# Paul Fulton Scholarship

## Remote Monitoring in the Appalachian Basin

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**Executive Summary**

My proposal of research is to again look at remote monitoring in the Appalachians and try to present justification for it. A few questions I will be answering to help get an idea of remote monitoring include: What is remote monitoring? Why hasn't it been in the Appalachians? Why do we need to take time to look at this?

First, I will be getting into what types of products are available on the market to purchase. I will do this by researching companies with such products. Secondly, I will be focusing on what each product does by getting an understanding from the selling companies and talking with there engineers. Thirdly, I will be centered on the costs of the available products.

The next thing I will talk about is the reasons to take a look into remote monitoring for the wells in the Appalachian Basin. I believe there are several reasons we should look into this, for the economic advantage as the cost of oil and gas are increasing, it is much more effective for companies to use, and also the price reduction has made it more cost efficient.

I will also speak about the telemetry and the SCADA (Supervisory Control And Data Acquisition) system that is used to help gather and analyze the real time data.

This technology will help service companies with all of the operations that come to hand in the oil field. The main reason this hasn't been applied in the Appalachians is due to the cost of such technology. I am going to take a look into whether it is cost effective to use in the Appalachians or not.

# Remote Monitoring in the Appalachian Basin

In more then a decade, the downhole production monitoring acceptance and adoption has grown significantly. The systems that were initially on the market were very expensive, were complicated to install, and were only able to support limited applications. In the beginning, progress was slow as the technology was first being developed. The largest problem in the developing stages was creating an instrument capable of receiving and processing large volumes of information from several sensors at very high speeds.

Major companies started implementing this new technology into their fields and once they began seeing successful rates of return, they began to use more products (EP Solutions). After other companies heard and saw the success from the products, they too began to acquire and employ this technology in their fields. The technology and availability of products will continue to grow and improve, and will be implemented into oil and gas fields for several years to come.

This paper is written to inform and explore the technology that is out there to make our lives easier. I will be explaining what kind of products are out there and what measurements they are capable of calculating. I am going to go into how these products work and why companies in our region are not using this technology. Finally, I will be incorporating this information to the Appalachian Basin.

Remote monitoring is a method of monitoring and sharing information between many networks and consoles. By using remote monitoring we are able to measure the aspects of certain attributes without being there. We get the information through our networks, which help to plan and make a decision before we actually arrive on the scene (EP Solutions).

There are many companies in the world selling the same types of monitoring products to be used in the oil field. I have focused on a few companies that are using these products in the Appalachian Basin. These products include: ESP Controllers, Plunger Lift Controllers, Rod Pump Controllers, Polished Rod Load Cells, Water Cut Meters, PT Controllers, Motor Controllers, Differential Control Systems, Tank Gauges, etc. I will be explaining and going into detail about the products that are being used in our region.

Electrical submersible pump (ESP) controllers monitor and control the operations of the pump. These controllers are implemented in applications where the well site visits by the pumper or operator are not frequent due to remote locations, prolific producers (any downtime is a major loss of revenue), or trouble wells due to dirty power. Weatherford EProduction Solutions, Inc. has an iESP controller that provides automatic remote control of ESP wells. It also has the ability of connecting with a variety of other sensors at the well site. The iESP gathers and stores the information, then transports it to a control center where it is analyzed for real-time solutions (EP Solutions).

Plunger lift controllers are designed to provide automatic high/low- pressure shutdown. Most of the controllers accept analog and digital inputs, including data from other sensors. These controllers are implemented in applications where there are simple

plunger lift operations, high/low shutdowns, and wells just beginning to liquid load. Weatherford EProduction Solutions, Inc. has a two, three, and four plunger-lift controller. With these controllers there is a solar panel option to increase the battery life. It also has simple control for user friendliness and a single retrieval system to get all the necessary information from the well site (EP Solutions). EDI has a dual valve timer that records the plunger-lift arrivals and failures, and also records the battery life (EDI).

Rod pump controllers are designed to provide daily fluid production to give daily flow rate information and minimize fluid pound from pump-off. With radio communication, operators can centralize the data collection and have the ability to maximize the systems use by making real-time decisions. EProduction Solutions, Inc. has three versions of Rod Pump Controllers. With these controllers the well is controlled by continuous position sensors, the current status can be viewed locally or remotely, a dynamometer card stores real-time and historical data, and it collects the peak and minimum polished rod load data (EP Solutions).

