The Lease Pumper's Handbook

CHAPTER 11

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Chapter 11
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Section A

MOTORS

A-1. Fundamentals of Electricity.

There are three characteristics of electrical power that must be matched to a piece of equipment. First, the equipment will require either *direct current* or *alternating current*. Electricity that flows in one direction is called direct current (DC). Battery-powered equipment, including flashlights and radios, operate on direct current. Most equipment that runs on electricity from commercial power lines uses alternating current (AC). Electricity in an AC power system rapidly switches flow direction as it moves through a circuit. AC power generates less heat than DC, so for transmitting current over high lines for a long distance, AC is used.

How quickly AC power switches direction is referred to as its cycle rate. In the United States, electricity operates at 60 cycles per second. A cycle consists of two changes in direction, so 60-cycle current changes direction 120 times per second.

In Europe and many other countries, electricity operates at 50 cycles per second. Electrical equipment will not operate at the correct speed or may not operate at all if the correct cycle rate is not used.

The third concern is that the voltage of the electricity and the voltage requirements of the equipment match. The typical house voltage in the U.S. is 110 volts, though 220-volt power is used for some appliances such as heating and air conditioning systems, clothes dryers, and water heaters. At the well site, electrical lighting and standard power outlets will generally operate on 110 volts, though larger equipment such as pump motors will often use 220 or even 440 volts. System voltage is changed through the use of transformers. The electricity being carried through power lines over long distances will be at voltages of several thousand volts. A transformer on the lease site power pole will step the power down to the level to be used by the site equipment.

Electrical plugs and outlets with different voltage ratings will differ to prevent equipment from being plugged into the wrong system. Standard electrical systems in some foreign countries are 220 volts.

A-2. The Lease Electrical System.

Most higher voltage equipment (220 V and above) operate on three-phase power. Three-phase power has to be converted to single phase to power common consumer items such as drills, lights, etc. A network of electrical lines distribute power to each installation and equipment across the lease. Occasionally, a system will have four overhead lines, but a three-line system is more common and is described in this section.

This network of pole-mounted high lines originates from generators miles away. It distributes electricity to surrounding areas for many hundreds of square miles. The amount of electricity consumed on a lease is

insignificant compared to the overall amount of electricity supplied to an area. Consequently, if the lease suffers a loss of electricity, the power company will not be aware of the problem until they are telephoned or otherwise notified.

After the electrical power line enters the lease, it is distributed to poles containing three fuses and appropriate step-down transformers suitable to operate the wells (Figure 1). As voltage is stepped down through a transformer in a direct ratio, the amperage, a measure of how much work electricity can do, is stepped up. Electric motors run on 110, 220, or 440 volts. Occasionally, a different voltage will be encountered.

Figure 1. Typical line fuses and step-down transformer common to most leases.

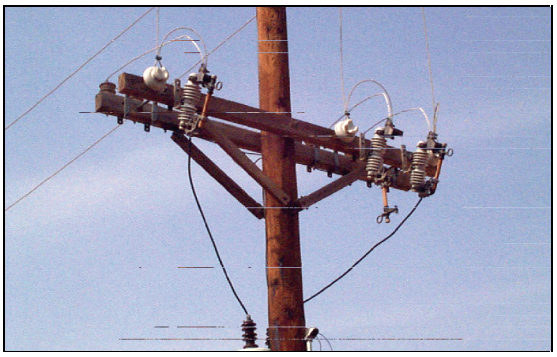

Figure 2. Pole with one fuse out of service.

As shown in Figures 1 and 2, there are three fuses on the electrical pole. Figure 2 shows a blown fuse. A blown fuse is easy to identify because fuses are spring-loaded and, when blown, will usually trip loose and hang down. If this should occur, all equipment downstream from the circuit served by those fuses should be removed from service as quickly as possible and left out of service until the fuse has been replaced. This prevents equipment burnout.

The electric company that owns the line must be notified when a fuse is out. They are generally understanding of the severity of the situation and respond quickly to replace it.

A-3. Control Boxes and Equipment Fuses.

The last high line pole should be installed far outside of the well servicing guy line area for safety reasons. The power line trails down the pole into a fuse box, with an adjacent disconnect lever to electrically isolate the site while performing major repairs. The electrical line continues down the pole and runs underground in galvanized waterproof pipe (conduit) to the pumping unit or other equipment.

