

Avoid the Shock

Contractors need to take steps to prevent the leading on-the-job killer – electricity.

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Data from the U.S. Bureau of Labor Statistics show that 89 water well drillers died on the job between 1992 and 2002, and 28 of these deaths were electrocutions (Figure 1). In fact, electrical accidents are the leading on-the-job killer of water well drillers.

The use of electricity is such an integral part of our lives that we usually take it for granted, but if we don't understand or choose to ignore the hazards associated with electricity, the results can be deadly.

Why is electrical shock so dangerous? If the voltage (of a shock) is sufficient to drive electrical current through your body, just 10 milliamps of current (1000 milliamps = 1 amp) can cause muscles to contract and prevent you from releasing an energized wire or tool in your grip. As little as 30 milliamps of current can paralyze your breathing, and 75 milliamps can cause your heart to stop pumping blood (ventricular fibrillation). As a comparison, a small bedroom night-light draws about 30 to 60 milliamps.

Other factors influence how severely you'll be shocked if you touch a live electrical circuit, such as the path electrical current takes through your body and how long it flows, as well as your body weight. How much voltage is needed to drive electrical current through your body? Not much! Generally, any power source at 50 volts AC or higher is considered dangerous.

Power Line Hazards

Nearly all of the 28 electrocutions reported occurred when drillers accidentally contacted overhead electrical power lines with tools or equipment. Therefore, it's very important that all water well drillers know how to recognize and avoid overhead power line hazards. Most overhead power lines are not insulated and they often operate at several thousand volts or higher, so contact with *any* power line can kill you and your coworkers.

When a drill rig touches a power line, the rig chassis will become energized to nearly the voltage of the power line. This will be true whether the rig is on tires, crawlers, or jacks, and whether the work site is bare earth, turf, or pavement. A person on board an electrically energized rig and not touching the ground will normally not be injured because they are not a path to ground for electrical current. A person touching an energized rig and the ground at the same time, however, will create a path to ground for electrical current and probably be severely injured or

