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WHAT'S NEW IN SCADA TECHNOLOGY

Department of Energy automates strategic petroleum reserves

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COGGINS

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Department of Energy automates strategic petroleum reserves

Advanced SCADA computer control techniques being used to improve crude oil transfers

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THE U.S. Department of Energy (DOE), is automating the process control system for the major Strategic Petroleum Reserves (SPR), located along the Gulf Coast of Texas and Louisiana (Fig. 1).

Coggins Systems, Inc., of Atlanta, Ga., has been contracted to provide a system at the West Hackberry, Big Hill, Bryan Mound and Bayou Choctaw SPR sites. Completion of the four control systems is scheduled for the end of 1988. The Big Hill and West Hackberry systems are already online and are the primary means of control.

Each of these crude oil storage facilities is being equipped with a Coggins Systems Series 8100 Distributed Control System. This system is programmed for automatic operation, while affording ease-of-user interface through color graphics process display terminals (operator's terminals).

Under normal operations, a single operator is able to manage an entire facility. Complex control operations require only function selection and initiation through simple keystrokes with the aid of process display menus.

The SPR storage facilities are under management of The Boeing Petroleum Services, Inc., based in New Orleans, La.

General configuration. The primary objective of the Distributed Control System (DCS) is to provide each storage facility with a simple, but reliable, means to monitor and control underground crude oil storage caverns, pipe lines, pumps, valves and ancillary equipment (Fig. 2).

Supporting objectives involve interfacing with field instrumentation to achieve overall site instrumentation and control capability and incorporate flexibility for future additions.

The system provides the operator, at a central location, the capabilities to initiate, terminate and channel crude oil, raw water and brine transfers while simultaneously observing changes in status of critical parameters and inventory related information. The system is designed for reliability, maintainability, safety and flexibility.

By nature of its design, the DCS uses distributed intelligence to maximize system performance and reliability. This intelligence is programmed into remote distributed units (RDUs), which are strategically located throughout a facility in close proximity to the equipment and process being monitored and controlled.

All control devices and status alarms are arranged to provide the operator with a convenient and logical means of maintaining surveillance over the complete process. Safeguards are provided to discourage the operator from entering into any operation which could result in damage to equipment or which could present conditions that are detrimental to personnel or the environment.

The operator interacts with the system through simple-to-use process display terminals. Schematic layouts of the process piping and related equipment are presented to the operator through color graphics displays. These displays are simple to use, yet offer enough detail to permit less experienced personnel to quickly become proficient with the system.

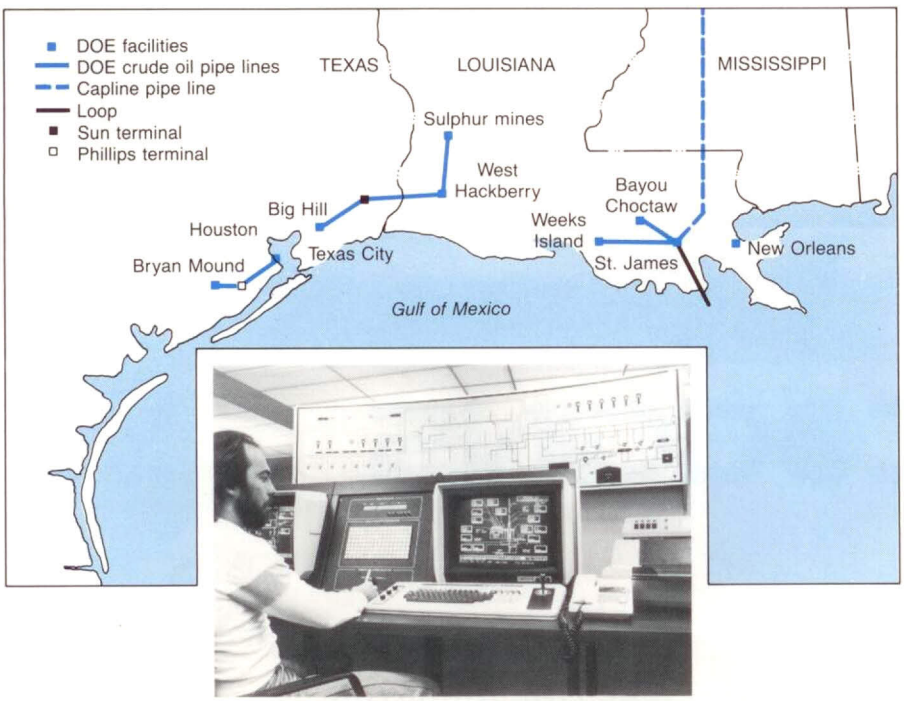

Fig. 1—DOE's Strategic Petroleum Reserves along the Gulf Coast of Texas and Louisiana. The operator's console (inset) is the centralized point of interface between operator and Distributed Control System hardware and software.

