Living and Working Around

HIGH-VOLTAGE POWER LINES
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety First</td>
<td>2</td>
</tr>
<tr>
<td>Induced Voltages</td>
<td>3</td>
</tr>
<tr>
<td>Safety Dos &amp; Don’ts</td>
<td>4</td>
</tr>
<tr>
<td>Using the Right-of-Way</td>
<td>4</td>
</tr>
<tr>
<td>Irrigation Systems</td>
<td>4</td>
</tr>
<tr>
<td>Underground Pipes and Cables</td>
<td>7</td>
</tr>
<tr>
<td>Wire Fences</td>
<td>7</td>
</tr>
<tr>
<td>Vehicles</td>
<td>7</td>
</tr>
<tr>
<td>Lightning</td>
<td>8</td>
</tr>
<tr>
<td>Fires</td>
<td>8</td>
</tr>
<tr>
<td>Kite Flying</td>
<td>8</td>
</tr>
<tr>
<td>Model Airplanes and Drones</td>
<td>8</td>
</tr>
<tr>
<td>Vandalism and Shooting</td>
<td>9</td>
</tr>
<tr>
<td>Metal Objects</td>
<td>10</td>
</tr>
<tr>
<td>Trees and Logging</td>
<td>10</td>
</tr>
<tr>
<td>Climbing</td>
<td>11</td>
</tr>
<tr>
<td>Pacemakers</td>
<td>11</td>
</tr>
<tr>
<td>Explosives</td>
<td>12</td>
</tr>
<tr>
<td>Concerning Towers and Conductors</td>
<td>12</td>
</tr>
</tbody>
</table>
High-voltage transmission lines can be as safe as the electrical wiring in our homes—or as dangerous. Education and awareness promotes that safety. Do not allow human error to override common sense. If you live or work around power lines, the tips in this booklet could prevent accidents. If in doubt about specific situations, call the WAPA office identified on the inside back cover of this booklet.
SAFETY FIRST

Western Area Power Administration’s (WAPA) facilities meet or exceed the rules of the National Electrical Safety Code and applicable state and local restrictions. Serious accidents involving transmission lines can be avoided if simple precautions are taken. Treat all electrical systems—from the 120-volt wiring in your home to a 500,000-volt transmission line—with respect. The most significant risk of injury from a transmission line is the danger of electrical contact. Electrical contact between an object and an energized conductor (wire) can occur even when the two do not touch. High-voltage transmission lines can create an electrical arc across an air gap.

For example, during operation of a 500,000-volt line, arcing can occur across a distance of seven feet or more. This distance varies with line operating voltage. Unlike wiring at home, conductors of overhead transmission lines are not covered by electrical insulating materials.

Injuries occur more frequently with lower voltage power lines (12,500 to 115,000 volts) than with higher voltage lines because contact is more likely. The electrical conductors of lower voltage lines are closer to the ground, smaller, and less noticeable. However, injury caused by contact with a 12,500-volt line can be just as serious as that from a 500,000-volt line.
SAFETY NOTES

The National Electrical Safety Code specifies a minimum safe clearance distance for each level of electric transmission voltage. WAPA lines are built so that clearance between line conductors and the ground meet or exceed Code minimums.

Due to their weight, transmission line wires sag, or droop, between their supporting structures. These wires usually come closest to the ground halfway between supporting structures, and clearance is usually greatest near supporting towers or poles.

Vehicles and large equipment (including antennas, etc.) need to stay at least 15 feet away from power lines. This includes harvesting combines, bale wagons, stack movers, cranes, derricks, and booms traveling under all WAPA lines that pass over roads, driveways, parking lots, cultivated fields, or grazing lands.

Operate farm equipment under or near power lines with care. Operating equipment that can be extended inside the minimum 15-foot clearance needs to be done with extreme care, including bale wagons, stack movers, dump bed trucks, cranes, or derricks. When in doubt, contact WAPA for review and specific requirements.

The 15-foot minimum is a federal Occupational Safety and Health Administration requirement (29CFR 1910.269). The clearance maintains safety for operators and laborers alike. Please note that transmission line sag increases when it becomes heated by load and ambient temperatures. What was safe to drive under in December could mean disaster in July.

Lines owned by other utilities may have different height limitations.

Contact WAPA if the need to move your equipment would exceed this in normal use.

INDUCED VOLTAGES

Under certain conditions, a noticeable voltage can be induced on objects such as a large vehicle, a fence, metal building, or irrigation system. This can happen when the object is near a high-voltage transmission line and is insulated from the ground.

