PROPER PROCEDURES, COORDINATION, COMMUNICATIONS, AND TRAINING A MUST FOR ECONOMICAL SUBMERSIBLE PUMPING OPERATIONS

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ABSTRACT

The importance of proper procedures, well data coordination, communications, subcontractors and employee training for submersible pump operations cannot be overstressed. This paper points out how some operating practices can result in unnecessary expense, and provides recommendations for helping to reduce these costly mistakes. It is felt that if these recommendations are followed, it will result in highly successful submersible operations for the user. It is recommended that the producing company evaluate the points of this paper and put into action the good working practices and training that will result in efficient operations with good economical results.

INTRODUCTION

Emphasis should be put on adopting the proper operating procedures, communications, engineering, and employee training for all phases of well preparation, equipment handling, installation, and after-operations for submersible operations.

Substantial amounts of money have been spent and wasted unnecessarily on submersible operations due to poor communications, poor operating practices, and poor employee training. The majority of these costs could have been avoided with the proper operating procedures and training.

Electrical submersible pumps (ESP) are a natural consideration where high withdrawal rates are desired and where the cost per barrel in lifting cost must be maintained at a minimum to ensure good profits.

A typical ESP consists of seven basic components: electric motor, multi-stage centrifugal pump, balancing seal, power cable, motor flat extension, switchboard, and transformer(s). In addition to these basic components, various auxiliary items are used. In some cases, variable speed drives, soft starters, etc. are used. The system is designed to operate the total unit automatically. A typical arrangement is shown schematically in Figure 1.

Submersible pumping equipment is manufactured in numerous sizes and types to fit the well specifications (such as casing size, desired producing volume, total lift, electrical power supply and environment).

Selection of the proper submersible pumping system for a given application is important; however, this paper does not cover the actual sizing process. This paper <u>does</u> stress the importance of user companies setting up a program to train any employees involved in submersible operations on the basic procedures of sizing, the functions of all components that make up a submersible system, maintenance, operating procedures and safety.

Properly educated employees and well servicing crews can be very important to successful operations. Periodic seminars can save thousands of dollars in costly mistakes by pointing out critical areas to be aware of during installation and after-operations.

COORDINATION

In conjunction with training, there should be complete coordination and communication between all departments involved in submersible operations. In most operations, there are several individuals working on different phases of production operations. Problems can be experienced unless there is coordination and all data is collected in a central location.

A computer can be utilized to collect all data pertaining to a well and a complete up-to-date well history generated. All operations pertaining to the well could be coordinated and production graphs produced. On any artificial lift system, periodic tests and equipment analyses are required to obtain the most efficient operations. With good concentrated data, it is an easy task to determine what operations are best. This data could be available for analysis quickly and efficiently when problems or changes occur in a well.

DATA IMPORTANCE

The proper production and operating data for a pumping unit can be used to:

1. Check the installed design and operation
2. Resize, if required
3. Signal the possibility of a problem that could cause premature failure
4. Identify problems
5. Evaluate economics of installation
6. Corrosion control effectiveness
7. Aid for determining reasons for failure
8. Comparison of other offset wells
9. Other criteria that are important to monitor.

AMMETER CHART IMPORTANCE

In the majority of articles, the ammeter chart has been stressed as a very important tool for monitoring a submersible pump's operation. However, many operators continue to ignore this useful tool or their employees are just not aware of how useful it is. As an example: In one field visited, the ammeter chart had been turned around so the white surface was facing out. The explanation was that the pumper could see the chart easier without getting out of his truck. With this type thinking, one could certainly assume that all other procedures were just as lax. Unless extremely lucky, this type operation ultimately would result in a high amount of unnecessary expense for the operator.

The length of this paper does not allow going into depth on ammeter chart analysis, but it is felt that some examples are in order. Figure 2 illustrates an ammeter chart for a new unit installed in a well. The unit had pumped off and shut down on undercurrent, then restarted automatically, pumped off and shut down, etc.

