"REAL TIME" INFORMATION THROUGHOUT TEXACO: A NEW APPROACH TO SCADA SYSTEMS

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ABSTRACT

A Supervisory Control and Data Acquisition (SCADA) System developed by Texaco Exploration and Production Inc. uses modules to construct a distributed control system. The SCADA System is constructed in the field using both distributive process controllers and Windows based software tools. Using the dynamic data exchange capabilities of Windows and existing Wide Area Network delivers field information anywhere in the organization on a "pseudo real time" basis for engineering analysis and processing.

INTRODUCTION

Several acronyms will be used in this paper to describe different processes, equipment, programs, or other items that we feel must be defined. These acronyms are:

- DG - Data General - Texaco's current host mini-computer.
- RTU - Remote Terminal Unit - Electronic field equipment that monitors and controls activity on location. Data is reported to the office.
- PC - Personal Computer - Normally a 386 or 486 machine
- DC - Data Concentrator - Device used to control communications and store information from the field.

- MTU - Master Terminal Unit - This term refers to the PC and software used at the office to monitor and control the field RTU's.

- SCADA - Supervisory Control and Data Acquisition - This phrase describes the entire system from the RTU to the MTU.

- DDE - Dynamic Data Exchange - Method of moving data transparently between two or more Microsoft Window's Applications.

- Netbios - Network Basic Input/Output System - Allows the computer to access and distribute information across a network, ie. Banyan, Novell, etc.

- Server - 386 or 486 PC running a UNIX networking software such as Banyan or Novell.

- LAN - Local Area Network - A group of computers connected through a common server allowing the group to exchange data or share information.

- WAN - Wide Area Network - A group of local area networks linked together by communication medium.

Existing field automation within the Midland Division uses Data General (DG) based office equipment and a wide assortment of field remote terminal units (RTU). When developed, this system was state of the art. With the advancement of technology over the last ten years, this system has become obsolete. Field personnel are frustrated by the difficulty of modifying screens and reports on the DG system. Texaco currently has seven DG systems operational within the Midland Division .

The Midland Division set forth in July of 1990 to develop a PC based SCADA system that would be user friendly, modular, and constructed with off the shelf products. This task was accomplished by formulating

a team to evaluate and select the optimum software and hardware for the Division. The controlling factor in the selection process of both equipment and software was to insure platform flexibility for future growth. This type of team provided all types of operational backgrounds thus creating a total buy in from all entities within the Midland Division.

SELECTION PROCESS AND CRITERIA

The team would develop standard equipment and software for both the field and the office. The team consisted of a variety of experience levels and backgrounds. Members included automation technicians, foreman, engineers, and internal software developers. The team configuration provided acceptance across the Division when the study was complete.

Two independent evaluations were completed by the team. Evaluation of the field equipment and software was completed first followed by the Master Terminal Unit (MTU) or office software. Separating the two studies would guarantee a complete evaluation of MTU software independently of the field equipment host software.

The RTU equipment and software evaluation included site visits to other automation installations both inside and outside Texaco. Two man teams were assigned to each vendor and their product. Each product was thoroughly evaluated based on the criteria shown in Figure 1. Each two man team reported their findings to the group. Two finalists were selected and evaluated based on the following qualities:

- Reliability
- Modular construction of both the equipment and software
- Communication flexibility - 450/950 MHz, satellite, direct phone link, cellular phone link, and hard wire
- Networking capability of the equipment - Truly a distributed control system

- Programming flexibility - Allowed the unit to be used in many different aspects of control. Same unit could be an injection controller, gas flow computer, or sub-pump controller. The only modification required is a change to programming on location.

This type of system allows Texaco the flexibility to move equipment to various locations, modify the program on site, and have the unit running in less than a day.

The MTU software selection process was similar to the field equipment process. A list of over forty different MTU software packages was evaluated in approximately two months. This list narrowed to ten and then to four finalists. A Midland Division team combined with the assistance of Texaco's Information Technology Department in Houston evaluated the four remaining MTU systems. The selected software was chosen for the following qualities:

- Networking Capability with Texaco's Wide Area Network (WAN)

- Graphical Interface - The system was extremely easy to build with the object oriented graphics.

- Protocol drivers were available to communicate with any equipment installed within the Midland Division.

- Software Flexibility, Programming Language, and Growth Capability - User-Friendly

- Ease of System Construction or Integration - Field personnel could construct and maintain.

This software is a Windows based product using object oriented graphics, dynamic data exchange (DDE), and a standard Netbios. Information is provided to any Windows compatible spreadsheet, such as Excel, or other computers on the LAN or WAN running the SCADA

software. System control is available whether the user is at the office, at home through dial-in modem, or logged-in from another computer on the network through the Netbios and DDE connections.

DISCUSSION

Development of a distributed control system with a net workable host software provides Texaco with maximum flexibility and growth potential for the future. The systems are easily constructed and modifiable on site thus eliminating expensive integration charges as is the case with UNIX based or hardcoded (Fortran) based products. By design the SCADA software enables field personnel to construct and modify new and existing applications. Empowering field personnel with this type of control creates an accomplishment of "I created it, I know what it is, and I can maintain it."

