The Lease Pumper's Handbook

CHAPTER 7

ELECTRICAL SUBMERSIBLE LIFT

A. Electric Submersible Lift

1. Electrical Submersible Pumps.
2. Advantages and Disadvantages of the Electrical Submersible Lift System.
   - Advantages.
   - Disadvantages.
3. Downhole Components.
   - Motor.
   - Protector.
   - Gas separator.
   - Pump.
   - Cable.
4. Surface Components.
   - Tubing head.
   - Chart meter.
   - Control box.
   - Transformers.
   - Electrical supply system.
5. Special Surface Considerations.

B. Operating Electrical Submersible Lift

1. Well Operation and Automatic Controls.
2. The Electrical Submersible Pump Well.
3. Continuous Operation.
4. Intermittent Operation.
5. Servicing the Well When Problems Occur.

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Section A

ELECTRIC SUBMERSIBLE LIFT

The previous chapter explained the use of mechanical lift as a means of bringing fluids to the surface when bottom hole pressure is not adequate in a new or previously naturally flowing well. With time, production may decline to the point that mechanical lift is no longer effective. The lease operator may try changing the mechanical lift system to compensate for the declining production by adjusting the length of stroke on the pumping unit and changing the sheaves to increase the number of strokes per minute. A long-stroke pumping unit with lighter counterweights may be installed.

As the production of natural gas and crude oil continues to diminish and water production increases, particularly in water-driven reservoirs, the lease operator may begin *waterflood*, an enhanced recovery method in which water is injected into the reservoir at one well to drive hydrocarbons to other wells (see Chapter 15). However, with time oil production will continue to fall and water production will increase. As this occurs, the pumping time is increased until the lease pumper is producing the well twenty-four hours a day.

At this time, the most practical way to improve production is to install a system with greater production capability. One of the choices, especially in high-volume waterflood operations, is the electrically driven submersible pump. A submersible pump is one that is lowered into the fluid to be pumped.

A-1. Advantages and Disadvantages of the Electrical Submersible Lift System.

Advantages. One of the most important advantages to this system is its ability to pump very large volumes of fluid at shallow to medium depths. Casing size is also not important to being able to pump these high volumes. As waterflood volumes increase, it is common to pump several thousand barrels of fluid a day while trying to improve formation sweep efficiency.

This system is easy to adapt to automation and can pump intermittently or continuously.

For shallow wells, the investment is relatively low.

Disadvantages. The buildup of scale deposits or *gyp* can interfere with the operation of submersible pumps. Also, the cost of electricity can also be very high, especially in remote areas. The system has limited flexibility under some producing conditions, and the entire system in the well must be pulled when a problem is encountered.

A-2. Electrical Submersible Pumps.

An electric submersible pumping unit consists of an electric motor and a pump (Figure 1). The motor is on the bottom of the assembly, and the pump is on top. An electrical line is strapped to the outside of the tubing, and the whole assembly is

lowered into the hole with the pump and motor set below the liquid level. As the motor turns, it rotates a stack of liquid-lifting cups or disks in the pump. The more cups that are added, the higher it will lift the liquid.