The unit started normally at point A and continued to operate normally until point C. At point C, there was a decrease in amperage as the fluid level was pumped down. At point D, the fluid level in the well approached the pump intake with a resulting amperage decline. Finally, the pre-set undercurrent level was reached and the unit dropped off line (pumped off).

The unit pumped off and triggered the undercurrent. The automatic restart sequence went into effect. The unit restarted automatically after a pre-set time delay. During the shutdown time, the fluid level rose slightly. When the unit restarted, the fluid level had not reached static. Therefore, the pump-off cycle began somewhere in section C.

This condition exists because the unit is improperly sized for the application. There are several options in this case:

1. Lower the pump, if possible, taking into consideration the well's depth and the existing pump design. Note: It is possible that the pump doesn't have sufficient head capacity to pump efficiently at a lower depth.
2. Stimulate the well.
3. Choke production back. Note: This usually never works when a unit is sized this poorly. Choking back can be detrimental to the equipment.
4. Operate unit and program downtime cycling for maximum fluid withdrawal, using the fewest number of cycles. Note: Repeat starts are detrimental to equipment.
5. Resize. Note: The pump should be resized on the next pump change.

Additional data can be derived from the ammeter chart such as well production at present conditions and build-up time.

Figure 3 indicates gassy fluid or an emulsified fluid. Using the proper data in conjunction with the ampchart, it is possible to determine which fluid is being handled.

ACTUAL EXAMPLES

The following are two actual examples of how the proper analysis of available data could have resulted in better economical operations.

The first example involves wells in a Mid-East field. The problem presented was that the production had dropped from 3000 BPD to 1500 BPD on six wells in this particular field. The production drops had been attributed to gas interference.

Obtaining the proper data was difficult as there was very little coordination. The following was found:

1. All affected wells were equipped with the same size submersible equipment and set at the same depth.

2. The problem had developed over an extended period of time.
3. The fluid levels had increased.
4. A trip to the field showed that the ammeter charts all showed the same or similar characteristics.
5. An analysis of present and past production data showed that the water cut had changed in all of the wells.

Using experience with ampchart analysis, review of the production data and the running of several other tests, it was evident that the production loss was due to a blockage caused by an emulsion problem.

One well was selected and an emulsion breaker was used. As a result, the well was returned to the original production. The same results were obtained on the remaining five wells.

The point here is that the ampchart was one key. Using this key with other centralized data could have provided further analysis and pinpointed the actual problems. Not following proper procedures and going on assumption resulted in a large loss of production.

The second example involves a New Mexico well equipped with a submersible pump.

The pump in question had been pumping 1400 BPD for a year. The production suddenly dropped to approximately one-half the normal volume. The fluid level had increased considerably.

It was assumed that the pump was at fault, so the unit was pulled and a new unit of the same size was installed. The unit was put back on production and after the kill fluid was pumped out, the unit continued to pump at one-half its capacity.

At this point, a complete check was started, assuming that it was improbable that the new pump was bad. However, the decision to pull the second pump and install another was almost made.

In talking to the field personnel, it was discovered that the only change made to the well in the past two weeks had been a change in chemical treatment. The treatment was stopped and the rate returned to its original production. The chemical being used was not compatible with the well fluid.

With centralized data and communication, the well's problem would have been extremely obvious. The lack of coordination resulted in several thousand dollars of unnecessary expense.

TRAINING

Individuals should be carefully selected for their overall ability to learn all phases of submersible pumping operations. A team or individual with the responsibility of training a team should be specifically trained for submersible operations.

A submersible pump installation is a pumping system that involves a substantial amount of basic electricity. There are four basic instruments for testing electrical characteristics: ammeter, voltmeter, megger, ohmmeter. Employees involved with submersible operations should be trained to use these electrical instruments with a complete knowledge of what they are reading. This training would include all the necessary safety precautions.