Polished rod load cells are used in the oilfield to monitor the loads being pulled by a pumping unit. It is designed with a suppression kit that works very quickly. The sensors in the kit have been tested to meet performance specifications. This product from EProduction Solutions, Inc. is very durable in the oilfield harsh environments. It was designed to be immune to salt and unaffected by $H_2S$. The cells can be ordered in 10, 15, 30, and 50 thousand pound capacities. Another product that is very similar is the clamp on load transducer. It can more accurately measure smaller changes in the load and is very easily installed. This tool is handy because with a simple finger adjustment the load transducer can fit many rod sizes (EP Solutions).

Water cut meters use sensors to accurately measure the range of water cut in a combined water and oil flow stream. The system has high accuracy and is easily installed. It can be used as a stand alone that calculates instantaneous water cut values. This is an EProduction Solutions, Inc. product that has unmatched accuracy. The measurement is close to an infrared absorption spectroscope, which makes the water and the very easily differentiated. This product is new to the Appalachian Basin and after talking to a representative; he said he is just learning about the product (EP Solutions).

Pressure and temperature controllers are used to measure the temperatures and pressures in the well. The main purpose of the temperature measurement is to help make a compensation for the pressure reading. A product from EProduction Solutions, Inc. was developed on several basic requirements to ensure reliable data. Some of these requirements include; a wide operating range, large output signal to the transducer, repeatability, stability, and resistance to shock and vibrations as well as resistance to gases and liquids downhole. This design has minimal electronics to decrease the number of problems that could occur (EP Solutions).

Motor controllers are used to turn on and off the natural gas powered motors. The operator is able to control the number of cycles and the time between cycles. EDI has a product called a pumpmatic controller that is able to run 50 cycles per day. The pumpmatic can measure the number of starts and stops, RPM, and total run times (EDI).

Differential control system is a product from EDI that monitors and controls the casing pressure, tubing pressure, and differential pressure between them. The differential pressure is important because this helps achieve the most efficient production. This

product can automatically determine the cycle procedure from the differential pressures (EDI).

Tank gauges are used to measure the tank levels, so you know when the tank if full and needs to be picked up. The monitor system collects the data and sends it wirelessly to the server where the operator can see the data. There are a few different types of tank gauges that are being used, these include float monitors, radar monitors, and pressure monitors. Robertshaw Industrial Products has created the Centeron Wireless Tank Monitoring System. The system allows an advanced measuring system and high levels of operating efficiency (Robertshaw).

The products mentioned above are all products being used in the Appalachian Basin, however this is not all the products available due to many variations of products dependant of the supplier. There are many more monitoring products being used around the world for many different applications, and companies such as EProduction Solutions, Inc., Robertshaw Industrial Products, and Electronic Design for Industry (EDI) carry some of them.

When I asked a representative from EProduction Solutions, Inc. why the monitoring technology has not been in affect in the Appalachian Basin, the representative said that the economics play a big role. He said the marketing effort has been non-existent in the Appalachian Basin until 3 years ago. He said they mainly focused on the larger fields in Texas, California, and overseas (Weber,J).

There are many advantages of using automation monitoring systems such as: increased production, reduced operating costs and well failures, individual well management, efficiency in field operations, and efficiency in computer operations and

automation. Increased production comes from the operator being able to monitor the performance and make small changes. If the well encounters a problem, the operator will be notified even if they are offsite, and as a result the well can be put back online faster then before; increasing runtime and production. Also the automatic tools provide indications that a well might be going down, and the operator can go ahead and make changes before the well goes down. The early detection is a major advantage to the monitoring system (EP Solutions).

Reduced operating costs and well failures can be a result of closely monitoring for failures of all the components in the system. The systems help diagnose problems without the operators having to take actions. For example, by fine-tuning the rod pump controllers the operator can minimize rod stress and fluid pound. The monitoring systems can also diagnose pump wear, excess friction, rod overstress, gas compression, gearbox overload, and high fluid level. The systems typically reduce repair and maintenance by 10% to 30% per year (EP Solutions).

Individual well management can be seen by the system managing a well everyday. This way the operator can work on fixing problems and not worry about looking and waiting for them. Early detection, notification of well performance degradation, and comparison of well tests are three ways that show individual well management (EP Solutions).