Currently Texaco has systems operational in Midland (Mabee Unit), Levelland (Montgomery Estate Davies), and Sundown (Slaughter). The initial system was constructed at the Mabee Unit CO2 Project in Texaco's Midland Area. This like all initial systems had a learning curve to overcome. Construction of the field equipment was initiated in July of 1991. One hundred and seventeen (117) RTU's consisting of twenty-eight (29) automatic well test (AWT) satellites and eighty-nine (89) injection controllers were installed and the host system completed by January 23, 1992. All field work was completed by the Mabee Unit employees and contract electricians. The MTU software was designed and programmed by two Division and two Midland Area employees.

Data from the field units are gathered through a 450 MHz radio to a data concentrator at the office. The data concentrator maintains communication and stores data from the field units. The MTU software then polls the data concentrator for screen updates and information to be transmitted to the database on the MTU. At a certain time each day the data is uploaded from the MTU at the Midland Area office to the Midland Division CO2 group via Texaco's WAN. This allows engineers at both the Area and Division to discuss information on a pseudo real time basis. Engineers in the Division can analyze the data to determine

the response of the CO2 flood on a daily basis. Real time information daily provides Texaco with the ability to make critical decisions and plan future operational strategies concerning CO2 operations thus reducing operating expenses over the life of the project.

Texaco's Slaughter CO2 project is being equipped with automation equipment which mainly includes injection controllers. The MTU software at Sundown was designed and constructed by the field technician with very little assistance from the Division. By utilizing screens and attributes developed within the Mabee project this system will be modified by the technician on site with very little assistance.

The third project being developed is a mature waterflood in Levelland. This project consists of sixty-eight (68) injection controllers with seven (7) automatic well test satellites to be added in 1992. Installation of the injection controllers began in December of 1991 and will be complete in March of 1992. The MTU software was completed for the system in three weeks. As the stand-alone units made operational the RTU's communications are activated at the office. This system was completed by the automation technicians with Division assistance.

Production and injection information from the Sundown and Levelland will be transmitted in the same manner as the Mabee Unit. This will allow the CO2 and reservoir groups to evaluate the leases more effectively and with greater accuracy. This will provide better control and enable improved strategic planning over the life of the floods.

The computer proficiency of personnel at each site that automation is installed must be evaluated to determine the amount of Division assistance required. The method of instruction utilized is to set the individual(s) down at the MTU and talk them through the construction of each screen developed. This provides training at the same time the system is being constructed. When the system is complete, the technician building the system knows what is behind the system and can maintain the system from this point forward.

The keys to the success of this automation project is that the automation technicians build and maintain the system. Since the system

is modular and flexible, no programming expertise is required. The automation technicians build and maintain the system. Division responsibility is to provide adequate training and support. The modular construction of the system will provide the flexibility to replace antiquated software without affecting the system. This will also be important when new supervisors or engineers are brought in with a different operating philosophy. The software can be modified, changed, or new modules added with very little system impact.

CONCLUSIONS

Automating leases and transmitting production data to the appropriate entities within an organization is widely used among upstream operations. Improved communications and the utilization of object oriented graphics, DDE, Netbios, and the features of Windows has allowed Texaco to take automation to a new dimension. The domestic industry constraints of the 1990's dictate problem identification and resolution in the minimum time. Using the Texaco WAN in conjunction with the SCADA system will allow field offices to provide information daily without human intervention. This will improve operating efficiency and job performance by field personnel. Taking the development to the field will eliminate high overhead charges and reduce development time tremendously. Using the automation technicians to implement these projects will provide a "Pride in Ownership" type of approach.

OIL FIELD RELIABILITY

- Power requirements - normal/emergency
- Surge protection
- Temperature reliability
- Prior oilfield application

MODULAR CONSTRUCTION ALLOWING FLEXIBILITY

- Adequate memory storage
- Sufficient I/O
- Modem interface
- Modular I/O termination hardware
- Physical size
- Expandability
- Simple to service/repair/replace

STABLE VENDOR WITH ADEQUATE SIZE OPERATION

- Parts and service response time
- Reasonable delivery on hardware and completed software
- Necessary training

SOFTWARE FLEXIBILITY

- Program language - modular - built in packages - communication, AGA3-gas
- On-site programming
- Troubleshooting/diagnostics capabilities
- Support of descriptive I/O labels
- Multi-tasking with assignable priority
- Multiple master/slave operation on one radio frequency
- Capable of downloading from MTU to RTU
- Support multiple levels of password security
- Recovery procedures
- Ability to customize communication protocol

COMMUNICATIONS INTERFACE

- Compatible with existing PLCs and RTUs
- Multiple master/slave operation on one radio frequency
- Capable of downloading from MTU to RTU
- Support for different protocols
- Ability to customize communication protocol

HARDWARE FLEXIBILITY

- RAM storage and clock with battery back-up
- Math capabilities
- Local readout and port for portable PC etc.
- EPROM or RAM program storage choice
- CPU speed

COST

Figure 1 - RTU evaluation criteria