A comprehensive training program for submersible pumping operations should include the following:

1. Component identification and function
2. Basic pump sizing
3. Well preparation
4. Installation
5. Data gathering
6. Maintenance
7. Trouble-shooting, including ammeter chart analysis
8. Safety.

Training in the use of specialized equipment such as variable speed drives, etc. would have to be handled by special training sessions because such equipment is complicated and changes continuously.

CONCLUSIONS

A system approach is critical for proper submersible pump operations. A system should be set up that can be used for a complete analysis of each component and operation in the submersible pumping systems.

The data feeding the system must be accurate and of the proper type. Individuals should be trained to interpret the data correctly and trained in all other phases that ensure proper operations.

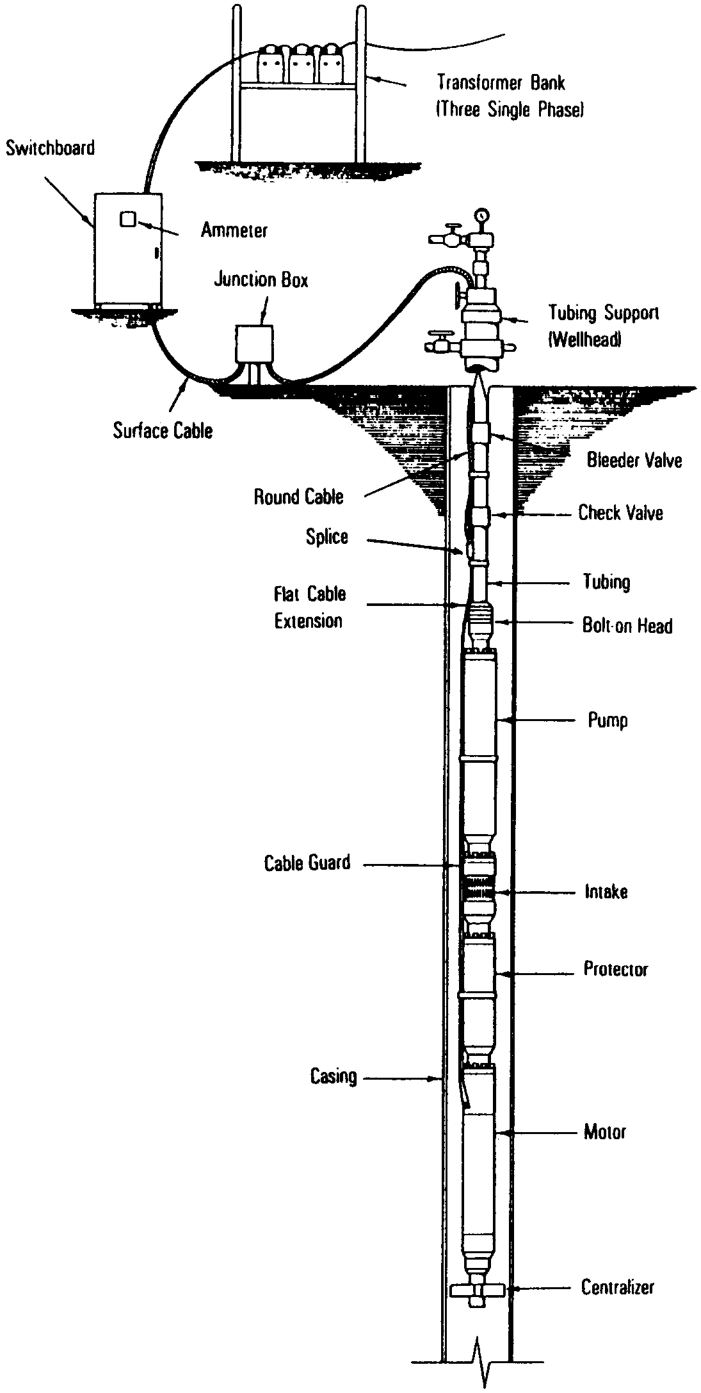

Figure 1 - Complete illustration of submergible installation

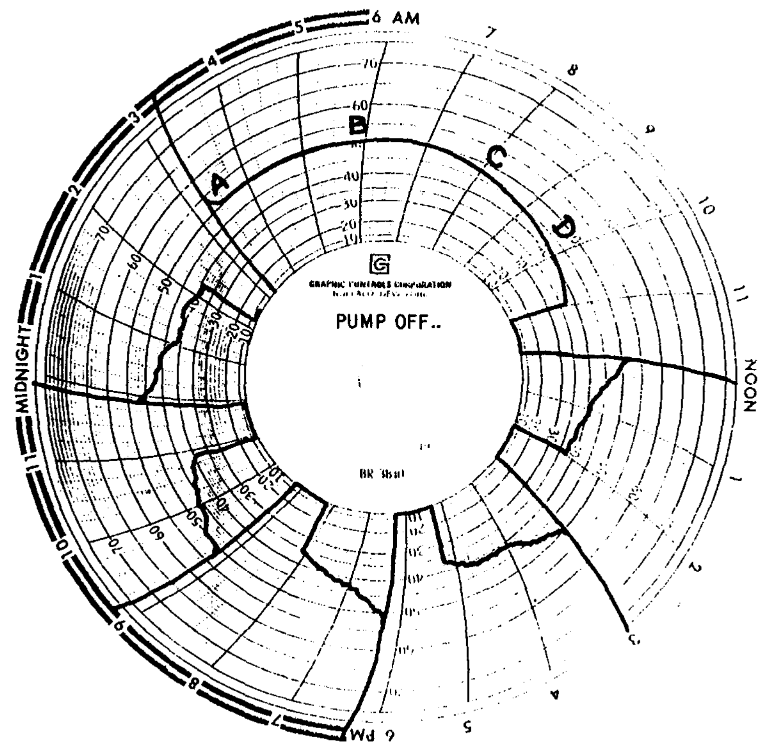

Figure 2 - Ammeter chart showing pump-off and shut down on undercurrent

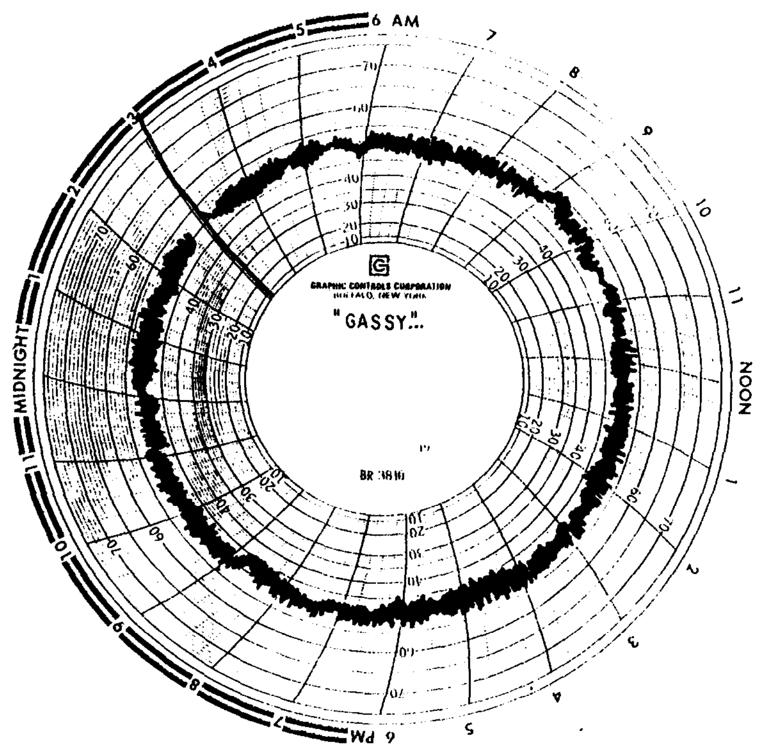

Figure 3 - Ammeter chart illustrating handling of gassy fluid or emulsified fluid