When an induced voltage is present, touching a vehicle, wire fence, metal building, or irrigation system can result in a sensation similar to the shock you may receive when you walk cross a nylon carpet and then touch a doorknob. The static discharge from the rug is momentary. The sensation from a voltage induced by an alternating-current power line is similar, but may continue to be felt as long as contact with the object is maintained.

The magnitude of an induced voltage depends on the voltage of the transmission line, the amount of power being transmitted, distance from the conductor, size or length of the object, and its orientation to the line. Shocks caused by an induced voltage do not usually present a hazard; for this reason, we refer to them as nuisance shocks. However, methods to remove the possibility of hazards are identified later on in this booklet.
Safe practices for various situations—including those involving irrigation systems and wire fences—are discussed below.

**SAFETY DOs & DON’Ts**

Don’t bring yourself, any object you are holding, or machine you are operating too close to an overhead line.

Don’t try to calculate how close you can come to a transmission line.

Don’t put yourself or any object higher than 13 feet above the ground in pedestrian areas or 15 feet above the ground in other areas when under a power line.

Don’t discount induced voltage. Noticeable voltage can be induced when an object such as a large vehicle, fence, metal building, or irrigation system is near a high-voltage transmission line and is insulated from the ground. Touching the object may result in a shock.

Do operate farm equipment with care when under or near power lines.

Do contact the WAPA office closest to you if in doubt about transmission line clearance.

**IRRIGATION SYSTEMS**

Many types of irrigation systems have been operated safely near WAPA power lines for years. However, use caution when storing, handling, and installing irrigation pipe, and in operating spray irrigation systems near power lines. Irrigation pipe should be moved in a horizontal position under and near all power lines to keep it away from overhead conductors. Plastic pipe (especially when dirty) should be considered conducting material.

Equipment used to install irrigation systems should be kept away from WAPA transmission lines if the equipment exceeds 15 feet in height. If you need to
exceed this height, contact WAPA first. If you are working near a line, supplement normal precautions by assigning one person to act as a “safety watcher” to warn other workers against unsafe moves such as equipment coming too close to the transmission line.

Observe great caution when moving a mobile high-pressure irrigation system under a transmission line. The small wheelbases of some of these systems tend to make them unstable. If one should tip while under a line, its boom could be lifted into a conductor.

Static voltage that occurs when unloading irrigation pipe near a transmission line is induced and, in this case, a nuisance rather than a hazard. To reduce or eliminate this nuisance, unload the pipe at least 50 feet away from the nearest conductor. If pipe stacked on a rubber-tired vehicle are unloaded under a transmission line, the possibility of nuisance shocks can be reduced by grounding. Clip one end of a wire to a metal rod driven into the ground and the other end to a pipe on the bottom of the stack.

Avoid all situations where a solid stream of water can come in contact with an electrical conductor. Should this occur, a person in contact with the irrigation system, or standing very near it (5 feet or so), may receive a severe shock. When asked, WAPA will help determine safe operating distance for installation or operation of an irrigation system to avoid hazardous situations.
If a sprinkler malfunctions and a solid stream of water reaches a conductor, turn off the water at its source—by switching off the pump—before attempting to correct the problem.

Nozzle risers should be equipped with spoilers or automatic shutoffs. This will prevent a solid stream from striking a conductor if a nozzle breaks or falls off.

Equipment with smaller diameter or fine mist spray nozzles do not usually present a problem. A broken water spray will not conduct a significant amount of current. However, spray containing fertilizer is much more conductive. Additional precautions should be taken if spraying water mixed with fertilizer near transmission line conductors.

High-volume irrigation systems using large nozzles and high pressure to sprinkle big areas are of special concern. Nozzle diameters vary from 3/4 inches to 1-15/16 inches, and water pressures range from 80 to 100 pounds per square inch. Thus, a solid stream discharged from one of these nozzles may reach heights of 30 to 35 feet and go as far as 200 feet. When this system is in operation, keep a safe distance between it and a transmission line. It should not be operated near a transmission line. Even when installation and operation of central pivot circular irrigation systems within WAPA’s easement is specifically authorized by WAPA, those near transmission lines can develop hazardous
shock potentials during operation and maintenance. To eliminate these hazards:

- Provide a good electrical ground for the pivot point.
- Park or perform maintenance on the center pivot system only when the pipe is at right angles to the power line to minimize voltages induced on the system.
- Do not touch the sprinkler pipe or its supporting structures when the system is operating under or parallel to and near a transmission line.

Contact WAPA for assistance in safely locating, operating, and maintaining irrigation systems near transmission lines.