An automatic control box (Figure 3, on the next page) is mounted near the installation to operate the equipment. In the photograph, the control box is located near the upper edge of the picture. The equipment fuses are the cylindrical objects in the lower front of the box. When performing any services or workover operations at the well, the breaker arm on the control box should always be pulled to electrically isolate the equipment and locked out in order to prevent electrical accidents at the well or installation. The installation illustrated also contains two timers, one automated and one manual.

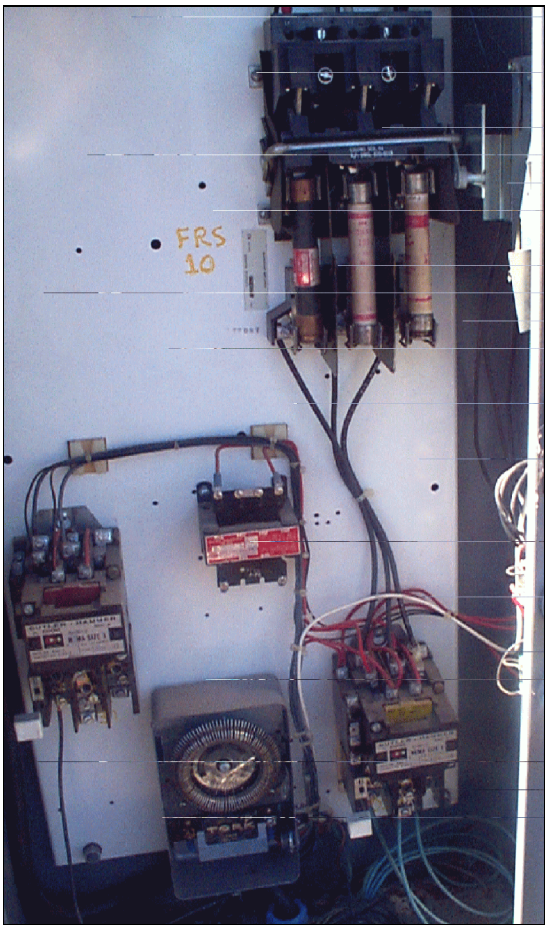

Figure 3. Control box containing one automated 24-hour time controller and one manual controller.

A-4. The Automated Control Box.

The lease pumper needs to understand the basic functions of the automated control box. In a typical unit, electricity enters the bottom of the box and is run to the upper right corner as it progresses through the box. The first wiring is diverted to a lightning arrester located outside the box. The box contains a breaker to disconnect the electricity and remove a unit from service.

Three fuses are located just below the breaker. This is the first line of defense to protect a system from overload. Two wires, one from a side lead and the second from the center wire, are connected to a small 110-volt transformer. These two wires then lead to the control switch located on the outside of the box.

The control switch has three positions. When turned to the **on** position, the equipment will run continuously. When the control is set to **off**, the equipment is turned off until the control is changed. If set to **automatic,** the time clock will control operation. This device has three leads to it from the fuses on the top side, and the leads from the bottom run out of the box and are connected to the power motor. Setting the time clock to a **run** or **on** position will engage electromagnetic units in the power control unit and the equipment will run. When the timer hits an off cycle, the power to the electromagnets is turned off, and springs separate or disengage the leads to turn the equipment off.

The power control usually has a carbon stack reset button and three heat safety controls that shut the unit in to protect the motor. With a minimum of instruction, the operator can troubleshoot simple problems, such as resetting the carbon stack or changing a fuse.

A-5. Time Clocks and Percentage Timers.

There are many styles of time controllers, but most can be categorized as either time clocks or percentage timers. The time clock is normally mounted in a metal box approximately 6 inches wide by 10 inches high by 3 inches deep. The percentage timer is a much smaller plastic control with one dial.

The 24-hour time clock. This type of clock is divided into 24 one-hour increments. Normally, the day half of the clock is

portrayed in silver while the night half is painted black. Most of these clocks have pins for on/off control in 15-minute increments. Running time can be divided around the clock or restricted to when the pumper is physically on the lease. A few timers are controlled in five-minute increments. For marginal wells, the timer is set to pump a certain portion of each hour on the time clock. With the well not pumping for extended time periods, the fluid buildup will prevent additional fluid from entering the wellbore.

