

PA PUC Gas Pipeline Safety Seminar

First Response & Incident Investigation

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Associated **A**lectric **E**nergy **G**as **I**nsurance **S**ervices

AEGIS

Background Information

- Utility Mutual Insurance Company (member owned)
- Formed in 1975 by 22 gas utilities
- Electric Utilities began joining in 1977
- 490 members – 95% utilities and related energy

AEGIS

Policy Types/Coverages

- Excess General Liability
- Directors & Officers
- Employment Practices Liability
- Excess Workers' Compensation
- Professional Liability
- Financial Products
- Property
- Other coverages through alliances

AEGIS Loss Control Division

- **Mission**

To assist AEGIS Member companies maintain effective and safe operating systems while reducing their overall long-term cost of risk, by developing and providing products, services and training specifically for this purpose.

AEGIS

Loss Control Division

- Products/ Services:
 - Risk Assessments
 - Self-Administered Risk Assessment Guides
 - Occupational Safety & Workers' Compensation Program Assessment
 - Training - Gas Operator
 - * First Response
 - * Investigation of Gas Related Incidents
 - * Leakage Program Management
 - * Gas Leak Pinpointing
 - * Customer Contact
 - * Utility Locating

AEGIS

Loss Control Division

– Lessons Learned Video Series

- * Too Little.... Too Late
- * Pressure Point
- * The Smell of Danger
- * A Toxic Tale
- * Hidden Danger
- * First Line of Defense
- * Recognizing and Avoiding the Hazards (Volume I & II)
- * Emergency Exercises “A Look in the Mirror”
- * People Don’t Know What They Don’t Know
- * Public Safety – Communication and Emergency Response
- ❖ Anatomy of a Gas Leak (A Collaborative Approach)



**AEGIS Lessons Learned &
Hazard Awareness videos (Gas
and Electric) can now be
streamed from AEGIS TV @**

http://www.aegislink.com/portal/aegistv/loss_control.do

AEGIS

Loss Control Division

- First Responder Emergency Response Tip Cards
- Hazardous Conditions (Red Tag) Procedure
- Employee Public Safety Awareness Program
- Webinars (3-4 year)
- Investigating Gas & Electric Incidents workshops (4+)

Information regarding the dates and registration for these webinars and workshops can be found at:

www.aegislink.com

Physical Properties of Various Explosive Liquids and Gases

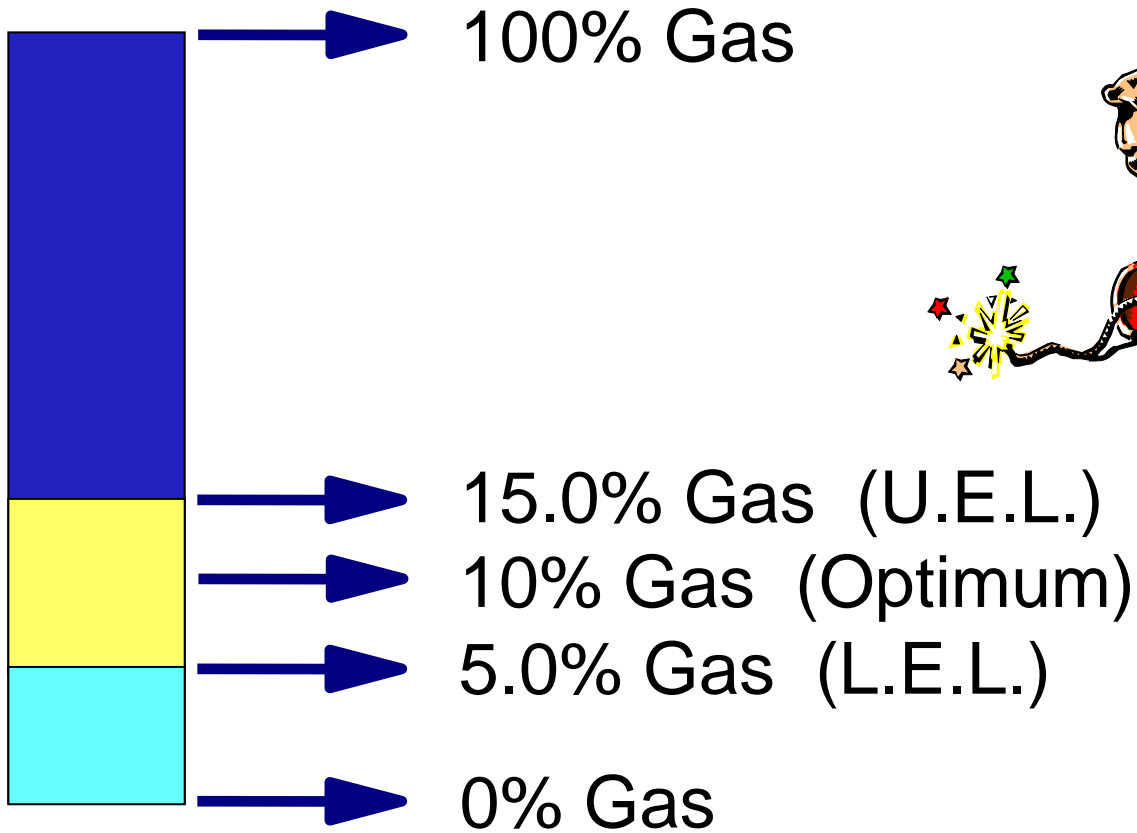
Material	Chemical Formula	Specific Gravity Air=1	Ignition Temp Deg. F in Air	Lower Expl. Limit (% gas)	Upper Expl. Limit (% gas)
Methane	CH₄	.55	1193	5.3	15.0
Natural Gas	Blend	.65	950-1200	5.0	15.0
Ethane	C₂H₆	1.04	993-1101	3.0	12.5
Propane	C₃H₈	1.56	957-1090	2.2	9.5
Butane	C₄H₁₀	2.01	912-1056	1.9	8.5
Hexane	C₆H₁₄	3.0	437	1.1	7.5
Gasoline	Blend	3-4.0	632	1.4	7.6
Acetone	C₃H₆O	2.0	869	2.5	12.8
Benzene	C₆H₆	2.8	928	1.2	7.8
Carbon Monoxide	CO	1.0	1128	12.5	74.0
Hydrogen	H₂	.1	932	4.0	75.0
Hydrogen Sulfide	H₂S	1.2	500	4.0	44.0

