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First Responder Beware Electric & Natural Gas Safety Trainer's Guide

Table of Contents

Introduction

The *First Responder Beware* training program from Duke Energy is designed to provide firefighters, police, EMTs, and paramedics with the information they need to recognize and work safely around utility infrastructure while responding to emergencies.

This trainer's guide will help you make the most of the *First Responder Beware* program. It contains six sections:

- **Know Your Audience.** An overview of first responders' learning preferences.
- **Utility Basics.** Information on how electricity and natural gas work.
- **Plan Your Session.** Tips for preparing an effective training session.
- **Your Five-Step Training for Survival.** Step-by-step training guidance.
- **Suggested Simulations.** Activities to help reinforce safety procedures.
- **Before and After Quizzes.** Reproducible utility safety quizzes to help trainers and participants evaluate the program's impact. Answer sheets are provided**.**

Section One: Know Your Audience

Understanding how first responders learn best will help you tailor your training session to this unique audience. Take into consideration the following learning preferences:

- **First responders tend to be action-oriented learners** who do best when given an opportunity to practice and repeat recommended behaviors, and they favor a hands-on approach.
- **First responders benefit from significant discussion time during training,** including opportunities to relate new information to prior experiences and events.
- **First responders are very focused on core priorities:** their own survival, safe and timely rescue of incident victims, and protection of property.
- **First responders respect authority and expertise.** Instructors should have a solid command of the topic and be well organized.
- **First responders are conscientious learners.** If the material is presented as being important to their work and lives, they will be a responsive, eager, and respectful audience.
- **First responders prefer practical (rather than theoretical) information.** Keep the focus on real-life situations.

Section Two: Utility Basics

This section will help trainers answer questions about electricity and natural gas from session participants. If you need additional information, please contact Duke Energy before your training session.

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 plastic, rubber, paper, 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.

How Does Electricity Work?

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. First responders should understand that even with training, their understanding of electricity is basic, and their equipment, even if it appears insulated, is not designed or tested to prevent electric shock.

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 can be ignited by a small spark or flame—even a lit cigarette.
- Natural gas burns within a specific concentration range, called the **explosive range** or **flammable range**: between about 4% gas to air and 16% 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 naturally odorless. Natural gas distribution utilities use chemical **odorants** to give the gas the familiar sulfur-like smell. 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.

How Does Natural Gas Work?

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 (often referred to as distribution 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. 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.

Between gas lines and individual structures are gas meters. Meters regulate the flow of gas into structures. Different types of structures require different types of meters.

Pressure, created at various points along the lines, moves the gas through the pipes. The size of natural gas lines varies greatly from less than 1 inch to as much as 4 feet in diameter; the pressure can vary from ¼ pound per square inch to 1000 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 and natural gas 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 training materials more relevant. Review all the materials and rehearse your presentation well before the session.

Make the Material Relevant

Identify the key utility infrastructure that first responders in your training session may encounter when responding to emergencies, and focus the group's attention on these topics during training:

- **What emergency situations** bring them close to downed power lines?
- **What emergency situations** bring them close to natural gas distribution and/or service lines?
- **What type of long or tall equipment do they use** that might come in contact with overhead power lines?
- **Where are the electric substations** in your area?
- **Where are the natural gas transmission lines** in your area?
- **What electrical or natural gas hazards** have participants encountered in the past? Recently?
- **What experience do participants have with electric shock victims** and how much do they know about the severity, nature, and proper response to shock and burn injuries?

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

Consider the size of the training space and audience. A large group will require different media than will a smaller one. If the room size is very large for the group, be sure it is arranged as intimately as possible to keep all participants involved.

Remember that first responders 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,** 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 because, some day, 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 first responders, incident victims, and bystanders from utility-related injury or death.

4) Present the First Responder Beware *materials*

Discuss the utility safety information in these materials and what electricity and natural gas emergencies participants might encounter. Ask participants to review their notes on the materials periodically to refresh their memory of the vital safety tips.

These materials use different types of first responders to exemplify different situations. You might preface them by pointing out that first responders of any discipline could be first on the scene in any emergency. Ask participants to pay special attention to how the information can be applied to their areas of expertise and emergencies they will encounter.

5) Discussion and Simulation

Participants will retain more information if they get involved in activities and discussions. Ideally, these exercises should be dispersed throughout the session. Here are some ideas:

- **Remind participants of the circumstances of any utility-related emergencies in your region.** Discuss how information in the materials is relevant.

