



Worker Beware[®]

Electrical and Natural Gas Safety Instructor’s Guide

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Introduction

The *Worker Beware* public outreach program from PECO is designed to provide contractors with information that will assist them in working safely around overhead and underground power lines and near natural gas pipelines.

This guide will help you make the most of the *Worker Beware* program. It contains five sections:

- **Know Your Audience.** An overview of workers' learning preferences.
- **Utility Basics.** Information on how electricity and natural gas work and some terms to know.
- **Plan Your Session.** Tips for preparing an effective session.
- **Your Five Steps for Survival.** Step-by-step guidance.
- **Before and After Quiz.** Reproducible utility safety quiz to help participants evaluate the program's impact.

Section One: Know Your Audience

Understanding how contractors learn best will help you tailor your session to this unique audience. Take into consideration the following:

- **Contractors are very focused on working efficiently.** Contractors may face pressure to cut corners where safety is concerned in the interest of saving time and money. Acknowledging this from the start—and cautioning against it—will put you all on the same page.
- **Contractors tend to be action-oriented learners** who do best when given an opportunity to practice and repeat recommended behaviors.
- **Contractors prefer practical (rather than theoretical) information.** Keep the focus on real-life situations.

Section Two: Utility Basics

This section will help you answer questions about electricity and natural gas from session participants.

What Is Electricity?

Electricity results from the flow of electrons between atoms that occurs when atoms carry different charges. Electrons are negatively charged and flow to positively charged atoms until the charge is level or neutral.

- The flow of electrons is called **current**.
- The force propelling the flow of electrons is measured in **voltage**, or **volts** for short.
- The rate at which electricity moves is called **amperes**, or **amps** for short.
- When an object or substance limits the flow of current, this property is called **resistance**. Resistance is measured in **ohms**.
- Materials with a high level of resistance are called **insulators**. Common insulators include plastics, rubber and air. These materials do not allow electricity to pass through them easily; however, even insulators can conduct electricity under certain conditions.

- Materials with a low level of resistance are called **conductors**. Common conductors include water, most metals and the human body. Electricity can pass easily through these materials under almost all conditions.

The Electricity Distribution System

Electricity is generated at power plants. A thick coil of wire spins inside giant magnets at the plant, moving the electrons in the wire and making electricity flow.

Wires on tall transmission towers carry high-voltage electricity from power plants to substations, where the voltage is reduced. From substations, electricity travels on smaller wires that branch out down streets, either overhead or underground.

Overhead and underground power lines carry electricity to transformers on poles or on the ground, where the voltage is reduced again to a level that is safe for typical use. From transformers, electricity travels into buildings through service drop wires. These connect to the meter and to all the wires that run inside walls to outlets and switches.

Note that electric-line workers receive extensive training and are experts in handling power lines. They also have special equipment for handling electric infrastructure. Contractors should understand that even with training, their understanding of electricity is basic.

What Is Natural Gas?

Natural gas, like petroleum, is a fossil fuel. It is found in pockets deep underground and is harvested by drilling. Here are some basic properties of natural gas:

- Natural gas ignites at about the temperature at which a cigarette burns.
- Natural gas burns within a specific concentration range: between approximately 5% and 15% gas to air. At the ideal 10% concentration, natural gas burns cleanly.
- Natural gas is lighter than air. Whenever possible, it will rise. If contained, it will move laterally or **migrate**, seeking an upward path, and it will follow the path of least resistance.
- Natural gas is odorless. Its distinctive, sulfur-like odor is the result of chemical odorants added so that you can detect even small amounts of escaping gas. Gas that has been treated with these chemicals is **odorized**; however, certain weather conditions can strip the odorant from the natural gas.
- Many natural gas transmission companies do not odorize natural gas transmission lines.
- Natural gas is nontoxic.

The Natural Gas Distribution System

To harness and transmit natural gas, we use millions of miles of pipes. There are three types of pipes used in the system: transmission pipelines, main lines and service lines.

Transmission pipelines move natural gas from refining plants across long distances. (In some cases, natural gas in transmission lines has not yet been treated with odorants and, thus, may have no smell.) Main lines carry natural gas from transmission pipelines into residential and commercial areas where it will be used. Service lines bring natural gas from main lines to individual structures.

Pressure, created at various points along the lines, moves the gas through the pipes. The size of natural gas lines varies greatly from 1 inch to 4 feet in diameter; the pressure can vary from ¼ pound per square inch to 1,000 pounds per square inch. The size of a gas line is NOT a reliable indicator of the internal pressure.

Section Three: Plan Your Session

A well-organized, informed instructor will gain participants' respect and be far more effective. Below are some recommendations to help you prepare for the utility safety session with confidence.

Know Your Material

Always preview the materials before showing them to session participants. Gathering information in advance can be useful and make the materials more relevant. Review all the materials, and rehearse your presentation well before the session.

Make the Material Relevant

Identify the key situations that workers in your session may encounter, and focus the group's attention on these topics:

- **What job site situations** bring them close to overhead power lines?
- **What type of long or tall equipment do they use** that might come into contact with overhead power lines?
- **What type of digging activities** might bring them close to underground power lines and/or natural gas lines?
- **What utility hazards** have participants encountered in the past? Recently?

