MICROPROCESSORS FOR LEASE OPERATIONS, DATA GATHERING AND REMOTE SITE CONTROLS FOR MAXIMUM EFFICIENCY IN EACH DISCRETE FUNCTION

Sheyrl Garrett and John Taylor

C-E Natco

For decades man has been learning to gain better control of his surroundings, his possessions, and his future. Part of each of these portions of his life is also controled by the laws of physics, especially in the industry of todays oil and gas production.

Through the more precise control of the existing laws of physics comes the improvement in efficeincy, and as it follows, his surroundings, his possessions, and inevitably, his future. It is our challenge in this time of falling oil prices, shakey economy, and expected world-wide surprises that we exist. If we could individually improve each of the conditions that shape our future, we would certainly make attempts in that direction. Yet, being only mortals, (even Arkansas mortals) we must religate our lives to the improvements that we can achieve. One of the greatest tools available to us today is the microprocessor and the derivitive controls which have become available because of its minescule yet vastly powerful existance. It is this small bit of silicon upon which we can impose our greatest wishes, and, if we should happen to use the right "language" combined with the proper "words" we can decree, and it will be done.

We are not going to discuss the powers of chips, we all know how seemingly unending are the applications. Neither are we going to discuss the special languages which must be spoken to achieve these wonders, for that is a language spoken only by those nearly sacred persons called "programmers". Lets make an assumption here....a possibly costly one if wrong, but we must make it for now. The first assumption is:

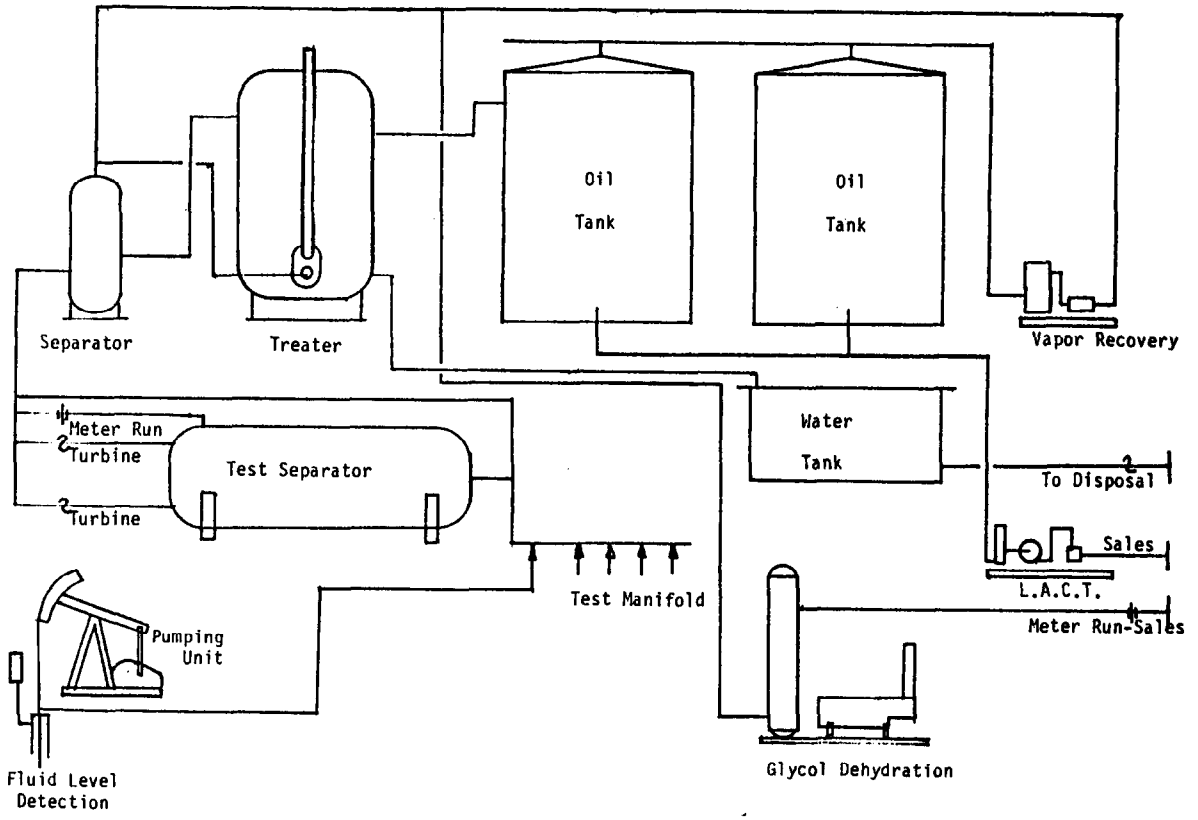
"The programmer knows what we want and how to do it."

