

# NATURAL GAS HAZARDS

BY FRANK C. MONTAGNA

**Y**OU ARE DISPATCHED TO A REPORTED GAS LEAK IN the street. Another "routine" gas leak, you think. You will call the utility, wait for a representative to respond, and then return to the fire station. This time, however, as you enter the block, you hear the deafening sound of a high-pressure gas main rupture. The distinctive odor of gas permeates the area. A homeowner flags you down, saying that a contractor's backhoe ruptured the gas line. As you speak to him, the gas ignites. This is no routine response.

Natural gas, when transported through your utility company's pipes and used properly, is safe. However, when third-party contractor damage, equipment failure, extreme weather, human error, fires, water main breaks, building collapses, and so on, are added to the mix, natural gas can become hazardous, especially for responding firefighters.

Do you know the hazards natural gas can pose to the public and to your firefighters? Do you know what to do, whom to call, and how to keep everyone safe when gas is leaking? This article is meant to

heighten the awareness of firefighters to the hazards they may encounter when responding to and operating at incidents where natural gas may be the reason for the response or is indirectly involved with the incident. Proper tactics, the assistance and cooperation of your local utility, and a good dose of common sense will go a long way to safely mitigating these incidents.

## SYSTEM OVERVIEW

Natural gas is delivered to you by pipeline from gas fields located in the southern or northern United States or Canada. Compressor stations move the gas through pipelines at approximately 750 psi. These gas pipelines, known as transmission gas mains, deliver the gas to your utility's gas supply grid. The gas is regulated down to high, medium, or low pressure and fed into the gas distribution system. This system is comprised of various sizes of mains that typically run parallel to the streets and avenues. From here, the individual service piping delivers gas to the structures and end users.

Piping for service or mains can be plastic, cast iron, steel, or a combination of these three. Ask your local utility to provide you with information pertaining to the gas pressures and piping material used in your jurisdiction as well as other critical information about your gas system.

## HAZARDS AND OPERATIONAL TACTICS

Listed below are hazards associated with natural gas firefighters may encounter at a gas leak and suggested tactics for mitigating them.

### Outdoor Gas Main/Service Ruptures Caused by Excavating Equipment

The following tactics are recommended for firefighters when life and property are *not* in jeopardy. When life is in jeopardy, the incident commander will have to decide which actions he can safely take, based on a risk/benefit analysis of the situation. For example, if a contractor is down in an excavation and the escaping gas has ignited, the IC must determine if it is a rescue or a body removal operation and formulate a plan based on that information. The plan should take into consideration the safety of the victim, the firefighters, and the general public. The material presented in this article is intended to help the IC intelligently decide the appropriate course of action.



(1) This natural gas explosion/fire required a fourth-alarm assignment to bring it under control. (Photos courtesy of author.)

■ **FRANK C. MONTAGNA** is a battalion chief and a 34-year veteran of the Fire Department of New York. For the past 17 years, he has served as a chief officer assigned to Battalion 58 and is currently detailed to the FDNY Bureau of Training assigned to curriculum development, creating training programs for chiefs, company officers, and firefighters. He has a degree in fire science from John Jay College, where he has taught fire science and management courses as an adjunct lecturer. He is the author of *Responding to "Routine" Emergencies* (Pennwell, 1999) and is a member of the editorial advisory board of *Fire Engineering*. Montagna lectures on various fire-related topics and is a contributor to *Fire Engineering* and *WNYF*.



- The leaking gas will create a vapor cloud that can ignite. Secure the area, and keep the public and fire department personnel out of the vapor cloud and at a safe distance. Position all apparatus and firefighters upwind, out of the path of escaping gas.

- The ignition temperature of natural gas is 1,165°F and can be easily ignited at the edge of the vapor cloud, where it is within the ignition limits. Where possible, eliminate all sources of ignition (backhoes, fire apparatus, lighting, electric- and gasoline-powered tools, for example) in the vicinity of the vapor cloud and at the location of the rupture.

- Hook up to a hydrant at a secure location and stretch a charged precautionary line to a safe area; the line should be enough to cover potential exposures. Depending on the situation, multiple precautionary lines may be necessary.

- Handlines and large-caliber streams with fog nozzles can be used to direct escaping natural gas away from exposed structures and potential sources of ignition.

- If the leaking gas ignites, the resultant radiant heat can threaten nearby structures, vehicles, and people. Set up handlines and large-caliber streams to protect exposed structures. Do not attempt to extinguish burning gas outdoors; let it burn.

An extinguished natural gas fire can reignite because of the fuel and heat that remain after the fire is extinguished. The safest way to extinguish burning gas is to stop the flow of gas feeding the fire.

