Use of Computers for Gas Measurement and Well Control in the Greta Field*

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Eighteen years ago—1947—the first modern-day electronic computer was put into operation. Fourteen years ago the first commercial automatic computer came on the market. This year the use of more than 20,000 major computers has advanced the industry to the point that the future of the computer industry depends on better means of gathering high-quality data. Computer authorities say that advances in computers will be limited until better data-gathering and processing means are developed. The computer industry is currently oriented toward time-shared computers with many remote key punch sources. This type of system will provide engineers with the resources of a computer on his desk. However, to reach this point in the business of production of oil and gas, we need better data-gathering means from the field.

One of the most expensive, cumbersome, awkward phases of our business is measurement and control of gas wells. Due to this feature, many types of automation and measurement features have been utilized. One of the ideal programs would be to have gas volumes controlled, measured, and printed out at one point—in such a manner that this print-out could be used to feed the computers to pay royalty checks, to balance volumes in a field and around gas plants, and to furnish allowable production data. We are on the verge of having such a computer system right now. The predecessor of this system, which can be modified to this work, is currently installed in Humble's Refugio District.

The Refugio District Greta computer system that I will discuss today is a specific system, with its individual problems and operation. I will present the features of this installation and the results to date.

The Greta Field, located 10 miles north of Refugio or 60 miles north of Corpus Christi, is a multireservoir gas and oil field. Humble has 32 gas wells that produce to the Tom O'Connor Gas Plant. The gas is sold to a transmitter company.

Currently, 15 of these wells produce into the high-pressure system (900 psi) and 17 wells into the low-pressure system (300 psi) in the Greta Field. All gas is sent to the gas plant and then sold to the transmission company.

The basic problems at Greta are the location and operation of leases and the nature of the sale. Humble's acreage is in three noncontiguous groups involving six leases. Two of these groups of acreage are split by a state highway with a parallel railroad track. Development of the gas production was on a one-well-at-a-time basis. This resulted in meter runs being scattered over the entire field. Installations were not uniform in any aspect.

To complicate this picture, gas is produced to a demand-swing-type sale. This means that gas volumes vary from all on to almost all off. This kind of change is sometimes required several times per day and at any hour. Consequently, 24-hour pumping was required to operate this system.

Gas gathering has been performed by two systems, a low-pressure and a high-pressure system. Fortunately, the low-pressure system is only occasionally required to swing and then only on the daylight towers. However, the high-pressure system, consisting of three separately joined 4-in. gathering lines, will swing from 0 to 45 MMcf per day or to any point in between.

The Greta Field is a highly competitive multireservoir gas field. Maintaining participation between these reservoirs requires continual surveillance. Consequently, when sales volumes are increased or decreased, certain wells are given priority to produce. This priority changes from time to time, based on workovers or changes in participation status.

With this picture of the production problems involved, some of the potential advantages

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of a consolidation and automation program become apparent.

The basic approach to this problem was to develop a system of control for each high-pressure well. This control was to be located at the Tom O'Connor Gas Plant and was to require a minimum of the gas plant operator's and gas pumpers' time.

The final plan resulted in the use of computers to achieve the desired control, as well as to record the gas flow from each well. All meter runs were moved to one of four central points. The automated facilities include the use of four computer stations located at the lease metering sites. A central console is located at the gas plant. At this console the total flow rate of the high-pressure gas wells can be adjusted by dialing in a flow rate required for each or any of the 15 wells. As I mentioned, this type of system is necessary as these wells are produced by a priority schedule rather than uniform distribution. On the console are digital totalizers for all wells. This totalizer will record a computed flow volume for each well with static and differential pressures, temperatures, gravity, and supercompressibility factors all taken into consideration. These volumes will be calculated by the computers located at the lease metering site and transmitted to the totalizers on the console. This will eliminate the need for the recording orifice meters currently in use. This will also provide a more accurate gas measurement than the eight-day charts currently in use.

A computer system is used to control the 15 high-pressure wells and measure gas from all wells. The computer is an analog type with an integrator to convert the readout to digital form. The computer is basically designed to compute $Q = C\sqrt{hP}$. It also has the capacity to receive a flow rate and compare the received value to the actual flowing value. Upon comparing these rates, it will provide an output signal which can be used to open or close a valve.

A computer is not very smart in that it cannot comprehend our normal field measurements. Data are furnished to the computer from transducers. A transducer is a means of converting a nonelectrical signal to a calibrated electrical signal. A static pressure, a differential pressure, and a temperature transducer are used to convert the pressure and temperature values into electrical signals that the computer can receive and comprehend.

