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Report Title: Real Time Remote Field Monitoring of Plunger Lift Wells to Reduce Production Down Time and Increase Natural Gas Production

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Disclaimer

Abstract

Optimization of the processes required to produce hydrocarbons constitutes an on going strategic concern and a major goal in the oil and gas industry. The goal of this project was to develop a low cost surface system to achieve the following: monitor the plunger lift process in wells, transmit well production streaming audio signals to remote locations, monitor in real time the performance of the entire field and determine if and when the wells stop producing. The purpose of monitoring the plunger lift process is to optimize the production and to minimize the amount of down time and lost production from wells. This new system acquires the information generated by the plunger as it travels in and out of the wellbore and monitors the fluids and gas being lifted by the plunger. The information is transmitted to a central control area where the operator can listen in real time to each well performance to determine if the well is producing. A person can be dispatched to the well site for evaluation if the well is not producing. A computer system was also developed to automatically listen and inform the operator if a well is not producing properly. This project has researched, developed and tested a low cost, high reliability, real time system to monitor the plunger lift well production process and provide the operator with production information to determine if the well is producing.

This system was optimized to differentiate collar sounds from the spring sound generated when the plunger gets to the bottom of the well.

The project was completed successfully.

Introduction

The Real Time Remote Field Monitoring of Plunger Lift Wells to Reduce Production Down Time and Increase Natural Gas Production project has progressed well during this quarter. The main goals for the project are:

- Surface system will permit the operator to monitor multiple wells performance in real time and determine when there is a problem.
- System will decrease the Operating Costs (OPEX) by having the company personnel travelling to a wellsite only when the well is not operational
- System will optimize the plunger lift process
- System will increase hydrocarbon production and decrease well down time

The system is able to transmit data 30 miles using antennas that will carry the sounds generated by the plunger inside the well. The antennas do not have to have a line of sight to be able to work properly. The surface data processing system can be used for permanent applications or for service applications where the system can be used to optimize the plunger process and removed from the wellsite.

The achievements for this project were:

1. Implementation and testing of the Real Time Remote Field Monitoring System.
2. Developed a wireless link where data is transmitted from a remote site to a control room using Internet stream audio techniques.
3. A remote surface panel was developed.
4. The system can measure plunger velocity based on the distance and time for the plunger to pass the collars.
5. The software is now capable of detecting and monitoring gas production so that it can start the plunger process once the software determines that the gas production has dropped below a predetermined minimum amount.

Executive Summary

Implementation and testing of the Real Time Remote Field Monitoring System was successfully developed for optimization of the plunger lift production process. The achievements for this project were:

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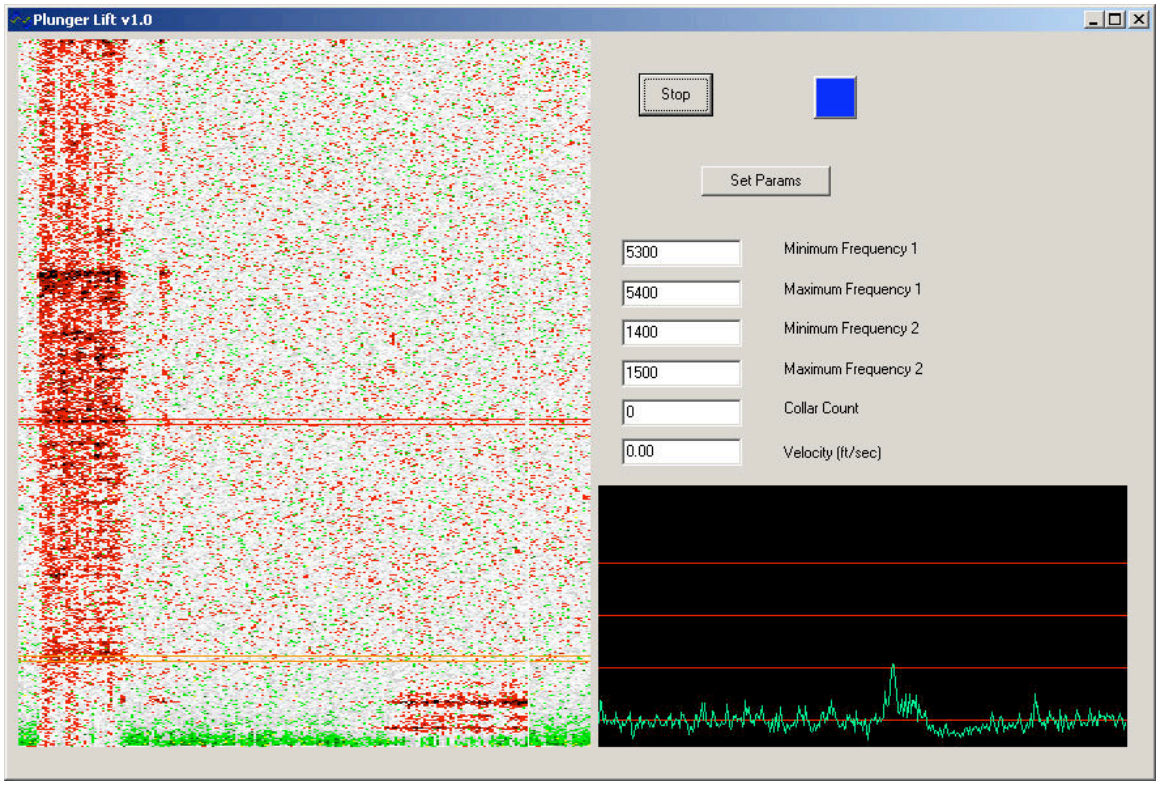
The surface system consists of a portable electronics and acoustic processing hardware, a Personal Computer and the wellhead acoustic to electrical converter. The Acoustic to Electric Converter Microphone (AECM) is strapped on the outside of the wellhead and it is used to listen to the noises generated by the plunger as it travels in and out of the wellbore. The AECM is attached via cable to the surface processing system. It contains the acoustic pre-processing and the data output. The Personal Computer will get the pre-processed data and evaluate for patterns stored in the system related to sounds generated downhole. Once the computer matches the sound generated by the plunger disk with the pattern recognition software it will provide and/or update the data on the computer screen and update the output module as well.