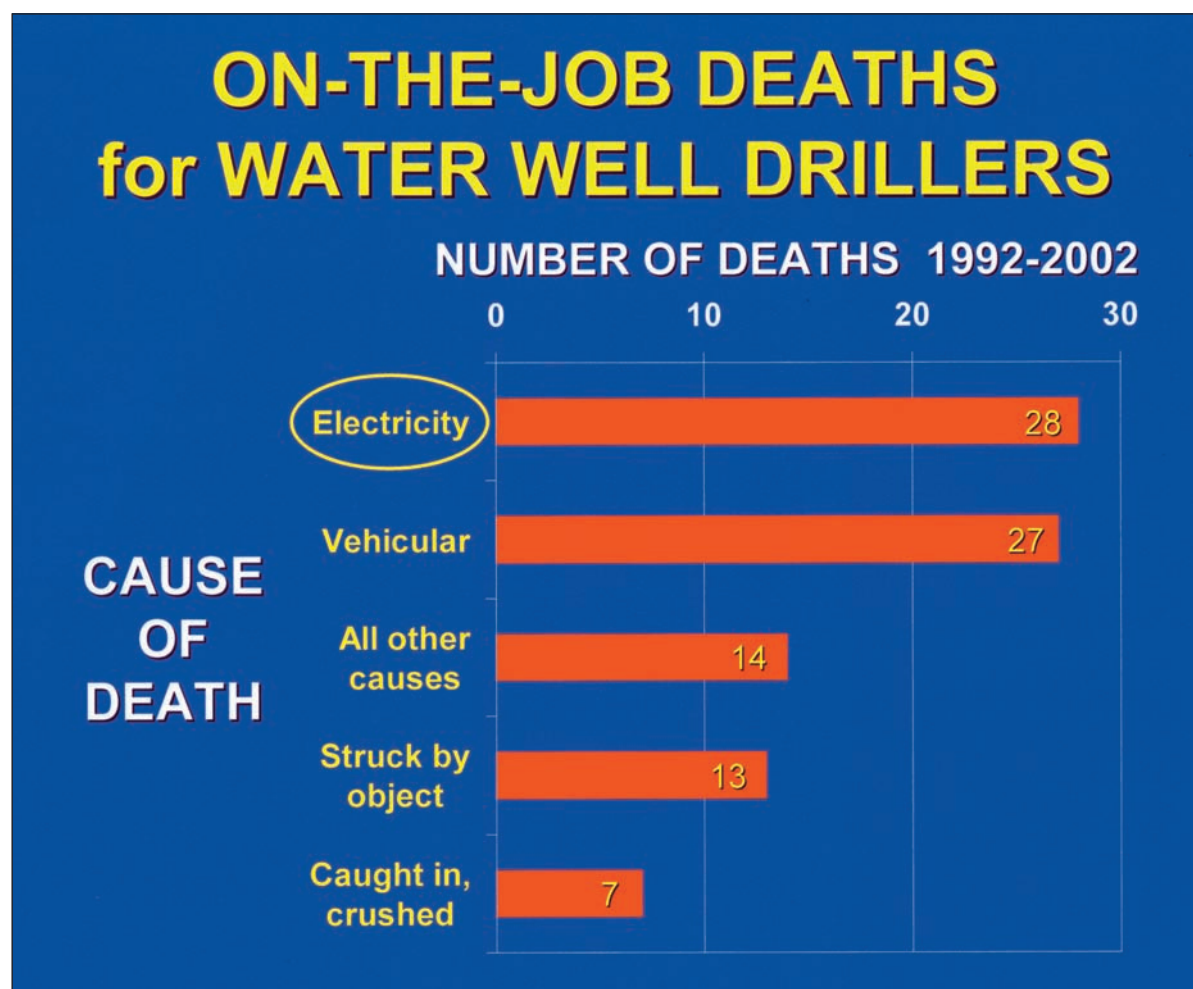


Figure 1. Electrical accidents ranked as the leading cause of job-related deaths for water well drillers over a 10-year period. (U.S. Bureau of Labor Statistics)

killed (Figure 2). In addition, anyone walking or standing near an energized rig can also be injured. How? Electrical current can flow from one foot to the other through a person's body, due to high voltages that can exist across the surface of the ground.

You can protect yourself from overhead power line hazards by taking a few simple precautions. Always look up when you arrive at a job site to determine if any power lines are nearby. Plan the job to avoid working near any lines you see, including service drops. OSHA regulations require that you stay at least 10 feet away from power lines up to 50,000 volts and require an additional 4 inches of clearance for every 10,000 volts over 50,000.

However, most people can't tell the operating voltage of power lines simply by looking at them. Play it safe — stay at least 35 feet away from all power lines with any part of a drill rig or any connected equipment. Use extreme caution if you must work in the vicinity of overhead power lines. It's a good idea to set up barriers and warning signs to keep anyone from operating equipment or handling tools and supplies closer than 10 feet from the lines.

As an added precaution, assign a crew member as a spotter (someone positioned to easily observe that 10 feet of clearance from power lines is maintained at all times) when maneuvering, raising, or operating equipment. Never move a drill rig with the mast raised. If you must work less than 10 feet from

power lines, the only safe way to do so is to work with the electrical utility company to control the hazard, such as having them de-energize and visibly ground the lines.

Try to anticipate situations that could accidentally put your rig or other equipment too close to power lines. For instance, while a drill rig mast is being raised or lowered, its path could bring it closer to a power line than was expected. Hoist and winch ropes that are safe while slack may contact a power line when tensioned. In addition, a mast may come closer to a power line than planned if the rig is on uneven ground or a stabilizer jack gives way. Finally, never store materials and equipment like pumps, drill steel, pipe, or casing under or anywhere near power lines.