Other values can be set into the computer as a constant. In Greta, the specific gravity and the supercompressibility are used as constants. Gravities are taken once each six months, and computer settings must be changed accordingly. Supercompressibility is relatively constant since the gas is metered at sales line pressure which is relaitvely constant. For conditions where this is not true, it can be calculated by a slightly more sophisticated computer.

For this type of installation, one computer is used for each well. Four sets of computers were installed, one at each of the four meter-run stations. It was previously mentioned that all meters were moved to one of four stations. Transmission of all electrical signals between the console and the computers is by an aerial multiconductor cable, a telephone cable installed for this purpose. The use of conventional cable sizes provides excess conductors which will allow the addition of more wells to the system if necessary. With this type of wiring used, any well can be switched to the other pressure system with only minor changes at the computer. The computers are also tied to the transducers on each meter run.

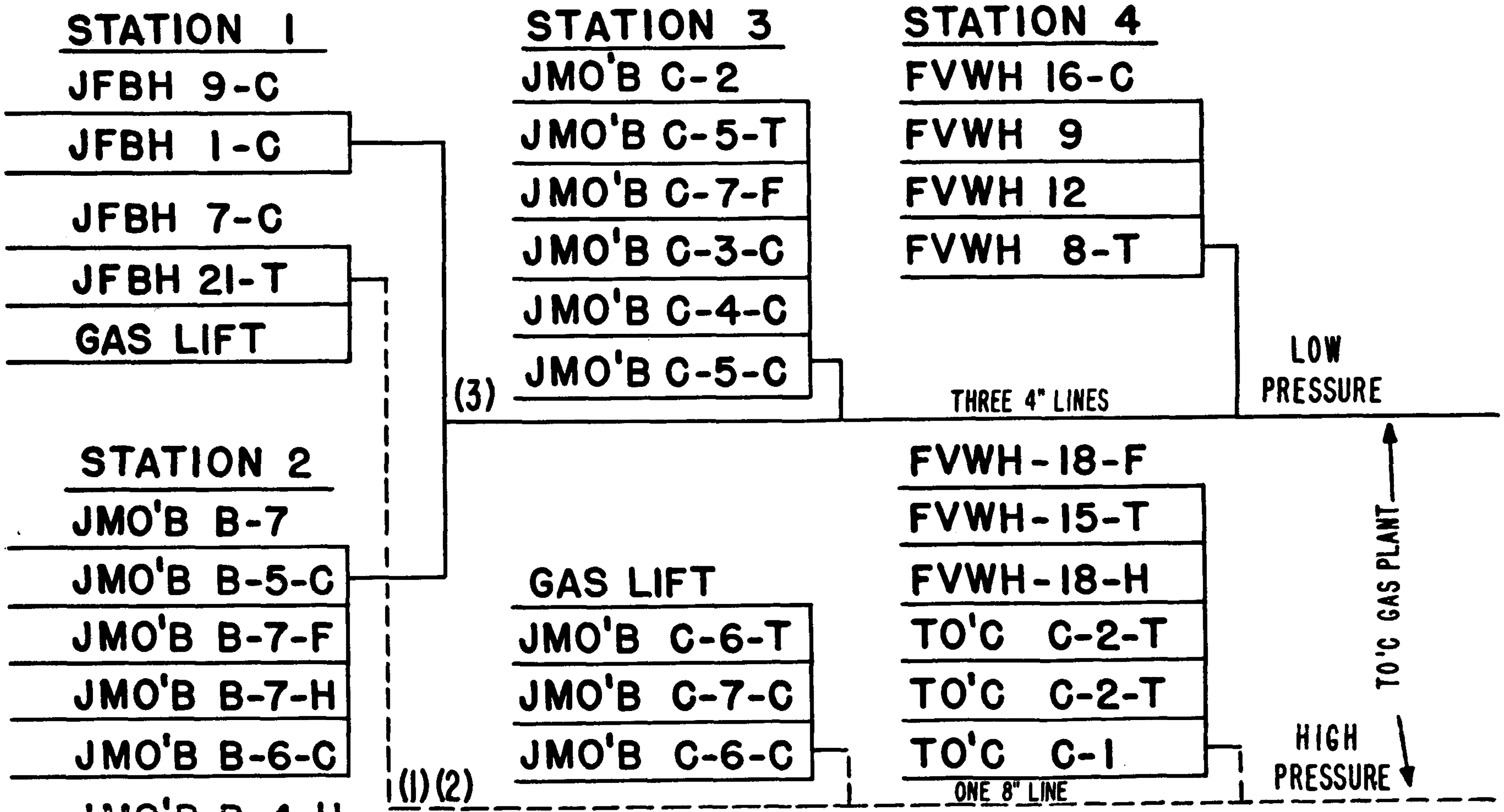
The calculated volumes from the computers are transmitted through the cable to the digital totalizing recorder on the console at the gas plant. These calculated volumes, corrected for temperature, specific gravity, and supercompressibility, are recorded at the gas plant. Each well has such a digital recorder. The volume is recorded in units of 10 or 100 cubic feet, depending on the quantity of flow.