- If possible, do not let water flow into the excavation. It will hamper the efforts of utility workers to stem the flow of gas and repair the damaged pipe.

- Natural gas has no odor. The odor we associate with leaking gas is provided by mercaptan, which is added to natural gas as it enters the utility's distribution system. If leaking gas passes through soil, the odorant can be scrubbed out, making the gas detectable only by a combustible gas detector. Using a gas detector, check surrounding structures for the presence of natural gas.

### NATURAL GAS PROPERTIES

- Colorless
- Odorless
- Nontoxic
- Vapor density 0.6 (lighter than air; it will rise)
- Explosive range 5% to 15%
- Ignition temperature 1,165°F

- If a backhoe damages a gas line, it may move it. Since a gas line can't stretch, it may be pulled away from any piping to which it may be connected. So, a damaged gas line may not only leak gas at the site of the damage but may in fact also have been pulled out of the building piping or even out of the gas main in the street. As a result, gas could be leaking near the building wall and in the street, remote from the rupture.

Leaking gas can become trapped underground by concrete, asphalt, or even a layer of frost and, as a result, may migrate underground for long distances. In this way, it can escape to the atmosphere or enter buildings at a distance from the original leak site. It can even enter the sewer system or underground electrical or communications conduits and travel long distances, eventually entering distant structures. This results in a larger than imagined danger area.

Avoid parking your company's rigs over electric or sewer manholes. Migrating gas may have accumulated in these locations and

your truck could provide an ignition source, endangering firefighters and damaging the apparatus. I am aware of several instances in which a fire apparatus provided the ignition source for the leaking gas.

- A combustible gas detector should be used to detect the presence of gas and to determine its concentration as well as the degree of hazard it presents. If the on-scene units do not have a combustible gas detector, special call a unit with one. If there are multiple structures to check, get multiple combustible gas detectors on the scene. Gas utility personnel are equipped with combustible gas detectors. Use their expertise to assist you with gas detection and hazard assessment. Using a combustible gas detector, check subsurface structures (electric/sewer/telephone manholes) and surrounding buildings for indications of migrating gas. If gas is entering buildings, evacuate as necessary.

- Do not attempt to stop the flow of gas from plastic gas lines (photo 2). Gas flowing through plastic pipe creates static electricity, which collects on the exterior of the broken gas pipe. Touching or coming near the pipe can result in a static discharge sufficient to cause ignition of the leaking gas. Utility personnel are trained to handle plastic pipe and must ground the pipe as well as all tools used. Leave plastic pipe shutdowns to the trained experts.



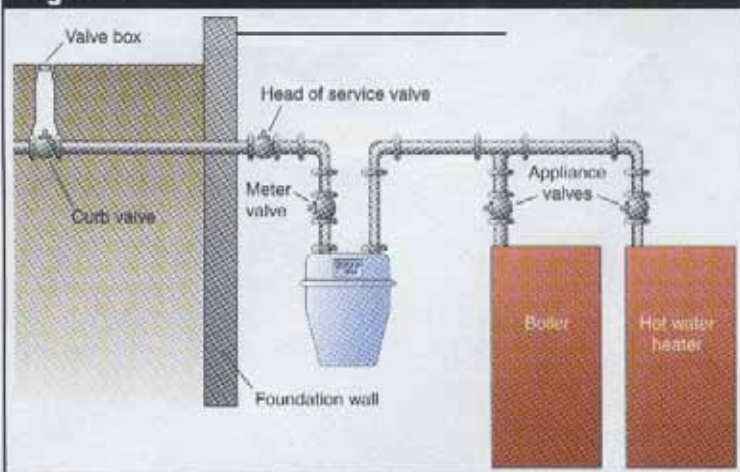
(2) A firefighter easily bends this plastic pipe, but doing so could result in a static spark that ignites leaking gas. Do not approach or touch leaking plastic pipe.

### Inside Gas Leaks—Appliance Valves

Attempt to isolate indoor gas leaks as close to the leak as possible (Figure 1). For a leaking appliance, shut the appliance valve. The next source of control away from the appliance is the meter valve, located just prior to the meter. (The meter may be inside or outside the structure, depending on local practice.) If necessary, the service valve—located inside at the point of entry to the building for the gas service—will shut down the gas to the entire structure. This is true for buildings where the gas meters are inside the building. For buildings with the meters outside, the service valve is found before the meters. If the building has only one meter and it is outside, there may be one valve before the meter that can be used to shut off the entire building. From the sidewalk, the curb valve can be accessed, shutting the gas supply to the entire building. Do not shut the street



**Figure 1**



The first shutoff point is the appliance valves. If that is not accessible, shut the gas at the meter, then the service valve, and finally the curb valve.

main valve. Refer to your department's standard operating procedures (SOPs) relative to operating valves.