- **Stress the importance of first responders keeping themselves, their tools, their equipment, and their vehicles at least 10 feet* from overhead power lines.** Discuss how this rule particularly applies to them and situations they may encounter. Also discuss how downed lines require 30-foot to 100-foot clearances because wires can jump and move with wind or when sparking and because the ground may be energized.

  **Higher voltages require greater clearances; please check with Duke Energy if you are unsure about the clearances for various types of lines in your area.*

- **Review the warning signs of a natural gas leak,** and discuss how conditions at an incident scene (such as line pressure, different types of structures, population density, and other factors) might inform their responses.
- **Invite first responders 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 give them 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?
- **Conduct tabletop simulations of various emergency scenarios.** Use toy vehicles and figures to simulate appropriate actions: where to park, how to avoid natural gas ignition hazards, manage aerial equipment around overhead power lines, and where to place emergency personnel and bystanders.
- **Ask each participant to name one thing he or she learned** from the materials or discussion that will help him/her be safer in the future.

Section Five: Suggested Simulations

Practice is essential to first responders' survival, and the successful resolution of emergency situations. There is often little time to think, and proper habits can save lives.

(Please note: The scope of this program is limited and does not include specialized devices and equipment. Some departments may use specialized equipment for detecting and/or ventilating natural gas. Follow departmental SOPs regarding specialized equipment.)

Tabletop Simulations

The use of tabletop models provides opportunity for small-group collaborations and for simulating multiple scenarios. This approach can be adapted to various room conditions and time constraints. Use of toy figures and scale models allows simulations to be easily reset for repetition. Possible scenarios include the following:

Electric Simulations

- **Stage a car accident using toy cars and small wires.** Have participants use toy figures to act out proper procedures beginning with arrival on the scene through a rescue of the occupants in an energized vehicle.
- **Simulate conditions after a serious storm where lines have fallen.** Use figures to practice proper procedures.
- **Practice where to park, how to manage aerial equipment around overhead lines, and where to place emergency personnel and bystanders** using toy fire trucks, police cars, and ambulances.
- **Stage a variety of electrical infrastructure fires.** These could involve a substation, power

line, or underground vault. Ask participants to use figures to demonstrate appropriate actions.

- **Place model infrastructure items such as electric meters, service drops, etc.** around structures and ask participants to "arrive" at that scene and identify these pieces of electrical infrastructure.
- **Describe a scenario where a fire or other emergency is taking place.** Have participants demonstrate proper procedures for different electrical infrastructure items.

Natural Gas Simulations

- **Model indoor natural gas leaks.** Have participants demonstrate proper procedures such as checking for gas migration, parking emergency vehicles, avoiding spark hazards, evacuation strategies, and use of standard communications devices.
- **Model outdoor natural gas leaks in residential, rural, commercial, and industrial zones.** Have participants identify the source of the leak in different environments. Practice checking for gas migration, parking emergency vehicles, avoiding spark hazards, evacuation strategies, and use of standard communications devices.
- **Place model infrastructure items such as natural gas pipelines, meters, etc.** around structures and ask participants to "arrive" at that scene and identify these pieces of natural gas infrastructure.
- **Describe a scenario where a natural gas fire is taking place.** Have participants demonstrate proper procedures for different hazards and conditions.

Role-Play Simulations

Role-play simulations are ideal for practicing first-aid techniques and detailed physical actions.

Electric Simulations

- **Practice proper jump-and-shuffle technique** for exiting energized equipment. Jump clear of the vehicle or equipment with your feet together. Do not touch the equipment and the ground at the same time, or you will become electricity's path to the ground and could be killed. Land with your feet together and shuffle away. Do not run or take long steps; if your legs bridge two areas of the ground with different voltage, electricity could travel up one leg and down the other. (This is because electricity spreads out in the ground with decreasing voltage from the point of contact.)
- **Place signs around the room that read "electric meter," "downed wires," and "overhead lines"** and have participants enter the room. Time how long it takes them to locate the infrastructure and respond appropriately.
- **Practice responding to a vehicle/pole incident** where downed power lines are known or suspected. Emphasize that participants should not contact the vehicle or the power line.

Natural Gas Simulations

- **Practice responding to indoor natural gas leaks.** Provide scenarios where a leak has been reported as well as those where responders must detect the presence of natural gas and locate its source. Be sure to include scenarios where the source cannot be identified.
- **Use signs to identify spark hazards, possible leak sources, and gas infrastructure.** Focus on proper communications, evacuation, and ventilation strategies with special consideration given to migration, spark, and explosion hazards**.**
- **Practice identifying CO poisoning.** Have one participant be the victim and have others

locate and diagnose whether CO is a factor. If your department trains in life-saving techniques, include them here.