Tailor the Session to the Space, Audience Size and Allotted Time

Remember that contractors are hands-on, action-oriented learners. The session will need to include opportunities to simulate recommended practices and to discuss potential applications of the material. Room size and arrangement can have a measurable impact on the participation level. Consider:

- **Will all materials be visible** to all participants, or do you need additional space or equipment?
- **Are the seats arranged in a way** that will foster discussion?
- **Is there adequate space** for participants to conduct simulations?
- **Is there adequate lighting** for all participants to see the instructor and materials and to take notes if necessary?
- **Will everyone be able to hear?**

Just as room and audience size can impact effectiveness, so can session time. No one learns well sitting for long periods. On the other hand, cramming too much information into a short session can reduce retention. Plan your session to allow time for discussions and simulations. If there is not time for all the materials, consider which ones will be most effective for these participants.

Section Four: Your Five Step Meeting Guide

Follow these steps for a high-impact meeting that will keep participants involved and reinforce essential safety information:

1) Advertise the meeting.

Post a notice well in advance of the meeting in a highly visible location.

2) Pass a sign-in sheet.

Keep attendance records of all safety meetings. Someday you may have to show who attended the meeting, what the session covered and when it was held.

3) Offer an overview.

Tell participants what you will cover in the meeting and what you hope they will learn. This is a good time to convey the importance of this information—that it can help protect contractors, their co-workers and the public from utility-related injury or death.

4) Present the Worker Beware materials.

Discuss the utility safety information in these materials and the electric and natural gas emergencies participants might encounter. Review these vital safety tips with participants periodically to refresh their memories.

5) Conduct a discussion.

Participants will retain more information if they get involved in a discussion:

- **Remind participants of the circumstances of any recent power line or natural gas line contacts** in your region. Discuss how information in the materials is relevant to those incidents.
- **Stress the importance of contractors keeping themselves, their tools, their equipment and their vehicles the required distances away from overhead power lines.**
 - **For tools and equipment other than cranes and derricks:** OSHA requires at least 10 feet of clearance from power lines carrying 50 kV or less. As voltage increases, clearance distances also increase. Please check with OSHA if you are unsure about the clearances for various types of lines in your area.
 - **When cranes or derricks are used in construction:** OSHA requires the operator of such equipment to maintain 20 feet of clearance from lines up to 350 kV and 50 feet of clearance from lines greater than 350 kV but at or less than 1,000 kV until the operator has taken specific safety measures. Consult the OSHA regulations at [osha.gov](https://www.osha.gov) for specific safety clearance requirements.
- **Review the proper “Call 811 Before You Dig” procedures and the utility color code.** Discuss why following the law and allowing extra time for a utility locate can save time and money in the long run. Discuss additional safety measures, such as asking the property owner about underground lines.
- **Invite participants to ask questions** about the materials and the safety procedures they outline. If they have questions you can't answer, research the answers yourself and provide that information as soon as possible.
- **Ask participants to brainstorm a list of key safety issues** identified in the materials.

Review these key issues and discuss incidents that resulted when related safety precautions were ignored. What were the consequences?

- **Ask each participant to name one thing he or she learned** from the materials or discussion that will help him or her be safer in the future.

Remember that discussions are intended to reinforce proper behavior—NOT to call out or embarrass participants. Maintain a cooperative, supportive atmosphere at all times, and encourage participants to ask questions and provide feedback.

Section Five: Utility Safety Quiz

The quiz on the next page is intended to help instructors and participants assess the program's effectiveness. Administer it before beginning the session, and ask participants to record their answers in the "Before" column. Then administer it again at the end of the session, and ask participants to list answers in the "After" column. The quiz is designed for two-sided photocopying.

Quiz Answers:

1. C
2. D
3. B
4. D
5. D
6. A
7. B
8. D
9. D
10. A

Name: _____

Date: _____

Worker Beware Utility Safety Quiz

Before

Questions

After

_____ **1. For tools and equipment other than cranes or derricks used in construction, what is the *minimum* safe clearance from overhead power lines?** _____

- A. 6 inches
- B. 100 feet
- C. 10 feet
- D. 5 feet

_____ **2. If you suspect a natural gas leak, you should** _____

- A. Bury your excavation
- B. Use your cell phone or radio
- C. Attempt to shut off the gas supply
- D. None of the above

_____ **3. If you must work closer than the safe clearance distance from overhead power lines, which of the following should you do?** _____

- A. Attempt to disconnect electrical service
- B. Call PECO in advance to make arrangements
- C. Evacuate nearby homes
- D. Both A and C

_____ **4. What does the law require that you do to determine the location of underground utility lines before digging on a job site?** _____

- A. Look for right-of-way markers
- B. Check your maps
- C. Call PECO
- D. Notify 811

_____ **5. How should you assist a co-worker who contacts a power line while operating heavy equipment?** _____

- A. Call 911 and PECO
- B. Encourage them to stay on the equipment until PECO personnel arrive
- C. If there is danger from fire or another hazard, tell them to NOT touch the equipment and the ground at the same time. They should jump clear, land with feet together and shuffle away with small steps, keeping their feet close together and on the ground at all times.
- D. All of the above

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_____ **6. True or false? Before digging, you should ask the property owner about any private underground lines that may not be marked by the locator.** _____

- A. True
- B. False

_____ **7. What is the job of a spotter?** _____

- A. To stabilize a load
- B. To prevent equipment from contacting power lines
- C. Both A and B
- D. None of the above

_____ **8. Which of the following is a warning sign of a natural gas leak?** _____

- A. A distinctive, sulfur-like odor
- B. Bubbling in a pond or creek
- C. A hissing sound
- D. All of the above

_____ **9. If your heavy equipment contacts a power line and you are not in imminent danger, you should:** _____

- A. Move the heavy equipment away from the line if possible
- B. Stay on the equipment and warn others to keep away
- C. Have someone contact 911 and PECO
- D. All of the above

_____ **10. True or false? You cannot be shocked by a service drop wire.** _____

- A. False
- B. True