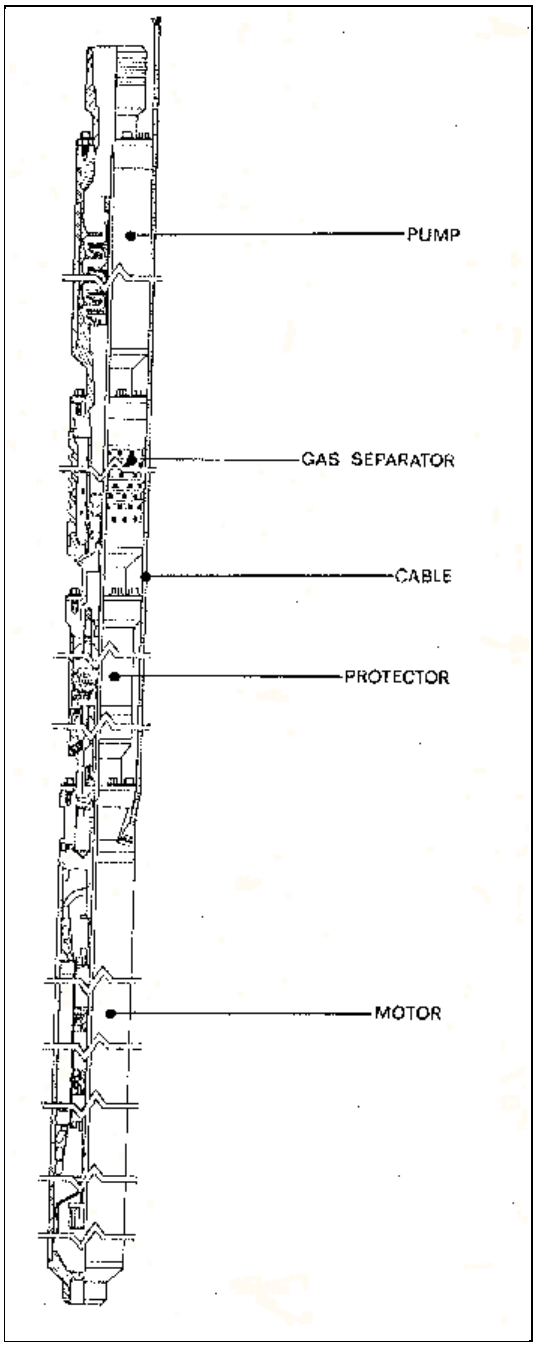

Figure 1. A motor and pump assembly.
(courtesy of Reda Pump Company)

A-3. Downhole Components.

Motor. The first component that is lowered into the well is the electric motor. The motor size is designed to lift the estimated volume of production.

Protector. The protector is attached to the top of the pump to seal the motor and allow a drive shaft in the center to drive the pump.

Gas separator. A gas separator separates the gas and liquid for pumping.

Pump. The pump is designed to carry the fluid load. The shaft may be of Monel, and the stages be made of a corrosion- and wear-resistant material. The pump has a rotary centrifugal action.

Cable. A cable leads out of the top of the motor, up the side of the pump, is strapped to the outside of every joint of tubing from the motor to the surface of the well, and is extended on the surface to the control junction box.

The cable consists of three strands of continuous wire. The cable is flat with the wires side-by-side as it reaches from the motor up beside the pump to the tubing, at which point it becomes round. The cable may have a metal shield to protect it from damage.

A-4. Surface Components.

Tubing head. The tubing head is designed to support the tubing string and provide a seal to permit the electrical line to pass through the head. This seal is usually designed to hold a minimum of 3,000psi.

Chart meter. An optional component, the chart meter records the daily performance of

the well that is easily read and can provide information that helps to identify a host of operational problems that may occur.

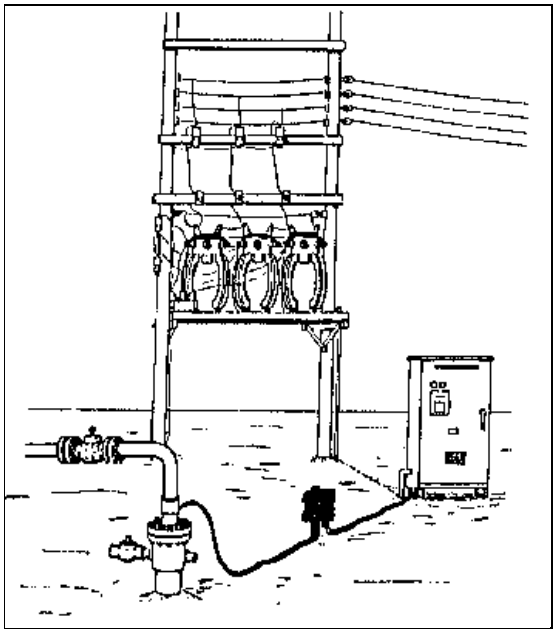

Figure 2. The surface equipment, including the power line, transformers, control box, meter chart, and wellhead. *(courtesy of Reda Pump Company)*

Control box. The control box controls the flow of electricity to the pump motor. It allows the well to be operated continuously or intermittently or to be shut off. It also provides protection from surges or changes in the electricity that may occur.

Transformers. The transformers are usually located at the edge of the lease site. They transform the electricity provided over the power lines so that it is the correct voltage and amperage to operate the pump motor.

Electrical supply system. This is generally the commercial power distribution system. The highest available voltage produces the most efficient performance.

A-5. Special Surface Considerations.

Many operators are very innovative when installing a new system. A joint of pipe from the well to the control panel will provide a conduit through which to run the power cable. It will be possible to run vehicles over the conduit, yet not damage the cable.

A post and hanger near the control panel may provide a place to hang a few extra loops of the pump cable so that the pump can be positioned lower without having to splice the cable.