- **Practice responding to outdoor natural gas leaks.** Provide scenarios where a leak has been reported as well as those where responders must detect the presence of natural gas. Be sure to include a scenario where the source cannot be identified. Use signs to indicate telltale evidence of a leak. Remember that not all natural gas leaks are detectable by smell alone.
- **Practice the correct procedures for natural gas fires.** Use signs to mark possible areas of migration and accumulation as well as re-ignition hazards.

Remember that simulations 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 about how simulations might be most effective.

Section Six: *First Responder Beware* Utility Safety Quizzes

The quizzes on the next pages are intended to help instructors and participants gauge the program's effectiveness. By administering them before beginning the training and then at the end of the session, trainers and participants alike can observe learning in action. The quizzes are designed for two-sided photocopying.

Electrical Safety Quiz Answers

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

Natural Gas Safety Quiz Answers

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

Name: _____ Date: _____

First Responder Beware Electrical Safety Quiz

Before	Questions	After
_____	**1. Which of the following should you do when you suspect electrical infrastructure is involved in a fire?** A. Attempt to disconnect electrical service B. Contact Duke Energy C. Secure the area and evacuate bystanders D. Both B and C	_____
_____	**2. Which of your standard-issue protective gear will reliably insulate you against electric shock?** A. Your gloves B. Your helmet C. Your boots D. None of the above	_____
_____	**3. What is the *minimum* safe clearance between overhead power lines and emergency equipment?** A. 10 feet B. 100 feet C. 6 inches D. 200 feet	_____
_____	**4. True or false? You cannot always tell whether power lines or objects are energized.** A. True B. False	_____
_____	**5. How should you assist someone who is in a vehicle that is in contact with downed power lines?** A. Lift them out of the vehicle B. If they are in imminent danger, instruct them to jump clear of the vehicle and shuffle away C. Pull them out with a non-conductive rope D. Encourage them to exit the vehicle normally	_____

6. When is it appropriate to disconnect electrical service?

A. When you can reach the electric meter

B. When you can cut power lines

C. When you can access a manhole

D. Never

7. True or false? Your body can conduct electricity.

A. True

B. False

8. If your equipment contacts a power line and you are not in imminent danger, you should

A. If possible, safely move the equipment away from the line

B. Stay put and warn others to stay away

C. Have someone contact Duke Energy

D. All of the above

9. If a substation or transformer is burning, you should

A. Enter the substation unescorted

B. Evacuate the area

C. Protect area exposures

D. Both B and C

10. True or false? Burning electrical equipment is difficult to replace and should be saved.

A. True

B. False

Name: _____ Date: _____

First Responder Beware Natural Gas Safety Quiz

Before	Questions	After
_____	**1. True or false? Natural gas is lighter than air.** A. True B. False	_____
_____	**2. Which of the following is the explosive (flammable) range of natural gas?** A. 2% to 5% gas to air B. 10% to 30% gas to air C. 4% to 16% gas to air D. 50% to 100% gas to air	_____
_____	**3. Which type of pipe carries natural gas from the refineries across long distances?** A. Service B. Transmission C. Main D. None of the above	_____
_____	**4. Which of the following devices should NOT be used in the vicinity of a gas leak?** A. Radios B. Doorbells C. Light switches D. All of the above	_____
_____	**5. When arriving at the scene of a natural gas emergency, where should you park your vehicle?** A. As close to the scene as possible B. Away from storm drains and manholes C. Upwind from the area D. Both B and C	_____

6. When is it appropriate to shut off natural gas service?

A. When you can safely reach the gas meter or appliance supply line

B. When you can access a major pipeline valve

C. When you can access a relief vent

D. Never

7. True or false? When the incident is resolved you can safely restore natural gas service.

A. True

B. False

8. When ventilating natural gas from inside a structure, you should:

A. Be sure the supply of natural gas is off

B. Make sure no one is in the structure

C. Begin at the top and work down

D. All of the above

9. If natural gas is burning, you should:

A. Evacuate the area

B. Protect area exposures

C. Both A and B

D. Attempt to extinguish the fire with water

10. True or false? Natural gas will move laterally, or migrate, until it finds a way up.

A. True

B. False