The Dangers of Gasoline

- Nearly 150,000 fires occurring in the United States every year are caused by gasoline.
- On average 500 Americans die every year in gasoline related fires.
- Almost half a billion dollars in property damage can be linked to gasoline annually.

***National Fire Protection Association (NFPA)**

Flammable Range for Natural Gas

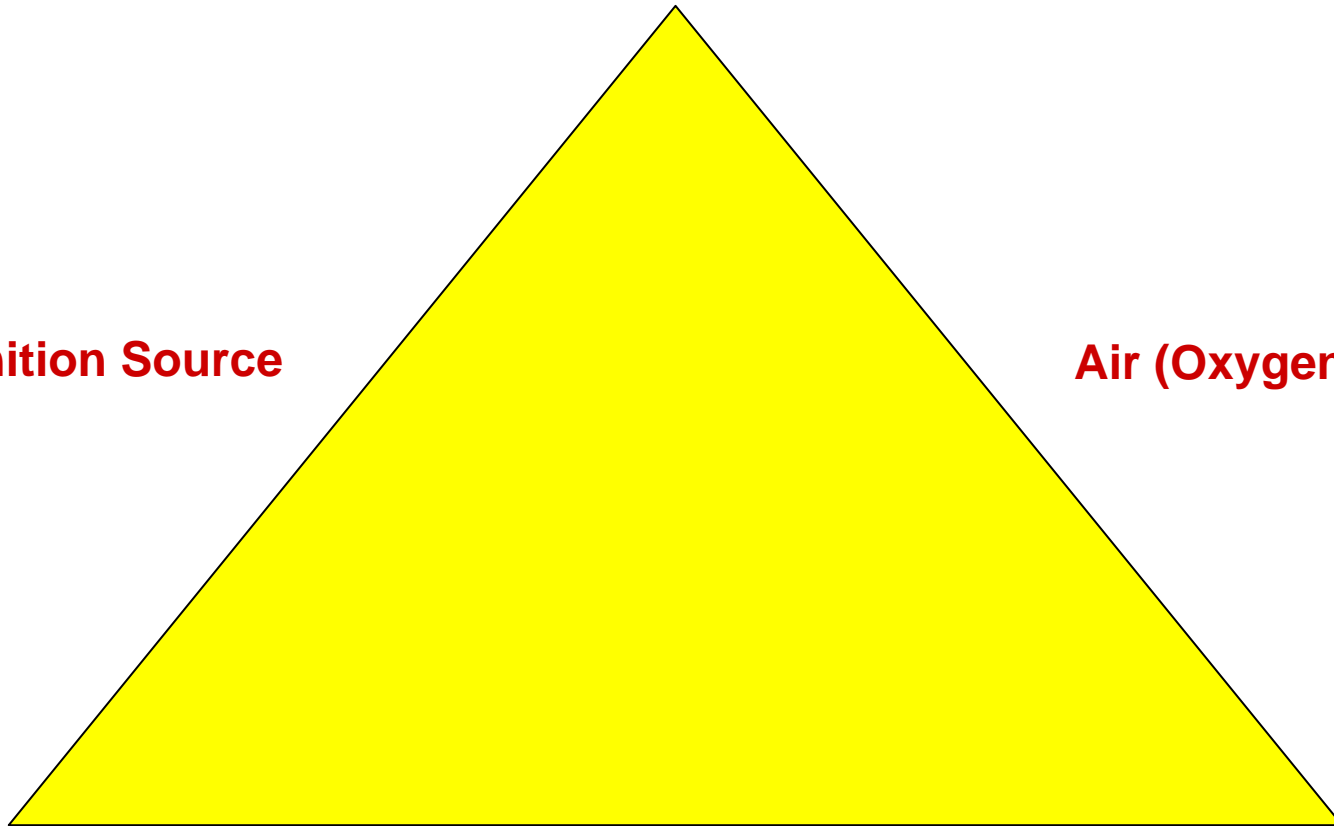


The Explosion Triangle

Ignition Source

Air (Oxygen)

Gas Concentrations between 5.0% – 15.0% Gas/Air



Potential Ignition Sources

- Doorbell
- Light Switch
- Pilot Light
- Flashlight
- Telephone
- Electrical appliance
- Automobile
- Security system
- Matches, lighter
- Cell phone/pager
- Back-up generator
- Lightning
- **Static electricity**
- And many others



Federal Odorization Standard 192.625 (2-22-88)

- (a) A combustible gas in a distribution line must contain a natural odorant or be odorized so that at concentration in air of one-fifth of the LEL (lower explosive level), the gas is readily detectable by a person with a normal sense of smell.

- (f) To assure the proper concentration of odorant in accordance with this section, each operator must conduct periodic sampling of combustible gases using an instrument capable of determining the percentage of gas in air at which the odor becomes readily detectable.

Odorant is the customer's leak detector.