The heart of this installation is the console. The console provides a central point from which all gas volumes can be read. The actual flow rate of each well can also be observed. The variations in flow rates, caused by such things as water production, can also be observed on the per cent flow rate dial on this board.

Each of the high-pressure wells can be controlled from the console. This is merely a matter of dialing in the well, dialing a flow rate, and pushing a button. This is a very simple, direct operation. In addition, once a flow rate is set into a computer, it will maintain that rate, regardless of line pressure, as long as the well is capable. This is not a feature of our electric pneumatic control systems currently used.

The physical control of the well is accomplished in a very simple matter. A pneumatic operator is mounted on a choke body. Two solenoids are attached to this pneumatic operator. A solenoid is an electric pneumatic de-

FLOW OF GRETA LOW AND HIGH PRESSURE WELLS TO THE TOM O'CONNOR GAS PLANT



(1) ALL HIGH PRESSURE WELLS TO HAVE 1000 PSI STATIC TRANSDUCERS.
(2) ALL HIGH PRESSURE WELLS SHOWN HERE TO BE CONTROLLED EXCEPT THE GAS-LIFT METER RUNS.
(3) ALL LOW PRESSURE WELLS TO HAVE 600 PSI STATIC TRANSDUCERS

2-80-79

Figure 1

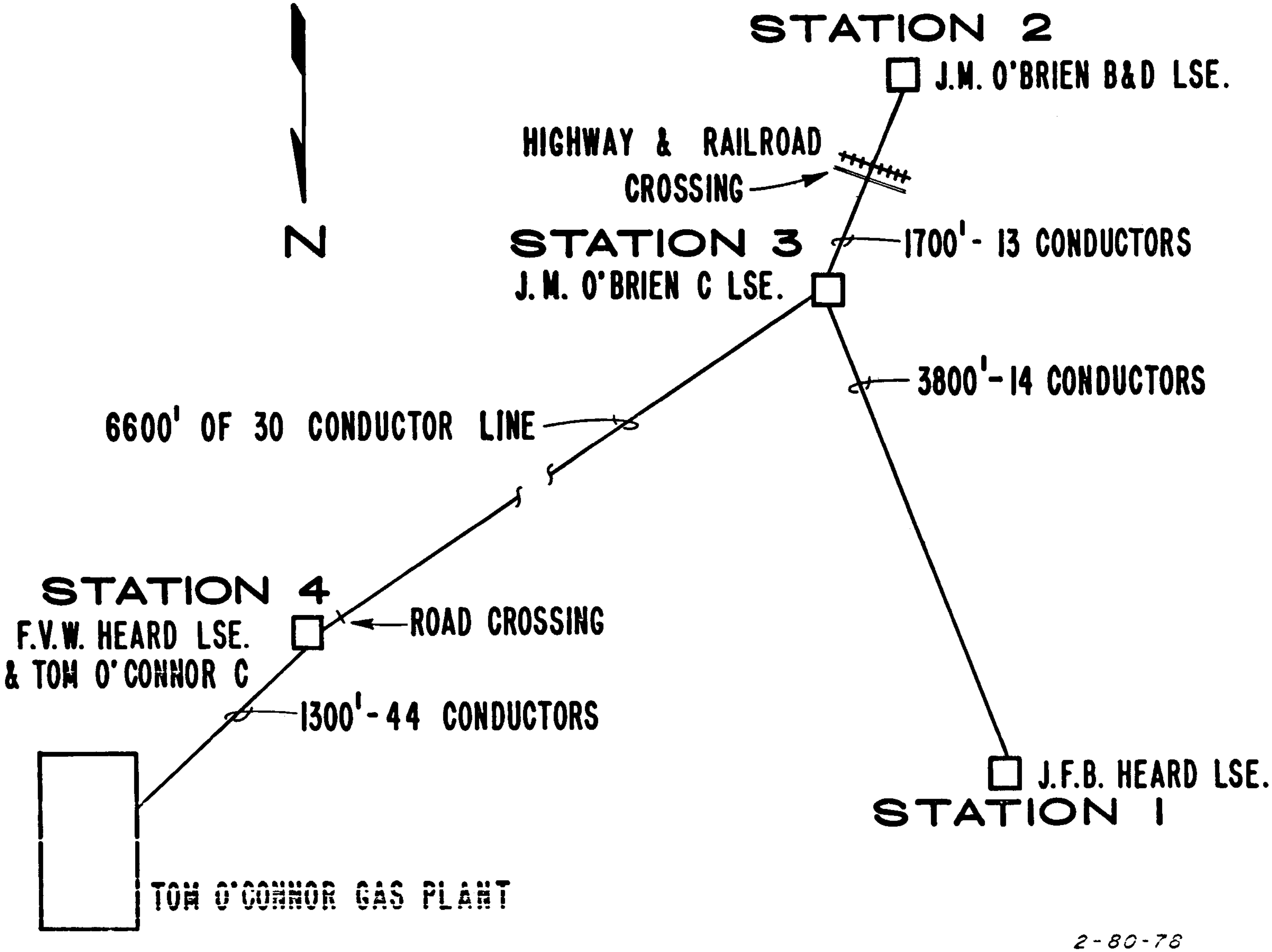

STATION 2
J.M. O'BRIEN B&D LSE.
HIGHWAY & RAILROAD CROSSING
N
STATION 3
J. M. O'BRIEN C LSE.
1700' - 13 CONDUCTORS
3800' - 14 CONDUCTORS
6600' OF 30 CONDUCTOR LINE
STATION 4
F.V.W. HEARD LSE.
& TOM O'CONNOR C
ROAD CROSSING
1300' - 44 CONDUCTORS
J.F.B. HEARD LSE.
STATION 1
TOM O'CONNOR GAS PLANT
2-80-76