Efficiency in field operations included less visits to well sites, because the information is easily displayed on screen in the office. The well sites still need to be visited but not as often which frees up personnel for other important activities. Alarm notifications built in the systems can call or page an operator if an alarm goes off at any

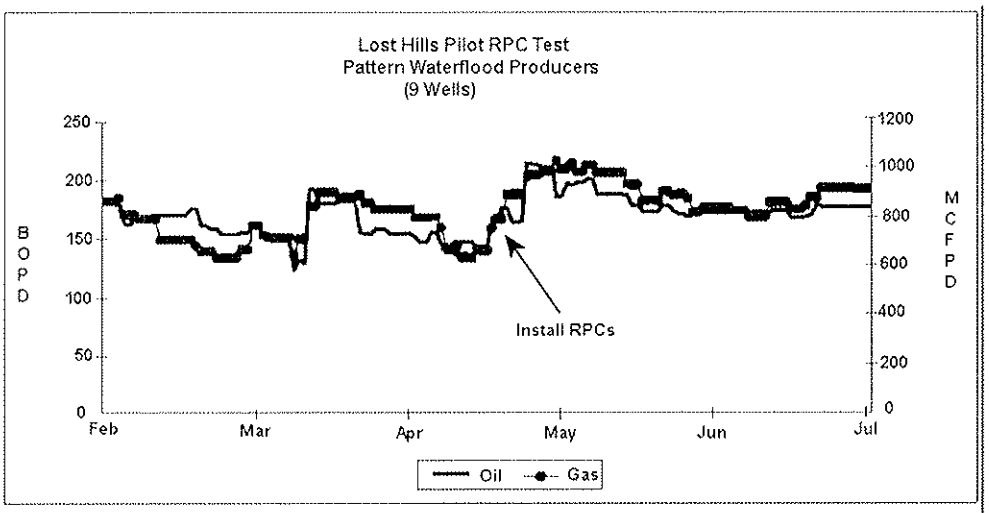
time of day. This way the operator can be doing other activities and doesn't have to be at the site or in the office (EP Solutions).

Efficiency in computer operation and automation is seen in time-reduced installations. Due to the simplicity of the installation, the amount of time personnel has to spend working on it is greatly reduced. Also the programs can be integrated to each other so there is less opening and closing of different programs (EP Solutions).

Real-time production optimization provides a solution for gathering and analyzing data so better decisions can be made. Real-time is broken into three parts; these include collecting data, analysis of data, and decision-making. The data is collected from the well site or shop through automations and manual entries. Then it is analyzed through pattern matching, historical trends, and IPR curves. Finally it is time for the operator to make the decision on what actions to take (EP Solutions).

The only way to know if the products are economical is use test wells in your field. An SPE paper on testing and applying pump-off controllers shows much success. A company producing in the Lost Hills Field had 250 wells where they were going to implement pump off controllers (POC). The approximation to put POC's on all 250 wells was $1 million. They ran 9 test wells where they implemented the POC's for a few months. Production and electric usage were measured during the test. Before the POC's were installed the nine wells made 160 BOPD and 767 MCFPD, and after installations the nine wells made 178 BOPD and 898 MCFPD. An increase of 18 BOPD and 131 MCFPD were seen as the result. On the electric side, the two and a half months prior to the POC installation the average electric was 523 kWh per day for the nine wells and the average electric after the POC's were installed was 422 kWh. A decrease of 101 kWh

was seen as the results. The graph below shows the production from the 9 test wells for the 5 months that they were monitored (Eckel, Abels, Merritt).




**Actual Production for Lost Hills Pilot RPC Wells**

I believe that we needed to take another look at this information because the prices for the products have decreased slightly. From the representative of EProduction Solutions, Inc., "On average once everything is set up and used properly, the products usually pay for themselves in 6-8 months". The value of the products is increasing due to the efficiencies they produce and the increase in the price for oil and gas. By making the operations more efficient will lead to better production rates and less expenses from failures that were unseen.

In conclusion, I have explored some of the more important products that are being used in the Appalachian Basin, presented and explained what these tools monitor and how they work, explained why we should take another look into remote monitoring. I believe that the price of this technology is becoming efficient to use in the Appalachian Basin as long as the company gets good rate of return from test wells. I believe test wells

are crucial, and should be used and monitored to see if the technology should be implemented in a field. Although not everyone will have the same results, there should be a definite increase in production and a cost savings.

This technology has been around for 25+ years, but it wasn't until 10 years ago that the technology was accepted and incorporated in oilfields (EP Solutions). The products are changing daily and will continue to change for several more years. I believe these products will be incorporated into oilfields all over the world for many years to come.

# Works Cited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