Odorizer shut-down
Contaminants in odorizer
Naturally occurring sulfurs
Distillates in pipeline
Pipewall adsorption
Oxidation in pipeline
Soil adsorption

Factors Which Affect Odorant Quantity



Physical ailments

Age

Masking

Distraction

Factors Which Affect Odorant Quality



Incident (2000)

Company Retention \$200K

- While parking the family car in his attached garage, a retired 83 year-old physician lost control of his automobile and struck the concrete block foundation that supported and elevated his home's heating and hot water equipment.
- The impact moved the boiler about one foot from its original position. The damage was severe enough to warrant an inspection, so the doctor called his regular plumbing and heating service provider who agreed to check the unit that afternoon.
- The doctor then called the local gas company and explained what had happened.

Incident (2000) Cont'd.

Company Retention \$200K

Cont'd.

- He was asked whether he smelled gas. He answered that he did not. The company's call center representative then explained that the company would not examine the damage unless he smelled gas, but if he did, he should please call back and they would gladly send someone out to his home.
- 90 minutes later the home exploded and the doctor and his wife were severely burned. Less than one month later, suffering from severe burns over most of his body, the doctor died.

AEGIS Incurred \$2.7 Million

What Happened?

- At times, customers and the general public seek assistance from gas utilities for situations that are not commonly encountered. Such was the case in this unusual incident. The call center representative did not recognize the potential severity of a situation involving an automobile striking the heating equipment.
- Listening to callers and their circumstances is critical to effectively achieve the ultimate goal of emergency response and the protection of life and property.
- The doctor, being 83 years old may have lost much of his sense of smell with age.

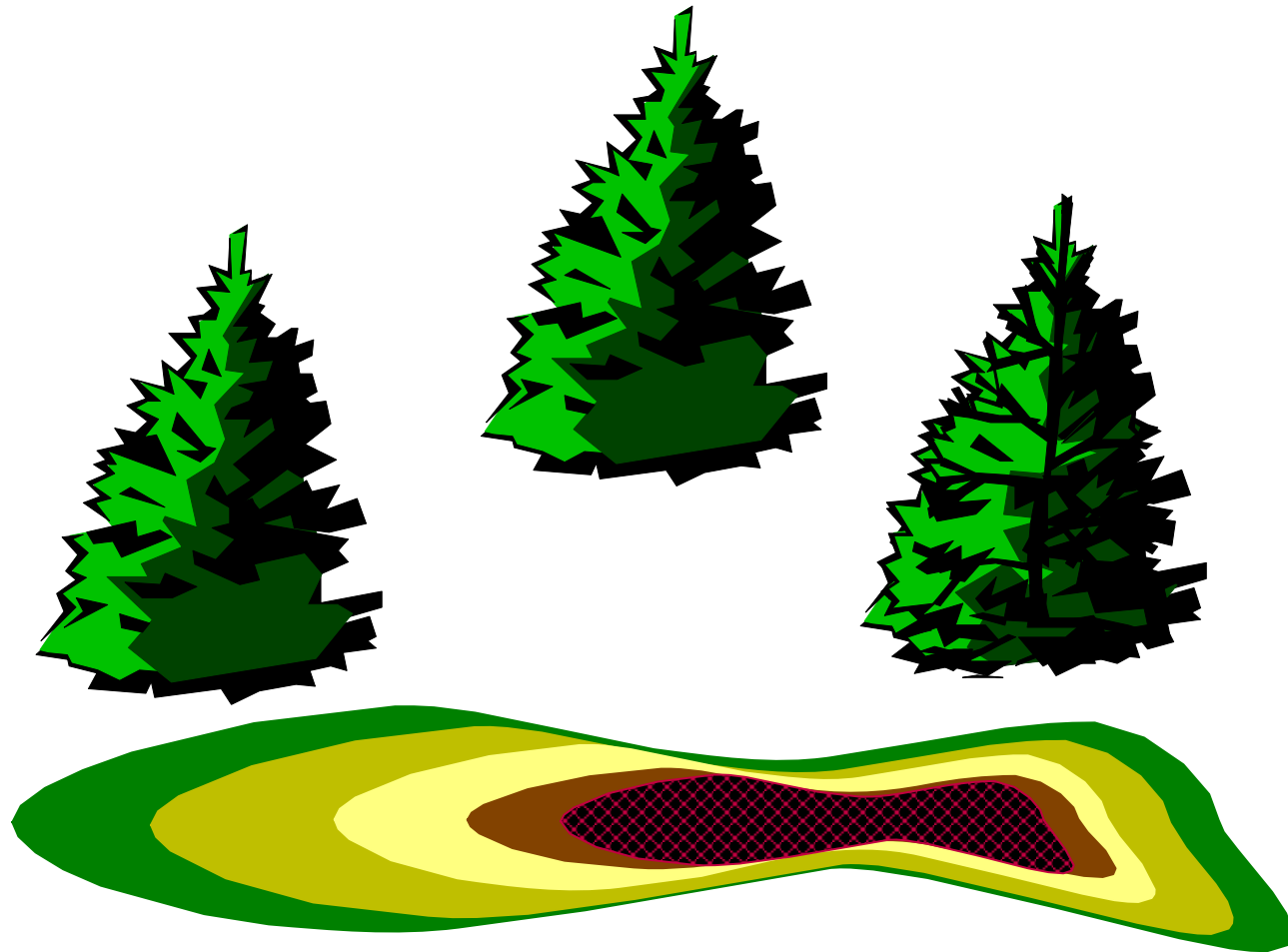
The call center is the “First Line of Defense”

Odorization must
be continuous
(every day)



and it must be
adequately
documented!