Figure 2

CONSOLE AT GAS PLANT

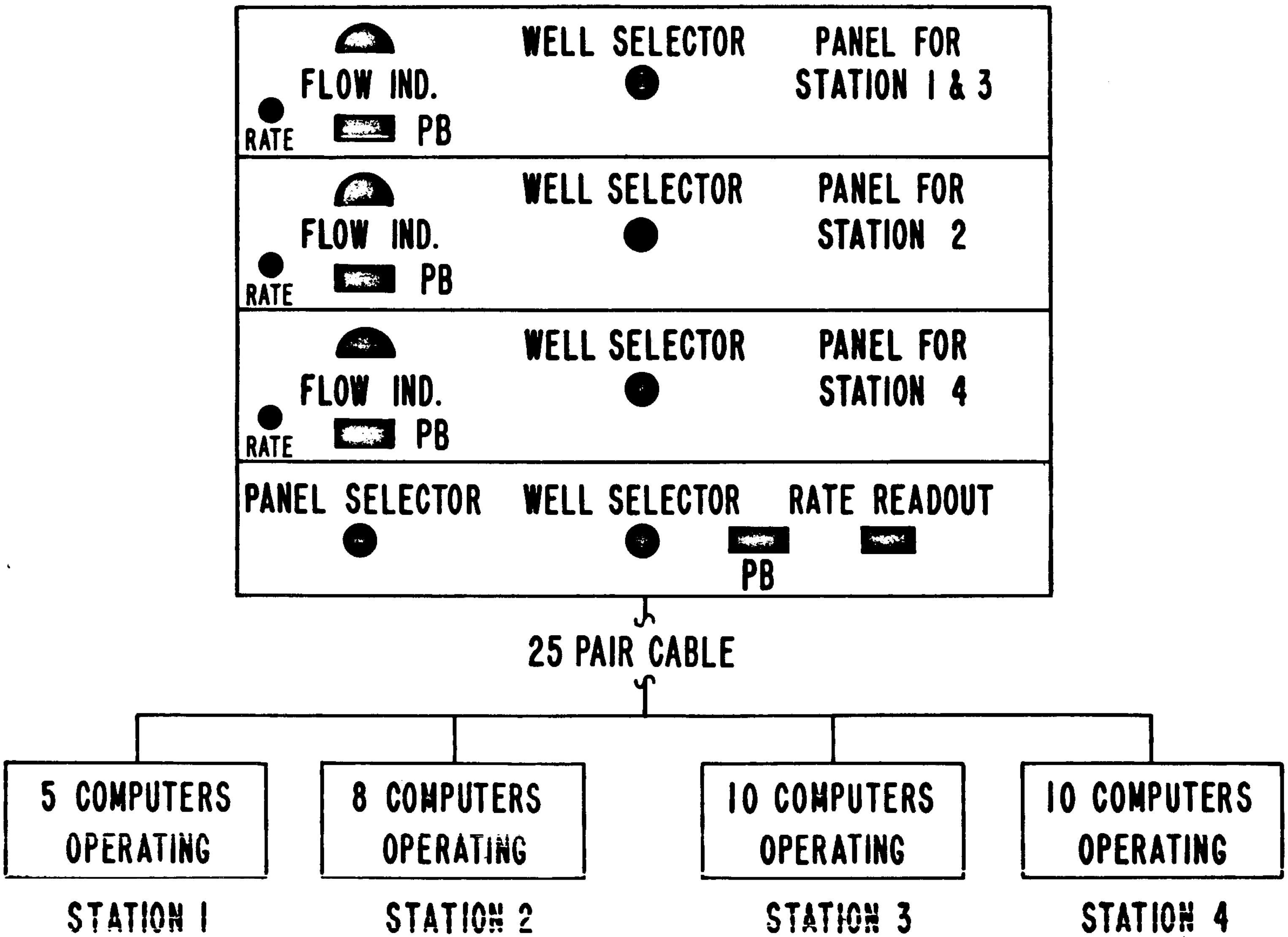


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Figure 3

vice, which in this case opens when it is energized. One solenoid opens to allow gas to open the valve; the other opens to bleed gas from the valve to close it. By using orifices to control the rate of gas entry and exit, the valves are smoothly opened or closed, based on the signal from the computer. Unique features of this remote control and recording system are the replacement of orifice recording meters and the exact maintenance of desired flow rates of orifice recording meters and the exact maintenance of desired flow rates regardless of changes in pressures in the gathering system within the limits of a well's capability to produce. The accuracy and reliability of the computer as a gas measurement instrument is being obtained by operating in parallel with an orifice recording meter. The recording meters will be removed upon completion of the test.

There are a number of specific problems that occurred with this installation. Some of these problems have been solved; some have not. The terms in which another company described their computer problems were "a high frequency of downtime has been experienced due to equipment weaknesses."

One problem is temperature. Temperature inside a closed cabinet which is exposed to a Texas summer sun can be in excess of 150°F. The computer components cannot tolerate this high a temperature. This temperature was lowered by the use of aluminum paint.

Failures in power and computer components due to electrical storms have been experienced. Lightning arresters, improved grounding, surge suppressors, fuses, silicon control rectifiers, and diodes have been used for this problem. In addition to knocking out the power supply, the electrical storms also caused the problem of extraneous control signals being sent to the computers. Needless to say, this is not desirable. This problem seems to have been solved, as the installation has operated without failure through several electrical storms. Additional work needs to be done in the field of message transmission and message security.