Experimental

The experiments performed during this project to verify that the system worke properly were as following:

1. The wireless link, consisting of two high-gain antennas with their transceivers, was tested at various distances to determine the relationship between link quality and distance. As expected, it was found that increased distance will decrease the effective bit rate. The wireless link used automatically chooses the highest bit rate possible based on the bit error rate, so the system was able to decode at all distances without loss of signal. The lowest bit rate observed was 160 kilobits per second.
2. The surface system is composed of an accelerometer, a programmable gain amplifier, an embedded motherboard, and a power supply. The operating system is Windows XP Pro, allowing the use of Remote Telephony features. The components are enclosed in a NEMA-4 enclosure. The surface system passed all qualification testing, including transmission of streaming audio.
3. The software work performed during the project was to develop a package to determine when the plunger lift passed a collar and use that information to determine plunger velocity and if the plunger is stuck in the well. The system monitors the time and distance traveled from when the surface system detects that the plunger disk has gone through a collar and calculates real time velocity of the plunger. See picture below



4. The system also monitors the gas production after the plunger is returned to the surface. After the gas noise levels detected are below a certain pre-determined level the surface system issues a change in the output on the 4-20 milli Amps output that allows the plunger disk to return to the bottom of the well. A recording was made of a plunger run and that recording was used to verify successfully the accuracy of the software to detect the gas production.
5. The system also provides a positive indication to the operator that the plunger has hit the springs located at the bottom of the well by using a software module that monitors for the springs noise pattern. The recording on a live well was also used to verify the detection technique for the spring detection. A window is created letting the operator know that the plunger has hit the springs and that it is in the bottom of the well. See picture below.

Results and Discussion

The system design and testing has been completed. The surface system and processing software were evaluated against prior recordings of plunger lift runs in wells in East Texas.

The software was able to detect and display on the computer screen when the plunger passed by a collar. The velocity of plunger was also displayed on the computer screen.

The surface system was completely tested and it is ready for commercial applications. The surface system passed all qualification testing.

The gas production level detection software was also completed and tested successfully using recordings from East Texas.

The system was successfully interfaced to a set of antennas that allows the data (sounds) detected by the acoustic detector at the wellhead to transmit the sounds using a stream audio Internet protocol to a remote location where a similar antenna detects the signals and connects the data to a processing surface system. The operator can now monitor the production of plungers from a remote location being able to determine if the plunger lifting system is operating properly and natural gas production is at an optimum level.

Conclusion

The plunger lift automation project is completed. The new surface system was finished, the new real time processing software was tested successfully and the new antennas were also tested and the results were better than expected. The project allows for the following improvements in the plunger lift production process:

1. Monitor the plunger as it goes in and out of the wellbore.
2. Monitor velocity of the plunger as it travels in and out of the wellbore.
3. Determine when the plunger hits the springs at the bottom of the well.
4. Monitor gas production after the plunger has returned to the surface.
5. Optimize the plunger gas production.
6. Transfer the data obtained at the wellhead to a remote location using radio antennas.
7. Transfer noise from inside the wellbore to a control room at a remote location using the Internet audio stream protocol so that these sounds can be heard in real time in the control room.

The project will help improve the production of natural gas that is produced using plunger lift systems.

References: none