Effects of Natural Gas on Soil and Vegetation



Effects of Natural Gas on Soil and Vegetation

- Displaces soil atmosphere
- Drying effect
- Eliminates aerobic bacteria
- Reduces soil components
- Changes pH

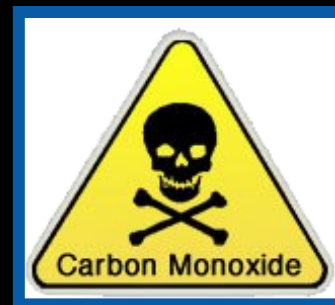


- Natural gas is a simple asphyxiant
- Carbon monoxide is a chemical asphyxiant

It takes far less CO to be deadly!

Carbon Monoxide

- Odorless
- Colorless and tasteless
- Product of incomplete combustion
- Deadly in very small amounts



Potential Effects of Carbon Monoxide Exposure

Excerpts from OSHA chart based on industrial use

PPM	Effects & Symptoms	Time
50	Permissible exposure level	8 Hrs.
200	Slight headache	3 Hrs.
400-600	Headache, discomfort	1-2 Hrs.
1000-2000	Headache, confusion, nausea, may stagger	1.5 Hrs.
2000-2500	Heart palpitation	30 Mins.
2500-3500	Unconsciousness	30 Mins.
4000	Fatal	30 Mins.

Effects may vary from person to person!

CO & Small Gasoline Engines

In 2008, 65 people died due to Carbon Monoxide poisoning from gasoline powered generators.

- *A single generator can emit several hundred times more poisonous Carbon Monoxide than the exhaust from a modern car.**
- *National Institute of Standards and Technology (NIST)**

Lessons Learned from CO

A farmer died of CO poisoning while using an 11 horsepower gasoline-powered pressure washer to clean his barn. He had worked about 30 minutes before being overcome.

Major Causes of Leaks

- Corrosion
- Mechanical failure
- Improper installation
- Improper design
- Faulty materials
- Third Party Damage - “Dig-Ins”

Incident (2001)

Company Retention \$1,000,000

- A gas explosion and fire destroyed a single family residential home causing three fatalities. An investigation subsequent to the incident revealed localized atmospheric corrosion had progressively thinned meter set piping eventually creating a hole. The meter set was located under the front porch of the home and it is believed that leaking gas accumulated in the crawl space and basement.
- Company records indicated that the bare steel service line and meter set piping were installed in 1937. Similarly aged gas services and meter sets in the immediate area were replaced due to their poor condition. Records revealed that this bare steel service line and meter set had not been inspected by the gas company since 1996.

Lessons Learned

Part 192, Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards requires piping exposed to the atmosphere to be inspected for evidence of atmospheric corrosion at least once every 3 calendar years, but at intervals not exceeding 39 months.

- This code mandates the inspection of all above ground natural gas piping including residential meter sets. In addition, Part 192 requires cathodically unprotected distribution lines, where electrical surveys are impractical, to be leak surveyed at least once every 3 calendar years at intervals not exceeding 39 months.
- If the operator had completed either of these code mandated inspections, this incident may have been prevented.

AEGIS Incurred \$4,594,000

- In the last 20 years, over 30% of natural gas-related incidents/explosions have been a direct result of “dig-ins”!
- This is the major reason why we should always promote the “Call Before You Dig Program.”



#682

#686



Our main job is *not*
finding & fixing leaks

Our main job is
public safety

Instruments For Detecting Gas Leaks

The Combustible Gas Indicator

- **CGI should be used to:**
 - Classify an atmosphere
 - Inside a building or in a confined space
 - Classify underground leakage
 - Determine “Where is the gas?”
 - Pinpoint underground leakage
 - Determine “Where is the leak?”
- **You must know:**
 - How to properly use it
 - What readings might constitute a hazardous condition

Combustible Gas Indicators (CGI)

- GMI Gas Surveyor
- J&N Sensit Gold
- Bascom-Turner Ranger
- MSA Passport
- And others



Proper Operation and Maintenance of CGIs

Batteries/Voltage Tests



Air Tightness Tests



Filters



Zero Tests



Span Gas Tests

Treat your combustible
gas indicator with respect.

It could save
your life someday!

Portable Hydrogen Flame Ionization (HFI) Instruments

- Search tool
- Visual and audible indication of gas concentrations in ppm
- Indications must be confirmed with a Combustible Gas Indicator (CGI)



Surface Sampling Laser Leak Detectors



- Heath Detecto Pak-Infrared (DP-IR)



- Southern Cross '46 Hawk



- Heath Remote Methane Leak Detector (RMLD)

Combustion Chamber Demonstration

Lessons Learned:

- Natural gas is lighter than air
- Flame wave moves up-over-down
- Pressure wave moves upward first
- The optimum mixture (10%) creates the most efficient burning
- The greatest forces are created when there is a low point of ignition
- The two major by-products of the combustion process are carbon dioxide (CO₂) and water vapor (H₂O)