Now, we can get into the meat of this paper. With all of this power from the chip, and magic language from the programmer, we can make our oil and gas production equipment "more efficient". We can make our oil and gas production equipment tell us what it is doing, and maybe even let it make decisions which until the recent decade, was not possible without a significant truckload of relays. We might call those old days...B.C... Before Chips? We also have the ability now, now that we can get the equipment out there, over the hills, across the valley, on the other side

of the world, even, to tell us what it is doing, and in turn, allow us to tell it that it is doing well, or that it must change. Then, with a stroke of luck, (remember the first assumption) tell it to make a change in the direction we want it to go.

What can be changed to improve the efficiency of our oil lease? Just about anything except the laws of physics. That, fortunately, never seems to change, so at least we have some constants to work with. Everything else can be changed, within reason, for improvement, for higher rates, for more economical operation, for more consistant conditions, for a higher degree of safety. Safety should always considered prior to making any changes in a program.

The following sketch illustrates a typical oil/gas production lease, one that you and I would like to have a couple of.....That would take care of our "Futures" for the time being, if we kept it operating properly. We intend to. We intend to make it operate as efficiently as possible for as long as possible, as long as is economically possible....while we take it easy, (easy is not lazy, easy is smart).



Pumping unit efficiency has traditionally been a measure of continuous or intermitant operation at a given range of torque which is a combination of function including fluid depth, pump diameter, rod design, stroke length, stroke speed, horsepower applied, and variations of each. Most of these functions can be related to a "perfect" dynograph card which electronically can be reproduced off-site via telemetry methods., Most of these functions are also variable and relate directly or indirectly to the fluid level which, by calculated methods can be determined. more efficient use of the pumping unit can be obtained by selecting a speed at which the equipment operates constantly at its most economical level of applied hrsepower. This function can be directly measured with current technology to control the pumping unit and track the depletion by a microprocessor based fluid measurement device. Will this device help us? Yes, by controlling the pumping unit's operation to its most economical pumping schedule and by allowing us to review on a weekly or montly any changes that are taking place over these longer periods. Trending is a function that will be addressed later in this discussion.

Well-Test functions are also reliable means of processing trends and observing changes in GOR, water production, and if equipped with a net-oil-computer, quality of production may be realized.

We intend to take as much data as possible since we are equipped with a computer which will automatically collect the data and crunch it for us, eliminating the man-hours which had once been a reason for not collecting data more than once per day or week. Since we can adequately compress the results, we can plot more "dots" on the sheet and increase our confidence level in the results. Over a three or four year priod we should notice significant trends... the sooner we start collecting, the sooner we achieve total confidence and quality in our future predictions.

Separators and treaters can be made to operate more efficiently mechanically as well as more maintenance-free by the proper use of preventative maintenance and scheduled service of expendable parts such as valve trim. We have also decided to use a microprocessor based control system for the burner on the treater and will control its draft and firing rate as constant as possible by monitoring the outlet oil quality as well as its temperature.

The burner will also notify us if it has had outages or flame failures which might signal additional attention to its operation and function. Like the pumping unit, continuous rate operation is most economical. Outages will also be picked up by our computer so that we can track downtime and service reaction time putting the equipment back on line.

Tank levels on our lease are monitored every 10 minutes for several reasons. The sonic sensor is accurate to 1/4" level over the 25 foot depth and feeds information into a collection terminal that stores the data and feeds it daily to our main computer as a continuity check on our production. It will also detect and alarm our system if a decreasing level is being indicated without the LACT in operation suggesting a leak or product theft taking place. The automatic phone-dial-up system can call the Sheriff's office if we program it to.