What if you accidentally contact a power line? Everyone on the crew has to know what to do and, just as important, what not to do. Have an emergency plan in place and know how to quickly contact local emergency services. The following procedures may save your life.

If you are on board the drill rig:

- Stay on board until the contact is eliminated or the utility company has de-energized the lines (unless forced off the rig by a fire). Getting off an energized rig can seriously injure or kill you.



Figure 2. This photo shows possible electrical current paths to ground through a drill rig and a driller's helper during an overhead power line contact accident. This helper would probably be seriously injured or killed.

- Warn anyone not on board to stay away from the rig. Try to move the mast out of contact with the power line, but only if this can be done safely without touching the ground.
- If you are forced to get off due to a fire, jump well clear of the rig. Try to land upright with your feet close together. Don't fall back against the rig or touch it and the ground at the same time. Quickly move away from the rig using short, shuffling steps or by hopping. This keeps your feet close together to avoid being shocked by high voltages on the surface of the ground.

If you are not on the drill rig but are working near it:

- Do not touch or approach the rig. Move away from it!
- Call the local emergency services for injured personnel. Call the utility company if the rig cannot be moved out of contact with the power line.
- If a coworker appears injured due to the rig's contact with the power line, do not approach the rig and try to help. You could easily become the next victim. Wait until the power line has been de-energized by the utility company.
- If the power line appears to de-energize on its own, do not assume it is safe. Many electrical utility circuits are equipped with automatically reclosing circuit breakers that can trip and reset automatically several times after a line contact accident. You cannot know whether the power line is energized or not.

Keep in mind that the precautions and procedures outlined here for drill rigs apply to any equipment capable of contacting power lines, such as hoist trucks and supply trucks equipped with small cranes.

Working on Electrical Circuits

Although most electrocutions of water well drillers involve overhead power lines, installing and repairing water pump systems can also be hazardous. Avoiding electrical injury while working on water well pump systems depends on several important factors, including hazard awareness, knowledge and

experience, proper tools and equipment, meeting code requirements, and always following safe work procedures. First and foremost, electrical work should only be done by qualified personnel.

Whether performing electrical repairs or simply working around pumping equipment, always turn off the electrical power unless it must be on to perform the work needed. It may sometimes seem like an unnecessary step, but taking a few minutes to de-energize a pump circuit may save your life. Simply turning off a circuit breaker will de-energize many residential pump systems, but a larger commercial system may require turning off the pump and then opening a disconnecting switch.

When de-energizing a system, be certain to turn off all sources of power to the circuits. Then "lock out and tag" the circuit at the disconnecting device or breaker. This involves installing a padlock (for which you have the only key) on a breaker or switch to prevent anyone else from turning the circuit back on while you are still working on it. Mark the lock with a warning tag (Figure 3). Multiple locks must be installed if more than one person is working on the same circuit. After removing power and locking out and tagging the circuit, use an appropriately rated voltmeter equipped with safe test leads to check that the circuit in question is actually off. Do this by measuring for voltage between each of the power conductors, and between all power conductors and the grounding conductor (and/or a grounded electrical box, conduit, etc.).

Be sure to check for voltage on the input and output sides of controllers, switches, and fuse blocks, as well as on leads from sensors and other control equipment. Treat the circuit as if it's energized while making these voltage checks.

Sometimes the power must remain on to perform tests, such as making voltage or current measurements to troubleshoot a problem on a pump circuit. When this is the case, work carefully and deliberately, use sufficient lighting, and avoid distractions. When working near live circuits, wear electrically rated gloves and safety glasses, and use electrically rated insulated tools. Use an appropriately rated voltmeter or ammeter with safe test leads, be sure it is in good condition, and understand its correct operation. Never wear jewelry such as rings, watches, chains, and bracelets, and don't work while you're wet.