Relative damage in a natural gas-related incident is related

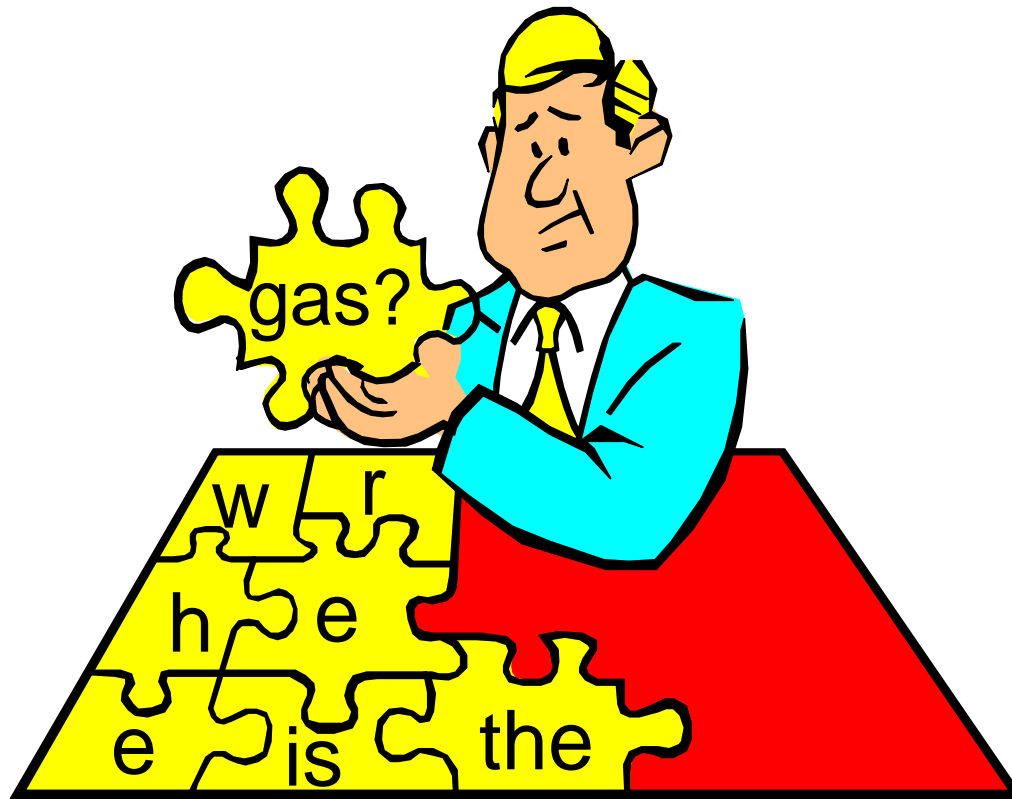
to:

- Point of ignition-vertically
- Point of ignition-horizontally
- Source of ignition
- Type of leak=volume of gas
- Type/structure of building
- Other combustibles in area



Evaluating The Leak

Where is the gas?



Evaluating The Leak

- **W**here is the gas?
- **H**ow much is there?
- **E**xtent of hazard (migration)
- **R**elation to other structures
- **E**valuate/evacuate

Factors Affecting Gas Migration

- Soil type
- Soil moisture
- Surface cover/frost
- Line pressure
- Depth of burial
- Leak size and age
- Change in elevation=slope
- Path of least resistance

Remember:

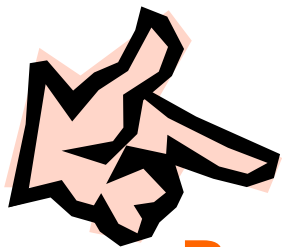
- The biggest built-in safety factor of natural gas is that it is lighter than air; however...
it will vent to the atmosphere someplace!



“Centering” = Where is the Gas?

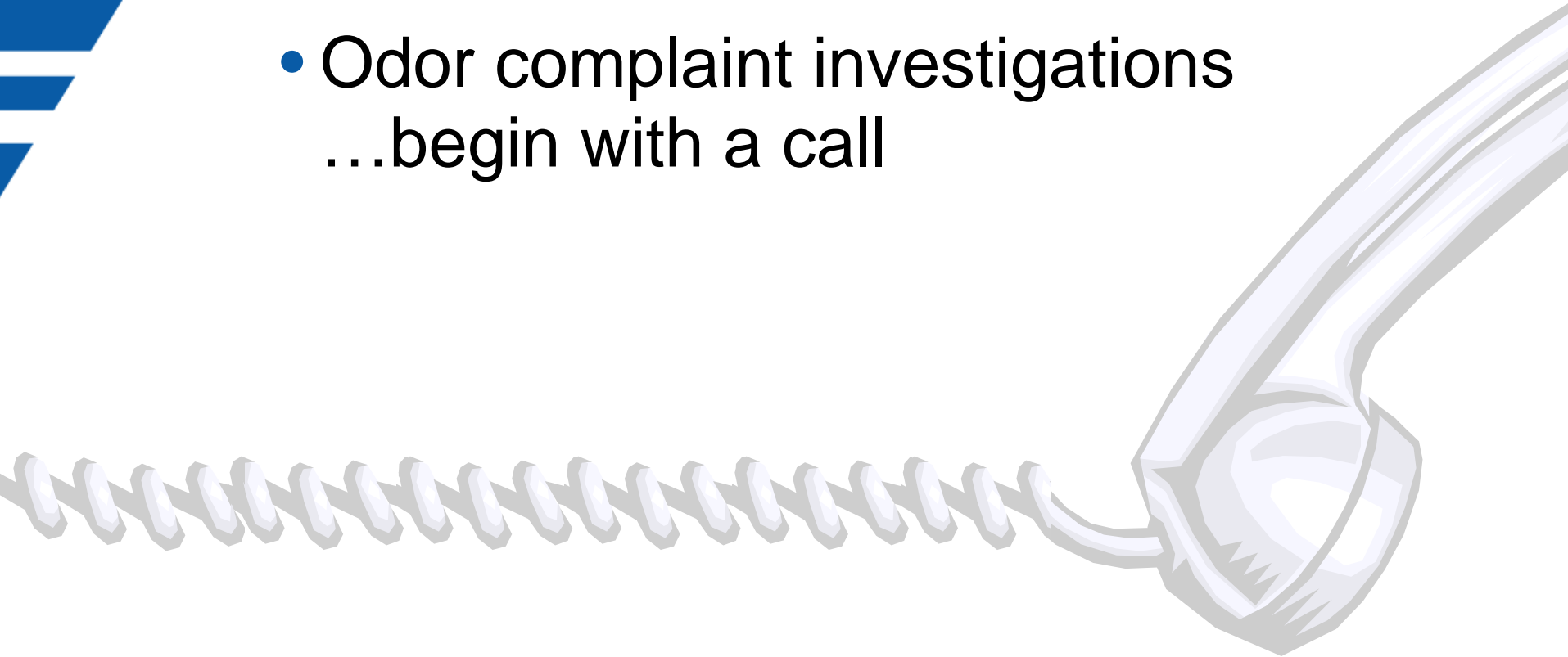
Centering The Leak

- Probe holes must be of sufficient depth
- Test all available openings
- “Zero out” N-S-E-W
- You must have sufficient information to make a good judgement



Be Careful – “Don’t make a leak, looking for a leak.”