**UNDERGROUND PIPES, TELEPHONE CABLES, AND ELECTRIC CABLES**

Underground pipes and cables are compatible with transmission lines if properly installed and maintained. Generally, underground pipes and cables may pass under a line. However, they should be installed at an angle of 60 degrees or more to the transmission line centerline (a right angle crossing is best). Pipes and cables should not be installed closer than 50 feet to a transmission line structure or the buried grounding system. Only in special situations should underground pipe and cable be located closer. Contact the nearest WAPA office before installing any pipe or cable that crosses a WAPA transmission line right-of-way.

**WIRE FENCES**

Ungrounded barbed wire and woven wire fences can become electrically charged when located near transmission lines. Normally, the voltage will not be noticeable. WAPA’s practice is to ground wire fences if the fence crosses the right-of-way or parallels the line within 150 feet of the transmission line centerline. These fences are grounded with a ground rod driven to a depth of not less than 5 feet into the ground and fastened with clamps to the fence wires. Non-electric fences on wood or concrete posts are grounded each 1/8 mile, and non-electric fences on metal posts are grounded each 1/4 mile. Metallic gates are grounded at the hinge end and electrically bonded to the fence. Fences crossing under a line are grounded on each side of the right-of-way. Electric fences are grounded through lightning arresters designed for use with electric fences. These grounding practices will avoid any possibility of a hazard. If nuisance shocks are experienced when contacting a fence or gate, or if you have any questions about the need for grounding, call the nearest WAPA office.

**VEHICLES**

A vehicle under an extra-high-voltage line (345,000 volts or above) will not normally carry induced voltage because of semiconducting tires. To further reduce potential shock, attach a chain that touches the ground to the vehicle. If the vehicle is parked on a nonconductive surface such as dry rock, a nuisance shock could still be experienced. An electric spark from an induced voltage could
ignite gasoline vapor that is created during refueling a vehicle, although WAPA has never had a report of a refueling accident. The possibility of such an accident is remote.

However, WAPA recommends that vehicles be at least 70 feet from the nearest conductor of an extra-high-voltage line when refueling. If a vehicle cannot be moved, connect the metal fuel can to the vehicle with a jumper wire before removing the cap. This lessens the possibility of an explosion. Nonconductive (plastic) containers should not be used in these situations.

**LIGHTNING**

Lightning will usually strike the highest object. In rural areas, this may be a power line tower or conductor.

Transmission facilities are designed to withstand lightning strikes by channeling them to ground at the tower. When lightning strikes a tower, damage is usually much less than if a barn or tree had been hit.

Play it safe. Stay away from power lines and other tall objects during electrical storms. Lightning is dangerous if one is standing near where it enters the ground.

**FIRES**

Smoke and hot gases from a large fire can create a conductive path for electricity. A fire burning under a transmission line could cause an electric current to arc through the smoke and hot gases from the conductor to the ground, endangering people and objects near the arc. Field burning and other large fires in and around transmission lines can damage transmission lines and cause power outages. Water and other chemicals used to extinguish those fires should never be directed toward a transmission line.

**KITE FLYING**

Kite flying within the transmission line right-of-way easement area is extremely dangerous and discouraged in close proximity of all lines. Always fly a kite so the wind will carry it away from power lines.

Use dry string, wood, and paper when flying a kite. Never use strings or kites or balloons made with metal, including aluminized mylar plastic and ornamental string with strands of metal foil inside.

If your kite gets snagged in a power line, do not pull the string or climb the tower or pole. Drop the string immediately and call the nearest electric utility.

**MODEL AIRPLANES AND DRONES**

Model airplane and drone flying is prohibited and dangerous within the transmission line right-of-way easement area.

Always fly model airplanes and drones well away from power lines.
Use only monofilament fishing line or other nonconductive material for a hand line.

If your model airplane or drone gets caught in a power line:

- If it has a handline, let go of it.
- Do not try to pull it down or climb up after it.
- Call the nearest electric utility.

**VANDALISM AND SHOOTING**

When hunting, look for power lines before you shoot to avoid severing conductors or breaking insulators.

Insulators, normally made of porcelain, are easily broken. Not only can broken insulators cause flashovers, an insulator string hit by gunfire could pull apart and let the conductor fall to the ground creating a serious hazard to anyone close to the line. It could also cause a power outage and a fire in dry areas.

Unfortunately, vandalism is the frequent cause of insulator damage. Hunters beware: Most land beneath power lines is privately owned. Making insulators and conductors fair game is illegal and can be extremely hazardous.

Anyone causing willful damage to power facilities or property along rights-of-way can be prosecuted by the federal government, the property owner, or both.
Report broken insulators and damaged conductor, or any other damage you see, to the nearest WAPA office identified on the back cover of this brochure.

**METAL OBJECTS**

When mounting an antenna on a large vehicle, do not let it extend more than 15 feet above the ground.