The LACT, like the burner panel, also uses a microprocessor for its logic control, signalling outages, alarms and flow irregularities. The unit is monitored for meter failure, tank-level monitor failure, high and low abnormal pressures and excessive wet oil divert conditions. These conditions are also tracked by our base computer. High flow rates alarm our pumper that a pipeline breakage has possibly occured because of the lack of the normal back pressure on the pump. Other outages or alert conditions may be alarmed in this way as well.

Since the LACT is also the liquids cash-register of the lease the maintenance and accuracy may be checked against tank levels, net-oil-computer and the BS&W monitor for production of "On-spec" oil. If, for instance, we are allowed to sell oil that is "not-to-exceed" 1.0% water, but our mechanical capabilities allow us, with safety factors built in, to produce oil that is 0.5% water. Why, if we can control to 1.0% oil, should we give away the extra 0.5% oil? Producing at the rate of 100 barrels per day, that is over $4,500 worth of free $45/bbl oil in a year's time. We should aim to produce on-spec oil if we are selling it. Most independents AND majors are selling a spec oil, they also have the capability to produce it.

The Vapor Recovery Unit is saving us some more money, and is also microprocessor controlled, monitored, and will alert the pumper, operator, and field service office if a critical shutdown occurs. The gas that is produced from the tanks in the summer time pays for the installation and operation of the unit.. minimizing our down-time will maximize our production time... we will produce more product, and more profit.

The gas is sold, at spec, to the pipeline after it is dehydrated to spec by the dehydration system ahead of our meter run. Again, as with the LACT, the gas is produced to meet, not exceed, or fall below, the contract level of water. This level is set to meet the 7 pound water per million cubic feet and is controlled to that level to minimize the gas used to fire the reboiler on the glycol system. The daily "put" to the pipeline is collected along with the LACT "cash register" so that we keep our daily accounting up to speed. Shortages, outages, and off-specification conditions are known and should be monitored daily. The computer will make short work of the weekly, monthly, and annual income statements. It will also show us if additional production is possible, probable, or only wishful thinking.

These trends in our production are, after a period of 3 - 6 months, predictable. Our total operating budget has been summarized, and our income has been reviewed. Can we do any better? Mass manipulation of the data which is only possible by the computer allows us to make these review. Just as we paid a geologist to review our logs and make his predictions, we must review our operation and make our own predictions. What can we expect

All of the above automation, based on the ability to control spec products, control efficiencies, and predict the direction of our investment, allows us to control our future.

Combined with our data collection capabilities, we will, through the use of the same collection computer, interface with a production evaluation system that has settable parameters including fluid levels, temperature levels, pressure levels, tank levels, test scheduling at various pressure, flowrate vs. temperature ratios, and other alarm set-points, alert points, and check-points. Sitting at your desk in your air-conditioned office you can reset the temperature in the treater by touching the control screen. You can change the phone number that will be called when an alarm condition is reached, and you can call the location and listen to the pump on the LACT that seems to be loosing pressure... is it bearings or something else. You have just saved yourself, your pumper, a trip to the location from 25 miles, and 45 minutes away, the return trip for a new motor bearing, and the change to still make your allowable for the day. In one call, you paid for the phone-calling, or auto-dial system. It will save you more money this winter.

The guideline for today and tomorrow's production is increased efficiency. If our lease can be made to operate just 1.5% more efficient, and our operating budget is in the area of break-even (as it could be in a year or two if we continue the present oil price trends) that savings could allow, and predict that we will be in business for another 6 - 8 months rather than starting a new or increased venture by going to a water, gas, or chemical flood sooner necessary.

Being able to predict the trends, by being able to expand our data collection and handling, our alarm and alert conditions, and return precise and effective control to our production facilities will pay dividends in your future, in our future, and in ouir industry's future. It may make the difference in our success or failure, and by safe monitoring, control that is designed through experience rather than whim, we will assure that our efforts towards today's necessary efficiency of operation will be profitable.

Are these tools available today? Yes, and more precise end-devices are being developed and commercialized each week for the market that services our industry. The larger equipment manufacturers and process equipment design companies have dedicated new product development personnel and equipment to the areas of improved and dedicated systems for production evaluation control, data collection, and alarm monitoring. Those are also the companies that will survive to supply you in the future, to service and provide your future requirements, as we join the other industries in becoming a high-tech high-efficiency future.