- Odor complaint investigations
...begin with a call

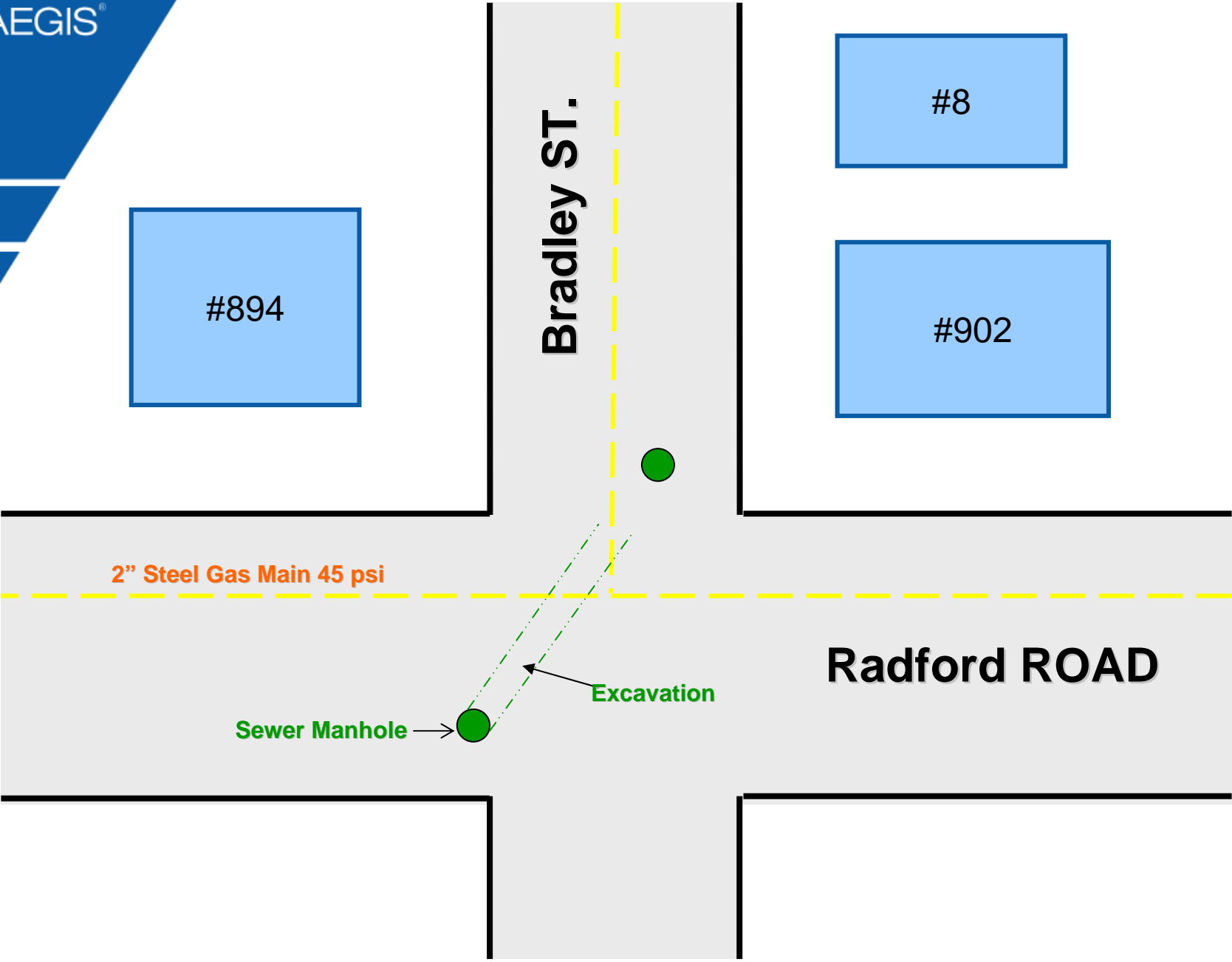


The Key Is Listening

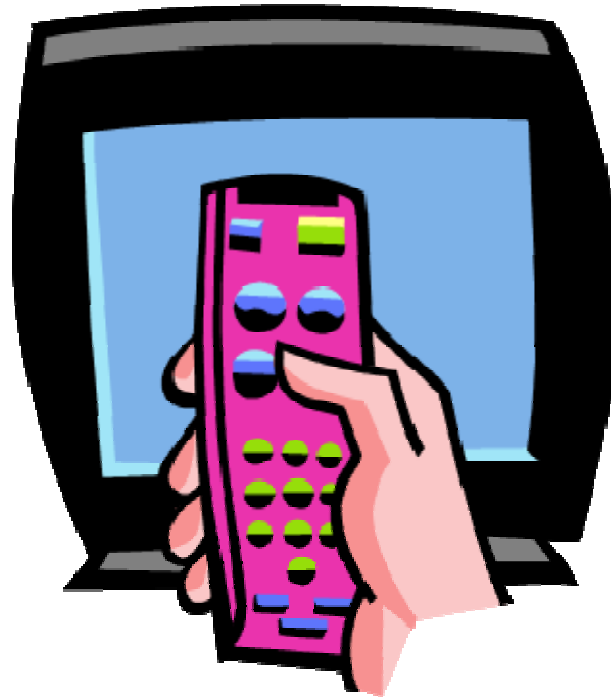
- Not every call is a gas emergency, however, calls involving an odor complaint should be considered an emergency.
- Listen to the customer and ask questions in order to gather the information needed



- An odor complaint call should be considered a Grade 1 leak...
until proven otherwise.