Since this type of installation was a first for the supplier as well as for Humble, many minor problems came up that have been handled. If we were installing this system today knowing what we know today, we could put in a superior system from an operational and maintenance standpoint; but it probably could not do the control and measurement job any better than this system. The supplier should be capable of building control cabinets that are easier to service and are more uniform in nature. Components such as mag-amps, static pressure transducers, rectifiers, power supplies, and comparators have been improved. The calibration procedure for transducers to computers has been greatly simplified, and field calibration time has been reduced by 90 per cent. However, more study is required in the area of improving calibration maintenance and operation.

Nature and order of some transmitted signals have been changed in the field in order to make a better system in terms of ease of operations. Potentiometer and control point changes have been made.

Some adjustment in attitudes of personnel of both companies was necessary as computer technicians had to become field oriented and Humble people had to become computer oriented. As a sidelight, two of our electricians were inspired to the point that they took an electronics course in night school, making a round trip of 100 miles to attend the school. Training and education requirements are increased by the installation of this type system.

The goals of the installed system are as follows:

(1) Reduce the pumper requirements from 24 hours per day to less than 8 hours per day to allow the use of two men in other capacities.
(2) Provide positive and faster control of swing wells by operating from a central point.
(3) Eliminate the need for recording orifice meter charts, thereby salvaging meters as well as eliminating the company effort to gather, process, and read these charts.
(4) Provide a more accurate gas measurement.
(5) Evaluate computers for this use.

I believe that final evaluation will show that all of these goals will be achieved and that computers will be a new field gas measurement and control tool for the industry.