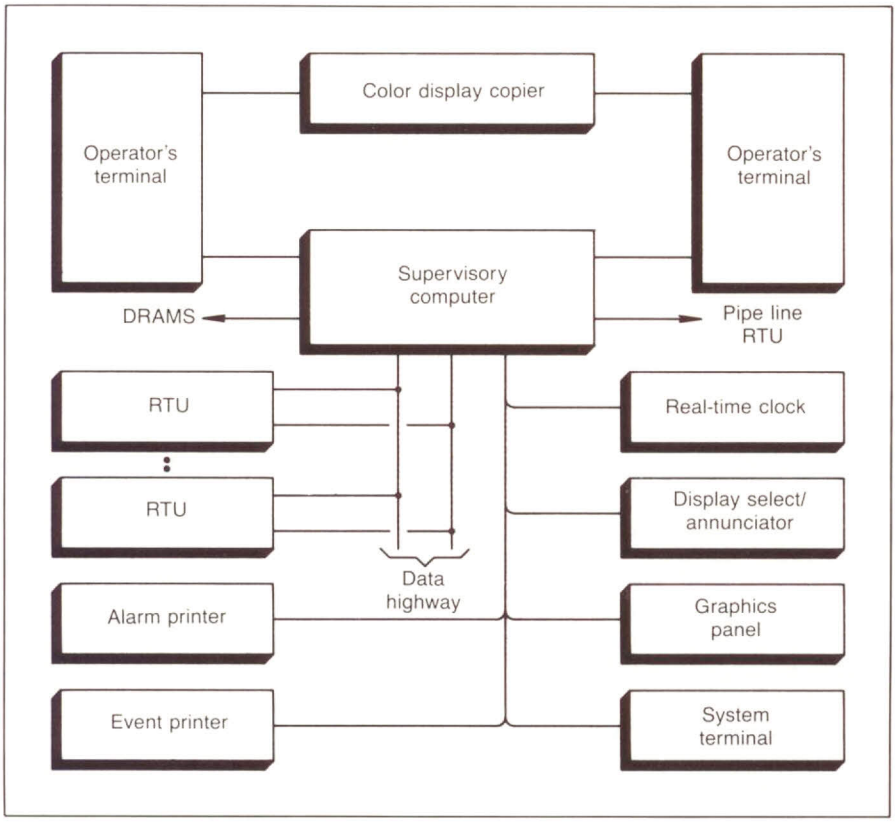

Fig. 2—Distributed Control System simplified block diagram.

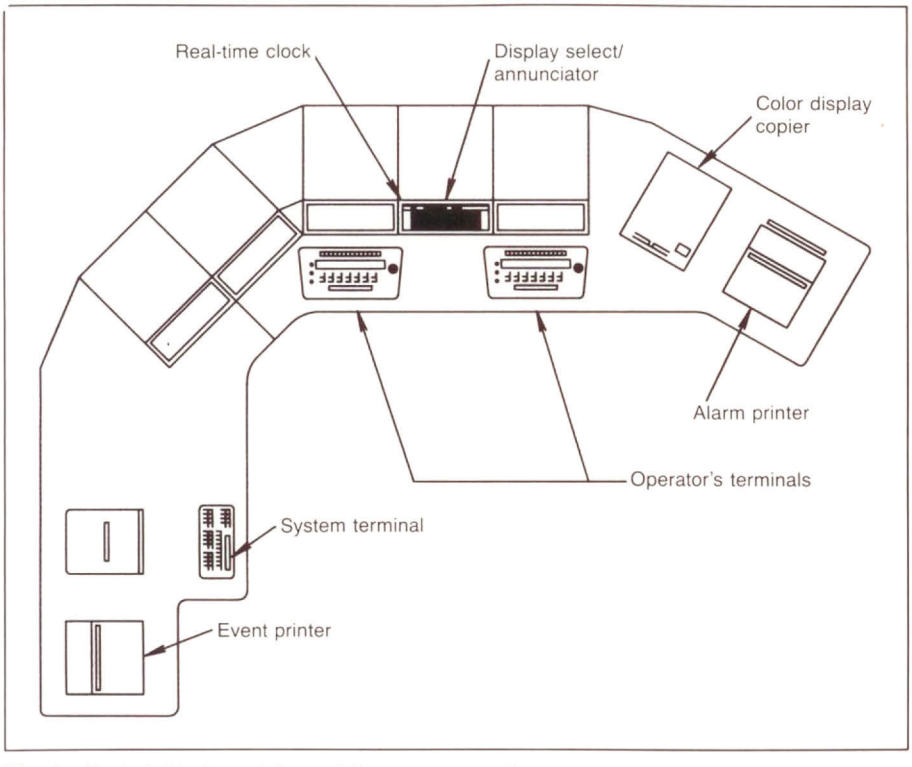

Fig. 3—Typical Distributed Control System operator's console.