Anatomy Of A Gas Leak A Collaborative Approach



Responding to Odor Complaint Calls

Remember:

- You must consider it to be a hazardous condition until you *prove*, by use of instrumentation, *that it is not!*

Conducting The Investigation

Do Not Assume Anything!

Test, Don't Guess



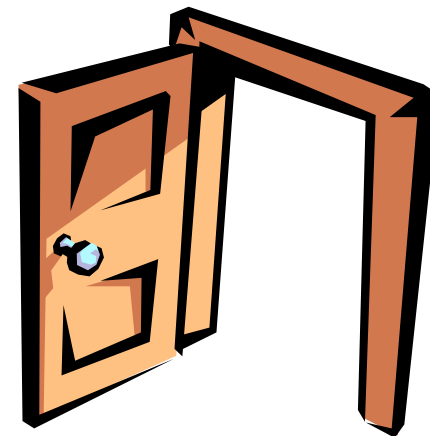
Approaching The Building

- **Visual observations**
 - Vegetation damage
 - Construction activities
 - Meter observations
- **Olfactory senses**
 - Do you smell anything?



Entering The Building

- CGI zeroed before entering
- Enter on LEL scale
- Check the problem area
- Continue search even if leak is found
- Did you find “*a*” leak or did you find “*the*” leak?



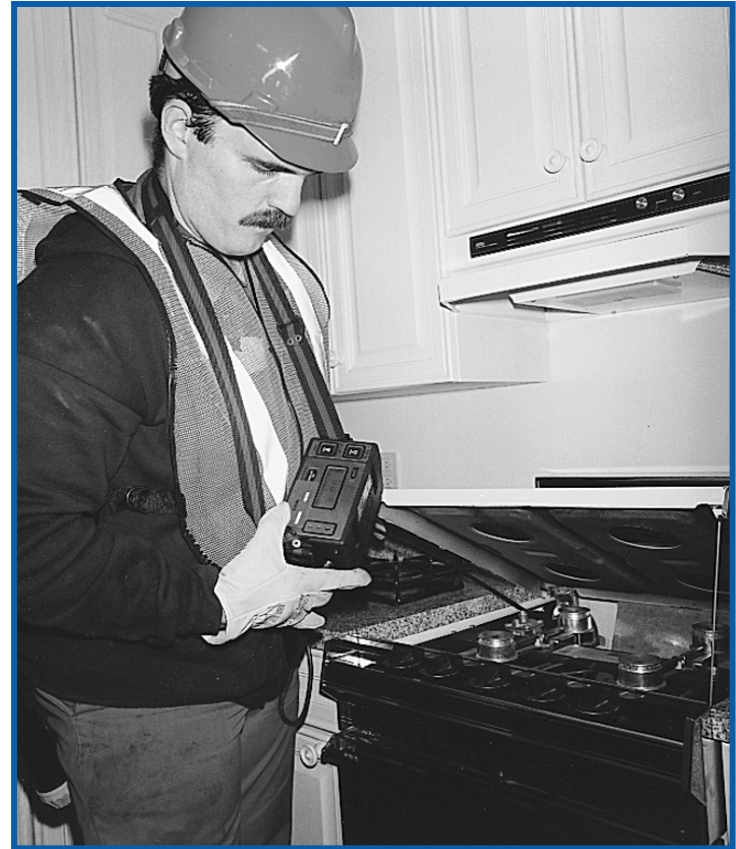
Expanding The Search

- Check the entire gas system
- Visual inspection of appliances and piping
- Check all utility entrances and floor drains



Other Conditions To Observe

- Carbon monoxide
- Other flammables
- Lack of make up air, vent size
- Scalding
- Other code violations



Action When A *Hazardous* Condition Is Found

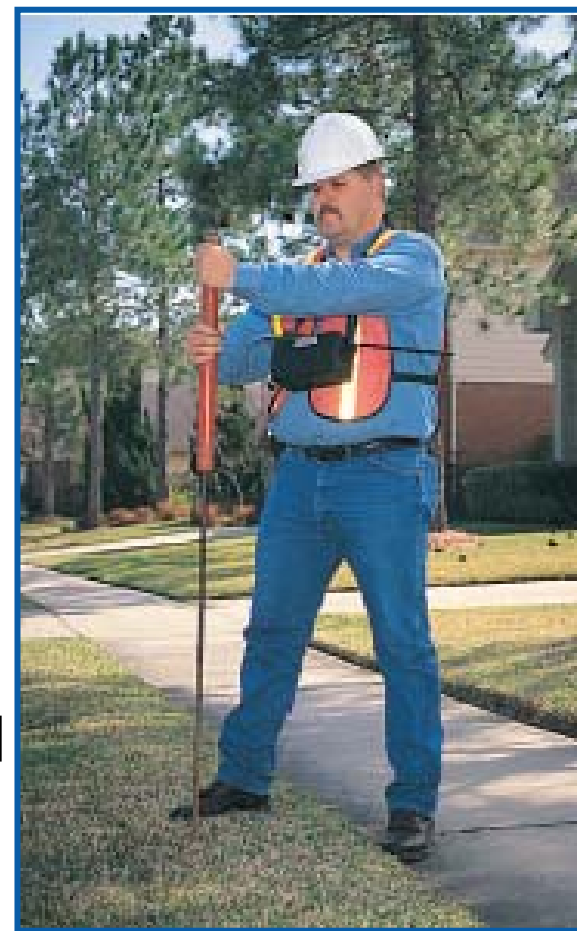
- Red or “Danger” Tag
 - Document
 - Communicate
 - Disconnect
 - Follow up

Policies may vary from company to company



Completing The Investigation

- Shut in test/clock meter
- Test meter/leak detection fluid
- Bar test
 - At the meter (riser), service, along main and check all available openings
- Expand search if odor detected
- Document findings



Leaks Found On Odor Complaints Must Be:

- Repaired
- Shut off & tagged
- Classified (is it safe?)

