactive actuated valve that controls the total flow to the field pipes. The total flow actuated valve can be remotely controlled to within 1 percent fully opened or fully closed through an associated graphic accessed from the push-button at the bottom of the screen. The user enters the percent valve opening desired in the appropriate valve control field box.

The recovered vapors then are processed through a moisture knockout tank to remove liquids entrained in the vapor stream. The knockout tank is equipped with ultrasonic liquid-level float switches and a transducer that indicates the level of water in the tank, displaying the water level in blue. Switches turn from green to yellow when activated. The "high-high" level switch in the tank will turn red if water reaches the top of the tank, and turn off the vacuum blower until the level drops to below the mid-level switch. A water pump, which pumps water from the knockout tank to the groundwater treatment system equalization tank, is activated when water trips the mid-level float switch.

Each pump in the process can be diagnosed from the office graphic for proper operation and for failure. Each pump is sent a signal from the PLC allowing it to turn on if the PLC logic parameters are met (i.e., the mid-level float switch trips). This is indicated by a large green rectangle within the motor symbol. Each pump sends a signal back to the PLC when it does turn on, and the small red rectangle within the motor symbol turns green. A pump failure would be indicated if the PLC is allowing the pump to turn on (large green square), the PLC conditions are met (corresponding level switch is tripped) and the small red square does not turn green, (i.e. the pump did not signal the PLC that it came on.) This setup allows each pump to be diagnosed independently, permitting the user to send field technicians equipped with the correct replacement pump to the job site.

The level switches can be visually monitored for mechanical failure. For example, if the mid-level switch changes color, indicating it has been tripped, and the transducer indicates the water level is at mid-level, but the low-level switch remains green — its tripped state — then the low-level switch can be diagnosed as having failed. The knockout tank, equalization tank and discharge tank are similarly equipped with ultrasonic level switches and transducers, and can be similarly diagnosed.

The knockout tank is equipped with a sediment trap on the water discharge line. The sediment trap will periodically fill, occluding the flow of water to the equalization tank. This can be diagnosed from a "trend screen" that plots the action of selected parameters over time. See Figure 3. The knockout tank discharge pump is monitored for how long it remains on, pumping out the tank. Because the tank volume from the low- to mid-level switches remains constant, an occlusion and the severity of the occlusion can be diagnosed by observing increases in the time required to pump out the knockout tank. The same method can be used to diagnose particulate filter occlusions, by monitoring differential pressure.

Applied vacuum pressure and recovered vapor concentration can be regulated through an actuated air dilution valve, open to the atmosphere. It is located just downstream of the knockout tank. The user can remotely open or close the air dilution valve in the same way he can operate the total flow process valve. In this system, the recovered vapor stream systematically is analyzed by a process gas chromatograph, and the concentration is dynamically reported in the data field to the right of the blower symbol. The PLC calculates and logs the pounds per hour of chloroform recovered and automatically, proportionately, opens or closes the air dilu-

The software is capable of handling historical logging of any parameter under control of the PLC.

