



Worker Beware[®]

Electrical and Natural Gas Safety Trainer’s Guide

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Introduction

The *Worker Beware* training program from SMUD 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 trainer's guide will help you make the most of the *Worker Beware* program. It contains five sections:

- **Know Your Audience.** An overview of contractors' 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 training session.
- **Your Five-Step Training for Survival.** Step-by-step training guidance.
- **Before and After Quiz.** Reproducible electrical safety quiz to help trainers and participants evaluate the program's impact.

Section One: Know Your Audience

Understanding how contractors learn best will help you tailor your training 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 Delivery 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. Local natural gas distribution utilities add a distinctive, sulfur-like odor to natural gas so you can detect even small amounts of escaping gas. Gas that has been treated with these chemicals is **odorized**; however, certain conditions can strip the odorant from the natural gas.
- Many natural gas transmission companies do not odorize natural gas transmission lines.

The Natural Gas Transmission and Distribution System

To harness and transmit natural gas, we use thousands 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. They are the largest pipelines. Note that natural gas in some transmission lines has not yet been treated with odorants and thus has no smell.

Always be aware of pipeline markers that indicate the need for extra care around a high-volume transmission line. For security purposes, these markers are general indicators only and do not show the exact location, path, or depth of gas pipelines. Call the number on the marker if you notice any type of suspicious activity or construction occurring nearby without natural gas utility personnel present.

From transmission pipelines, main lines bring natural gas 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 electrical safety training 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 training materials more relevant. Review all the materials and rehearse your presentation well before the session.

Make the Material Relevant

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

- **What job-site activities or 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?
- **Where are the natural gas transmission lines** in your area?
- **What electrical or natural gas hazards** have participants encountered in the past? Recently?

Tailor the Session to the Training 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 the effectiveness of training, 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 Training for Survival

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 crews, and the public from power line–related injury or death.

4) Present the Worker Beware materials.

Discuss the utility safety information in these materials and the electrical 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 pipeline 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:**
 - **When cranes and derricks are used in construction:** Keep the crane boom and load at least **20 feet** away from lines up to 350 kV, and **50 feet** away from lines greater than 350 kV but at or less than 1,000 kV. Always assume the line is energized, and allow nothing closer unless you have confirmed with the utility owner/operator that the line has been de-energized.
 - **If voltage is unknown**, contact SMUD at 1-866-473-9582 before work begins.
 - **For tools and equipment other than cranes and derricks used in construction**, Cal/OSHA requires that you keep yourself and your equipment at least 10 feet away from overhead power lines carrying up to 50 kV.
 - **As voltage increases, clearance distances also increase.** Contact SMUD and consult Cal/OSHA for specific safety clearance requirements and encroachment prevention precautions.
- **Review the proper 811 notification 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 pre-marking the dig area, conducting a visual site survey, and asking the property owner about any private underground electric or natural gas 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 they learned** from the materials or discussion that will help them 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: *Worker Beware* 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 training, 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. B

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 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 SMUD in advance
- 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 jobsite?

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

5. How should you assist a coworker who contacts a power line while operating heavy equipment?

- A. Call 911 and then SMUD
- B. Encourage them to remain on the equipment until utility personnel arrive
- C. If there is danger from fire or another hazard, tell them to jump clear of the equipment without touching the equipment and the ground at the same time, land with feet together, and shuffle away
- D. All of the above

6. True or false? Before digging, you should ask the property owner about any private underground electric or natural gas 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 water
- C. A hissing or roaring 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. Remain on the equipment, and warn others to keep away
- C. Have someone contact 911 and then SMUD
- D. All of the above

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

- A. True
- B. False