If you have an antenna installed where it could fall into a power line, request WAPA or your local utility to assist you in moving it to a safer location.

Before raising the mast or when sailing a boat, check the allowable clearance under any transmission line. We recommend that all masts or guy wires above the deck be connected electrically to an underwater metallic part such as the keel or centerboard. This precaution, reduces the hazard to passengers from lightning strikes or accidental contact with a power line and may save your life. If your boat is going to contact a power line, stay low in the boat and avoid touching metal surfaces or guy wires until the contact with the line is broken.

**TREES AND LOGGING**

Logging, tree cutting, or pruning should not be done within WAPA’s rights-of-way without first getting permission from the nearest WAPA office. Logging near transmission lines can be very hazardous and requires special caution. If you should come upon a tree that has fallen into a power line, stay away from it.
If you should accidentally cause a tree to fall into a line, run for your life! Do not go back to retrieve your saw or equipment. Call the nearest WAPA office or local utility immediately. If you have trees on or close to the right-of-way that need to be cut, contact WAPA. It is safer to have WAPA remove the trees for you than to do it yourself.

Trees or logs stacked within the rights-of-way may not be public property. People removing trees and logs without permission could be stealing and may be prosecuted.

CLIMBING

Do not under any circumstances climb on power line poles, towers, or guy wires. Such activities can be extremely hazardous.

PACEMAKERS

Under some circumstances, voltages and currents from household and other electrical devices may interfere with the operation of some implanted cardiac pacemakers. Studies have also shown that electric fields from power lines could affect a few models with monopolar implant and that are sensitive to the electric power frequency (60 Hz). No such cases have been reported to WAPA.

As a precaution, persons with pacemakers who have reason to be outdoors near high-voltage facilities should consult with a physician to determine whether their particular model may be susceptible to 60-Hz interference. (People inside vehicles or buildings are largely shielded from power line electric fields.)

If a person with a pacemaker is in an electrical environment and the pacemaker begins to produce a regularly spaced pulse that is not related to a normal heartbeat, the person should leave the environment and consult a physician.

Experience shows that the magnetic fields created by transmission lines have not affected the performance of cardiac-demand pacemakers. This experience is supported by a September 1976 statement from the Food and Drug Administration's Bureau of Radiological Health: “Any possible problems with pacemaker malfunction from electromagnetic interference have been generally eliminated through the development of pacemakers which are highly resistant to such interference. Virtually all presently manufactured pacemakers are not susceptible to interference from sources of electromagnetic radiation encountered in the environment.”

Tests indicate a monopolar pacemaker implanted in the abdominal area is the most sensitive to an electromagnetic field. Only 3 percent of all the pacemakers in use are this type. If you are uncertain about the type of pacemaker you have, consult a physician.
EXPLOSIVES
If you plan to detonate explosives near a WAPA transmission line, notify WAPA well in advance.

As a general rule, do not use electric detonating devices when blasting within 1,000 feet of a power line. Non-electric methods of detonation will avoid the danger of accidentally discharging an electric blasting cap.

CONCERNING TOWERS AND CONDUCTORS
- Do not climb towers.
- Do not shoot or otherwise damage insulators.
- Never touch or get near a fallen line.
- Do not attempt to dismantle tower steel members.
- Do not cut or remove tower or pole ground wires.
- Do not apply additional loads to tower members for temporary support of a structure or vehicle.
- Stay away from towers and lines during extreme wind storms, thunderstorms, ice storms, or under other extreme conditions.

Preventive measures include:
- Stay away from and report broken or damaged insulators to WAPA or your nearest electrical utility.
- Stay away from and report broken, damaged, or abnormally low hanging lines to WAPA or your nearest electrical utility.

Never climb towers or poles.

CONCLUSION
We live in an age of electric power. Almost everything we do requires electricity. High-voltage power lines have become about as commonplace as the wiring in our homes and are just as safe. Nevertheless, every year people are killed or seriously injured by power lines and wiring. In almost every case, lives could have been saved and injuries avoided if the basic safety practices outlined in this booklet had been followed. WAPA and your local utilities make every effort to design and build power lines that are safe to live and work around.

Ultimately, however, the dangers of high-voltage lines depends upon people behaving safely around them. No line can practicably be made safe from a person who, through ignorance or foolishness, violates the basic principles of safety. So, please, take time now to learn the practices outlined in this booklet and share your knowledge with your family, friends, and colleagues. Your own life, or that of a loved one, might well hang in the balance.
CONTACT US

Call or write your local WAPA office or Public Affairs in Lakewood, Colorado, to share your comments or to find out more about WAPA.

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