The percentage timer. This timer allows the pumper to run a unit a certain percentage of the day. Typical percentage timers operate based on an interval of time, such as 15 minutes or 1 hour. The time is set for a percentage of that time interval. For example, if the timer has a 15-minute interval and is set for 50%, it will run 7½ minutes and be off 7½ minutes. This will happen every 15 minutes or 96 times each day. Overall, the pump will run a total of 12 hours in a 24-hour period or 50% of the time.

A-6. Electric Motors.

As noted earlier, electric motors on the lease are usually rated at 110, 220, or 440 volts. While electric motors can be wound to run at many speeds, they typically operate at 1100, 1400, 1725, or 3450 rpm.

Most pumping unit electric motors have nine wires leading out of the motor and into the wiring box on the side of the motor (Figure 4). Each of these wires will be numbered, and instructions on the plate will indicate that they should be grouped into three sets of three. These three lead groups will then be attached to the three wires from the control panel. If the motor is running in the wrong direction when the power is turned back on, any two leads can be loosened and reversed to change the rotation of the motor.

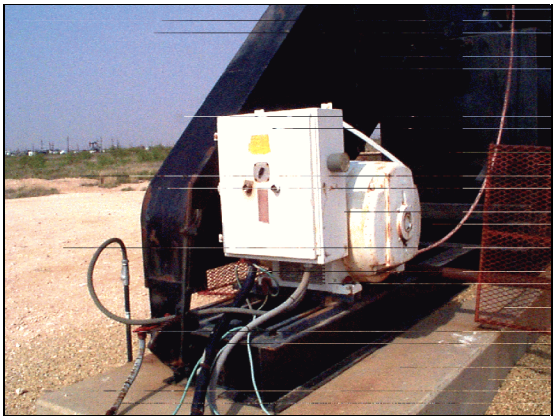

Figure 4. Electric motor and control box. The motor wiring can be changed to use three different motor speeds.

Some motors can accept either 220 volts or 440 volts. If this is true of the motor being installed, instructions on the motor's side plate will indicate which three wires go in each group for a specific voltages. If these instructions are not on the plate, the motor must be placed in service using the voltage stamped on the plate.

A-7. Electrical Safety.

The operator must always respect the lease electrical system. If handled improperly, it can be dangerous or deadly. This does not imply that electricity is too dangerous to use, but it does mean that good work habits must be developed and always followed. When a pumper is at work, there is usually no one within sight or hearing. The pumper must operate electrically powered equipment, change fuses, make minor changes, and operate automated controls with no one to help if trouble arises.

The best way a pumper can be protected is to be knowledgeable about handling electricity and to use good work habits. These include:

- Having a good pair of insulated work gloves to wear when handling electricity. They should not be used for any other purpose and should be kept clean.
- Isolating a system from electrical power before performing any service.
- Learning the correct way to perform electrical work duties.
- Not taking chances.
- Locking the electricity out of service as needed.

A-7. Costs of Electricity.

The company pays for the electricity delivered to the lease as part of the operating costs for producing oil. Generally, there are two major cost concerns in providing electricity to the lease: the initial cost of obtaining electrical service and the cost for the electricity consumed. These considerations can determine whether a marginal well is profitable and should be carefully managed.

Power companies may have a five-year minimum billing to cover part of the costs of installing the line to a new well. The production company will occasionally lay a temporary electric line on top of the ground from another well to run new wells until their productivity has been determined.

Power companies do not charge the same rate for electricity at all times of the day. Most charge a higher rate during normal office hours, such as 8 a.m. to 5 p.m. This is called their *peak hours rate*. Similarly the power company may charge a higher rate for periods of high usage, which is called their *peak load rate*. The lease pumper can help reduce costs by avoiding electrical usage that results in peak hour or peak load charges. For example, pumping units draw much more current when starting up than when they are running. This may favor running the pumps for a few long cycles rather than lots of short cycles if production can be maintained. The operator should alternate running units and stagger starting times in order to reduce billing. If possible, electrical equipment should run more during non-peak hours. The lease pumper may want to circulate tank bottoms and other functions while on the site during peak hours. This may be offset by running pumps during periods of cheaper power costs.

The operation supervisor should be aware of electrical billing practices and can provide advice in this matter.