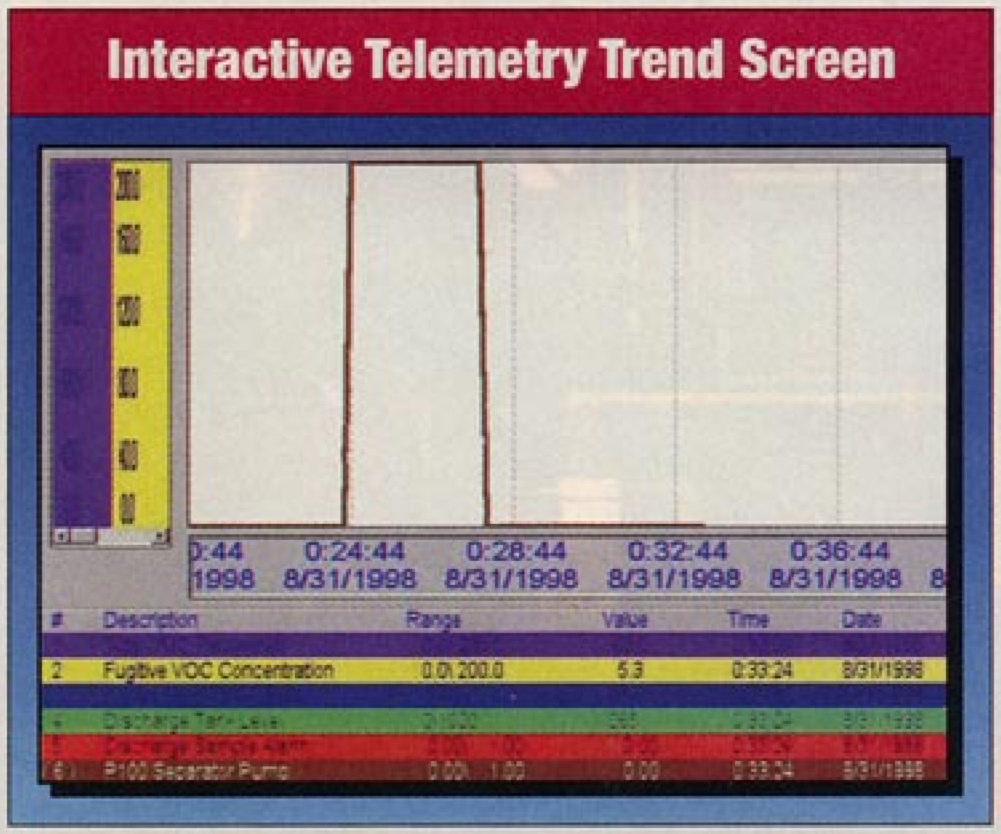

Figure 3. The brown line indicates when the separator pump turns on and off. By observing how long the pump remains on, it is possible to predict if there is an occlusion in the separator discharge line.

tion and total flow process valves to adjust the recovered mass of chloroform to within user-specified limits.

The blower exhausts the recovered vapors into a dual-bed carbon adsorption system equipped with on-site steam regeneration. The fugitive emissions from the carbon adsorption bed are analyzed by the process gas chromatograph, monitored and logged by the PLC. When a a predefined concentration set point is reached, the emissions are cycled into the steam-out mode. The carbon bed operation also can be remotely controlled through a graphical interface. The blower running time is recorded and logged, as are the analytical results from the recovered vapors, the fugitive emissions from the carbon bed and the return vapors from the air stripper.

Other graphical screens designed for this project include one for the field air sparge compressors and POC wells, and a master screen that shows all the analog input signals, the state of digital signals and alarm conditions. The field air sparge compressor screen shows the injection pressure (in pounds per square inch (psi)) flow (cfm) and on/off position of each of the 23 field compressors and the main compressor connected to the horizontal wells. The chloroform concentration of each POC well is displayed, and the alarm set point can be interactively controlled. If a POC well threshold set point is exceeded, the graphic will show which of the 23 sparge compressors is being automatically controlled to reduce injection pressure and flow, and allows the user to override the automatic function.

The software is capable of handling historical logging with a time and date stamp for any parameter under control of the PLC. Similarly, all analog and digital signals can be trend-plotted and historically logged. The software's alarm function allows the user to program alarming functions for any monitored parameter, including voice notification to telephones, digital numbers to pagers or typed messages to facsimile machines.

Costs

The impetus for using IT in this application was to reduce operation and maintenance (O&M) costs over the life of the project. The costs savings that resulted from the IT application were:

- **Immediate notification of alarm.** Whenever there is an unacceptable process deviation or an equipment failure, the IT system takes a predefined corrective action to minimize risks, and notifies the designated operator on duty. This around-the-clock monitoring system minimizes risk and improves response time. This translates into reduced O&M costs.
- **Efficient use of resources.** The reporting features of an IT system eliminate routine site trips to observe system operation and record system performance data required by regulatory agencies. Furthermore, the remote diagnostics, alarming and control capabilities of the IT system enable the operator to diagnose a problem remotely. This eliminates exploratory trips to determine the nature of a problem.
- **Earlier site closure.** The process performance and the equipment run-time reports can be used to optimize system performance and lower operating costs. They also make possible earlier decisions regarding site closure. The real-time data, as well as the summarized historical data provided by the IT system, can be used to assess and modify the operational characteristics of the process. These reports also provide a consistent feedback to the operator regarding how well the system responds to changes made. In general, interactive control provides a way to keep systems operational more of the time. Ideally, this will shorten the time required to remediate the site.

Engineers for the Freon facility had estimated annual remedial O&M costs at approximately $120,000 per year. The systems have now been operational for 36 months, and average O&M costs have been approximately $65,000 per year. Costs unique to implementing interactive telemetry capabilities, including software and programming, were approximately $75,000. Payout for IT at this site took place over approximately 1.4 years, resulting in project-to-date savings of approximately $88,000, with a continued estimated savings of $55,000 per year. This estimation does not include the intangible value of maintaining a 95-percent operational up time that should allow remedial efforts to be completed more quickly than would be possible with an all-manual operation.

David A. Pass, P.G., is an environmental risk manager with Paragon Insurance Services Inc., Atlanta, Ga., 800-688-0558. Charles Mamane, P.E., is president of MCM Systems Inc., Atlanta, Ga. 404-329-0192. For information about the interactive telemetry discussed in this article, call the authors or Consultech Environmental Inc., Atlanta, Ga., 678-377-0400.

Reader Interest Review

Please circle the appropriate number on the Reader Service Card to indicate the level of interest in the article.

High **209** Medium **210** Low **211**