If the leak has not been located, it is possible that it may be migrating into the structure from a leaking service or an outside main or seeping in from another apartment or attached structure. Use caution even when the source of a gas leak has been identified and turned off. The amount of gas in the structure still may be in the explosive range (5 to 15 percent), or there may be a second yet undiscovered source of gas leaking into the structure. Always use a combustible gas detector to determine when the gas level is safe. Evacuate if necessary.

### Sources of Ignition

You can reduce the chance of ignition by avoiding some potential ignition sources commonly found at the scene:

- When alerting residents, knock on doors. *Do not* ring the doorbell! The doorbell can provide a spark for igniting the gas.
- Use intrinsically safe handheld radios, and be mindful that turning your flashlight and thermal imaging camera on or off can generate a spark.
- Do not use cell phones in the structure.
- Notify your electric utility to respond to shut the power from the exterior of involved buildings. If shutting the power starts a backup electric generator located inside the building, shutting the power may not be a good idea, as the generator will become a potential ignition source. If the electric is to be turned off to eliminate possible ignition sources, do not shut the power at the building's electric panel or switches, and do not operate light or appliance switches. These actions can generate a spark that might ignite the gas. In addition, do not pull the electric meter because gas can migrate up into the meter pan. Pulling the meter can generate a spark.

### Never Reopen Any Gas Valves That Were Shut

If a gas valve is closed during an investigation and it is later determined that it had no impact on the leak, do not reopen the valve. Unlike water or electricity, integrity tests must be performed on the piping before it can be reopened. Also, any pilot lights extinguished because of the valve's closing will have to be relighted; otherwise, there will be blowing gas at these locations. Let the gas company

representatives know which valves were turned off. They will take care of the turn-on process.

### Carbon Monoxide Conditions Caused by Natural Gas Appliances

When improper combustion and faulty or defective flue/chimney conditions exist, all fuel-burning appliances have the capability to produce excess carbon monoxide (CO). When you encounter elevated CO levels in a structure, turn off any appliance suspected of contributing to these conditions.

CO is colorless, odorless, and undetectable without a CO meter. Always use your CO meter to determine when the area is safe. The Fire Department of New York notifies the utility to respond to a CO incident when

- more than nine ppm above ambient levels of CO are present,
- the fire department shuts the gas to a suspected faulty appliance, or
- the IC determines that utility assistance is needed.

Refer to your department's SOP to determine what specific actions to take at a CO leak.<sup>1</sup>

### Electrical Manhole/Transformer Fires and Burnouts

During manhole/transformer fires and burnouts, electric cables burning underground have the potential to burn through adjacent gas pipes. If you smell or detect natural gas with the gas detector during these incidents, have the gas utility as well as the electric utility respond.

### Downed Wires

Downed high-voltage wires can burn down through the asphalt street to the buried gas main and then burn through the pipe, possibly igniting the leaking gas. Have the gas utility respond in addition to the electric utility.

### Building Collapses

Building collapses—full or partial—may result in broken or damaged gas lines. When a building collapses, the gas lines in the building can break and the impact from falling debris can damage gas mains or gas services in the street/sidewalk. When operating at one of these incidents, notify the gas utility to respond to determine if



(3) At this type of building collapse, expect damaged interior gas pipes and suspect damaged in-ground pipes. Have the utility shut the gas to the building and check for leaks in the street.





**(4) A water main break severely undermined the street. The undermined gas main broke and the escaping gas ignited.**

there is an active gas service to the structure or a damaged main in the street/sidewalk. Have the utility turn the gas off before it becomes a hazard to the rescue workers (photo 3).

### Water Main Breaks

Be aware that the roadway and pavement weakening caused by water main breaks will put the subsurface utilities (especially gas lines) in jeopardy. Severe undermining can cause a gas main break. The leaking water can also damage electric lines, which can cause

leaking gas to be ignited by the resultant sparks and create a much more serious condition than the water main break. Have the utility company respond to determine if the gas pipes, electric lines, or transformers are in jeopardy (photo 4).

### Main Valves

Never attempt to operate a main valve. Rarely will shutting only one valve place the situation under control, as many gas lines are fed from more than one direction. Utility employees must access the mapping system to determine which combination of valves must be closed to stop the flow of gas.

Additionally, by indiscriminately closing main valves, you can cause more harm than good. A critical location—a hospital, nursing home, or housing project, for example—might be shut down. As mentioned previously, extensive integrity testing of all the affected buildings and pipeline will be required; as a result, once shut down, it may take weeks to restore gas service.