The DCS operator's console. This is the centralized point of interface between operator and the DCS hardware and software. The console typically consists of two operator's terminals, a color display copier, event and alarm printers, a system terminal, a real-time clock and a display selector/annunciator. (Fig. 3).

Both operator's terminals operate identically. An operator has only to select a process display from a menu of displays available, causing the system to display the desired screen in color graphics format.

Operator commands are issued by positioning the graphics cursor using a control level (joystick) or special keys on the respective operator's terminal, then pressing one or two function keys which are uniquely designed to execute the intended operation.

Supervisory computer system. This is the heart of each DCS. It consists of a Hewlett-Packard HP 1000 computer system executing Hewlett-Packard's RTE-A Real-Time Executive Operating System software under the control of Coggins Systems' Series 8100 software.

One of two supervisory computer system (SCS), configurations is used:

- Redundant supervisory computers for symmetrical failover or
- A single supervisory computer interfaced to a master control unit based upon Allen-Bradley's PLC-3 Programmable Controllers. Both configurations are designed for maximum system availability and overall reliability.

Color display copier. This uses ink-jet technology to reproduce any operator's terminal display screen onto a special clay-baked paper to allow the ink to dry instantly. A terminal-to-copier selector switch permits connection to either Operator's Terminal for copying of any process or data display.

Event printer. This printer logs all site reports, operator commands and system events.

Alarm printer. All alarm information detected by the system, including time, date, process name, description, variable name, current status and operator response is printed.

Real-time clock. An extremely accurate system time standard which ensures that all internal software clocks of the distributed control system are automatically synchronized at power-on and at predefined intervals.

Display selector/annunciator. This permits the operator to display a process display screen quickly. A separate backlighted pushbutton on the display selector/annunciator is provided for each display screen. The display selector/annunciator can be enabled to either of the two operator's terminals or

disabled by pressing the appropriately labeled pushbuttons.

System terminal. A monochrome display terminal is used as a backup means of operator interface or as a programming terminal. It is also used as the main site management data entry device for making data available to the New Orleans Data Reporting and Management System (DRAMS).

Graphics panel. A free-standing mimic graphic display unit provides a simplified pictorial representation of the site process. This panel shows the status of pumps and motor-operated valves and various alarm conditions. The color coding and light statuses for the pumps and valves are the same as the Operator's Terminal screen displays.

Audible alarm system. This emits one of three tones based on the priority of an alarm, signalling the operator of the urgency of action required.

Data reporting and management system link. This provides data and status information to the DOE central DRAMS center in New Orleans.

Pipe line terminal link. Communications between the site and its connecting pipe line terminal's RTU for monitoring of crude oil transfers is provided by this link.

Redundant data highway system. This system provides redundant communication links between the RDUs and the supervisory computer/master control unit. If the primary data highway fails, communications are automatically transferred to the secondary data highway to ensure uninterrupted communications.

The RDUs are stand-alone control systems strategically located throughout a site and are interfaced to field instrumentation and controls. Since each RDU is a stand-alone unit, the loss of communications with the control room signals the respective RDU to operate in a predefined mode of operation, continuing to execute its RDU program and process associated input/output functions.

DATA REPORTING AND MANAGEMENT SYSTEM

To aid the DOE in its overall management of the SPR, Coggins Systems is providing the hardware, software and installation of a DRAMS. DRAMS is an information system permitting remote monitoring from New Orleans of SPR sites equipped with a Coggins Systems Series 8100 DCS. Two main functions performed by the DRAMS are:

- Real-time process display with video hardcopy.
- Automatic collection of data and reports.

Real-time process is visually displayed in New Orleans by color graphics process display terminals. With these terminals, the user has direct access to any site's data base permitting immediate display of process information in color graphics schematic or data formats, identical to those which are presented to site operations personnel. Color video copiers permit hardcopy reproduction of any site's real-time displays or data displays.

Automated collection of data and reports is performed by the DRAMS automated computer system which interactively communicates with each of the individual sites. This system formats the acquired information into summary reports for storing and printing. Dynamic, periodic and on-demand reporting of process operations and site management data are available to the user for printing on either conventional or laser printers. The report data are also formatted for personal computer compatibility to support management's use of DRAMS information with other standard software products. ■

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