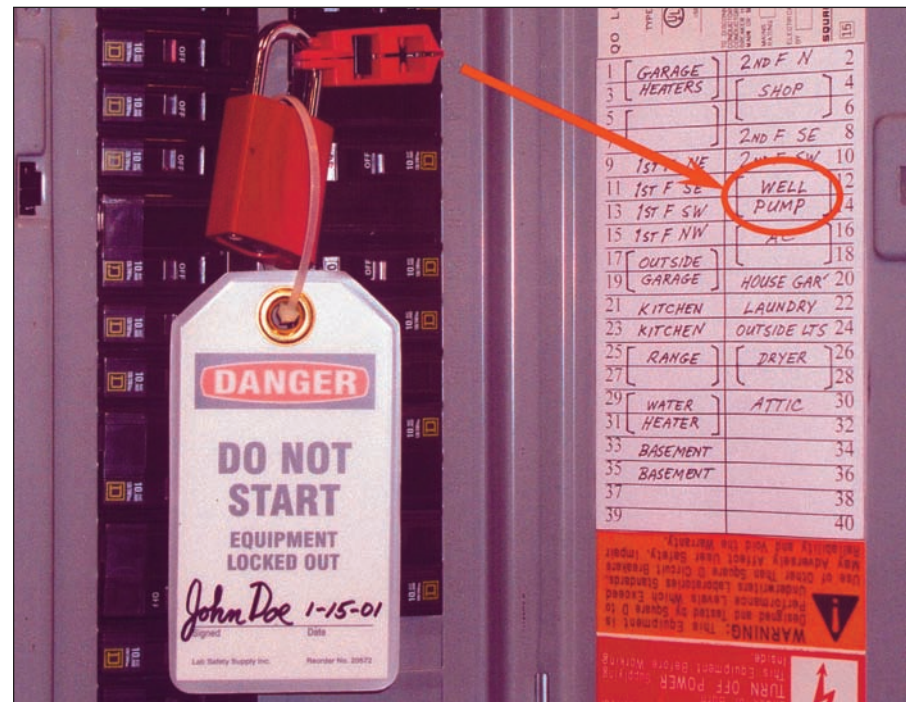


Figure 3. Unless a pump circuit must be energized for troubleshooting or testing, always de-energize the circuit and "lock out and tag" the breaker or switch before performing work. This will prevent anyone else from turning the circuit back on intentionally or accidentally.

Because there is potential for violent electrical arcing when working on energized circuits, you should always wear long-sleeved fire-resistant work clothes rated for electrical arc protection, even on residential systems.

On higher power installations, such as large three-phase commercial pump systems, you may need to wear more specialized fire-resistant protective clothing, including a face shield. Consult *NFPA 70E: Standard for Electrical Safety in the Workplace* for more information on the protective equipment and clothing needed for electrical work. When electrical testing is complete, de-energize the circuit, lock it out, tag it, and test it for voltage before continuing repairs.

Another important safety precaution is to ensure that all water well pump power supplies are installed according to appropriate local and national codes. For instance, the National Electrical Code (NFPA 70) paragraph 250.112 states:

Non-current-carrying parts of equipment and enclosures described in 250.112 (L) and (M) shall be grounded regardless of voltage.

(L) Motor-operated water pumps: Motor-operated water pumps, including the submersible type.

(M) Metal well casings: Where a submersible pump is used in a metal well casing, the well casing shall be bonded to the pump circuit equipment grounding conductor.

Electrical safety is something water well drillers can't afford to neglect. Simple precautions and safe work procedures can help you avoid accidents. Stay as far away from overhead power lines as possible. Never work closer than 10 feet from power lines. If you do hit a power line, never touch the rig and ground at the same time.

When working on a pump electrical system, always de-energize, lock out, tag, and test the circuit first. If you must work on an energized circuit, be sure to use the correct protective equipment and clothing, and follow safe procedures.

Don't you become the next victim of the No. 1 on-the-job killer of water well drillers — electrical accidents.

The recommendations in this article are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.