### Critical Locations

Contact your utility representative to identify any utility critical locations (metering, regulator, valve and transfer stations, gas-fed power plants and gas turbines, for example) in your response area. To enhance safety, conduct familiarization drills at these locations, and develop preplans.

### The Incident Commander

The IC should always look at the "big picture" and consider the

## Now More Than Ever



From decontamination to fire suppression to hazmat remediation, First Responders rely on Intelagard equipment for fast and effective solutions. Experience the power of World Class Compressed Air Foam systems. The portable Macaw™ to the large-scale Falcon III™, Intelagard has a system to fit your needs.

Contact us at 800.468.6090 or [info@intelagard.com](mailto:info@intelagard.com)

**INTELAGARD**

For More Facts Circle 149 on Reply Card

## TRACE DECON™

Decon Training System for HAZMAT/WMD

THE DECON TEST THAT CAN SAVE YOUR LIFE!



The look, the touch, the feel of real Chemical Nerve Agents

Available Exclusively From:

**LIFE SAFETY SYSTEMS™**

831-728-9090 • [www.lifesafetysys.com](http://www.lifesafetysys.com)

For More Facts Circle 150 on Reply Card





(5) One of the most efficient ways to help safely mitigate a natural gas emergency is to work closely with your gas utility company.

various hazards firefighters may encounter when operating at natural gas incidents. The IC should notify the utility of a confirmed gas leak and consider the following questions when sizing up these incidents and deciding whether to evacuate a building or an area:

- Where is the leaking gas going?
- Where is the gas collecting?
- Is it approaching the explosive range?
- What problems and hazards will be present if the gas ignites?
- Are firefighters, civilians, and apparatus in a safe location?
- What can go wrong?
- What additional resources, information, and equipment are needed to safely control and mitigate the situation?

Often, the answers to these questions can be obtained from the utility representative on the scene. Use the utility personnel as a resource. Contact your local utility companies and request training and familiarization with the various commodities they supply. Training with them and getting to know them will enhance the safety of firefighters, utility workers, and the people we serve.

FDNY has formed a "partnership in safety" with Consolidated Edison of New York, our local utility. In New York City, FDNY and Consolidated Edison of New York use the incident command system (ICS) to better communicate and coordinate during utility emergencies (photo 5). As a result of using ICS, FDNY is briefed on the situation; the game plan to make the situation safe; time frames; outages; and, most importantly, any hazards and safety concerns associated with the emergency. The utility has trained our firefighters, company officers, and chiefs to safely handle utility emergencies. Additionally, Con Edison provides utility training for FDNY members at Con Edison's Learning Center (its training academy), at division staff meetings, in fire stations, at joint familiarization drills, and during critiques of significant incidents.

By training and planning together, FDNY and Consolidated Edison have enhanced the safety of the first responders as well as the citizens of New York City. You, too, should contact your local utility and pursue a mutually beneficial relationship with it. ■

### Endnote

1. For more information about CO, refer to my article "Responding to CO Detector Activations," *Fire Engineering*, January 1996, page 99.

*Author's note:* A version of this article was previously published in *WNYF*, FDNY's training magazine. It was written to enhance the "partnership in safety" between FDNY and Consolidated Edison. Thanks to Consolidated Edison for its cooperation and free access to information.

Remediation

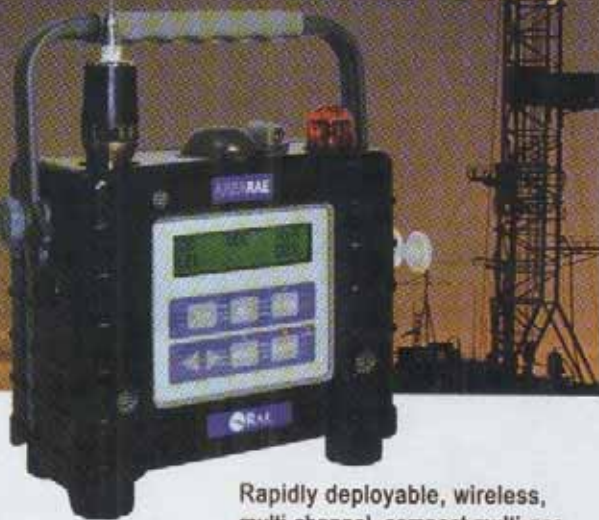


# Wireless Gas Detection

## Monitor Multiple Sites with a Single Solution

HazMat

Worker Safety



Rapidly deployable, wireless, multi-channel, compact multi-gas, radiation, IAQ monitors



[www.raesystems.com](http://www.raesystems.com)

For More Facts Circle 151 on Reply Card