There should be no other options!

Repeat Calls

- Use different equipment
- Send different personnel
- Send supervisor to verify
- Track time/conditions
- Is it natural gas? (verify odor)

Remember, you must respond

Remember: The Job Is Not Completed



- Until all paperwork/documentation is completed:
 - Neatly
 - Thoroughly
 - Accurately
- You may do everything right, but you may be judged by what **is** or **is not** documented

Our main job is *not*
finding & fixing leaks

Our main job is
public safety

Incident Investigation

Supervisory Responsibility at Incident Scene

1. Review of actions taken
2. Initiate additional measures
3. Establish liaison with emergency response personnel
4. Establish gas spread
5. Makesafe operations

***Remember**

Public & Personal Safety!



Makesafe

Actions to Consider

1. Implementation of emergency plan
2. Calling for additional help
3. Notification of police/fire departments
4. Evacuating premises
5. Blocking off the area
6. Stopping the flow of gas
7. Elimination of ignition sources
8. Venting an area

Time Is Critical

Remember Public Safety!

**“It is not over until it’s over...
don’t be a part of history.”**

After An Incident

Actions to Consider

1. Prevention of related incidents
2. Calling for additional assistance
3. Coordination of efforts with civil authorities
4. Preliminary search for gas by testing adjacent structures, bar-holing testing available openings – use good judgement
5. Record results of tests positive or negative
6. Focus only on the immediate area of concern

After An Incident

Other Actions to Consider

These actions should not be considered until the area is secured

1. Have a skilled photographer on the scene ASAP, photographic documentation
 2. Sniff tests, odorant tests, witness and document
 3. Names and addresses of witnesses
1. Verify equipment calibration/document
 2. Pressure testing -only when skilled employees and proper equipment are at the scene and *only* according to your standards
 3. Develop an event timeline

Fire Service Personnel

1. The main focus of the fire department should be securing the area
2. The gas company's main focus should be securing the gas
3. The common focus of both should be

Public Safety!

Fire Department Relationships

1. Understand that once the fire department is on the scene, they are in charge
2. It is very important to develop a relationship with them prior to an emergency
3. AEGIS video programs *Natural Gas Recognizing and Avoiding the Hazards” Volumes I & II* are designed to assist in developing this relationship

Initial Assessment of the Scene

1. What has been done thus far?
2. Do additional structures need to be checked or evacuated?
3. Have available openings been checked?
4. Has bar testing been performed and documented?
5. Are additional personnel and/or equipment needed?
6. Have the appropriate people/agencies been notified?

Initial Assessment of the Scene

7. Are pictures being taken of the incident scene/investigation by gas company personnel?
8. Are gas company employees wearing the appropriate safety equipment?
9. Has someone been contacted to perform an odorant test in the vicinity?
10. Who will be documenting the activities of the investigation?
11. Is Form 11 (Pipeline Failure Investigation Report) being used as a guide in the investigation?

Initial Assessment of the Scene

12. Does it appear that the use of outside experts will be necessary and who will notify them to be prepared?
13. Will a vapor sample or pressure test be needed and is the proper equipment to perform these task on site or enroute?
14. Have witnesses been identified for possible future interviews?
15. Are company emergency plans and procedures being followed?

Points to Determine During the Investigation

1. Type of fuel involved?
2. Source of the fuel?
3. How was the fuel ignited?
 - The type of fuel appears to have been from an outside leak (natural gas), it appears to have migrated into the structure by following a recently installed water line (source of fuel) and it apparently was ignited when the homeowner turned on the light switch upon entering her home (ignition source).

The Incident Scene

Photographic Documentation

1. Photographer Must be trained in investigative photography. The photographer should be called in ASAP.
2. Camcorders May be used to document the proceedings, but be careful about audio recordings.
3. Digital Cameras May be used to document the proceedings; however, since the pictures can be altered it may lead to problems down the road.

Discuss this with your attorney!

The Incident Scene

Photographic Documentation



1. The pictures taken should tell a story
2. Take only pictures pertinent to the investigation or possibly to future litigation
3. Who is taking the pictures? Who is taking the pictures e.g. camera phones

Vapor Sample Collection for Analysis

Do not delay!!

1. Use good sampling techniques (practice)
2. Lab will dictate sampling device
3. Take a spare sample and/or a comparison sample
4. Chain of custody form, if needed

It costs nothing to take the sample and you have it should you need it!

Vapor Sample Collection for Analysis

Documentation

1. Date & time
2. Location (drawing or sketch)
3. Name of person who took sample
4. CGI reading (% of LEL or % Gas/Air)
5. Witness and photograph



Odorization Testing

Only after MAKESAFE is completed, but as soon as possible

1. Difference between a “compliance test” and a “making sure you are odorized” test
2. Closest location to the incident location
3. Consider several locations
4. Use different testers i.e. company personnel, civil authorities official investigator on scene
5. Establish “readily detectable” levels

Incident Investigation

Considerations

1. The investigative team leader should coordinate efforts through fire officials, company supervision and the legal department
2. Photograph and document all aspects of the investigation
3. Use of outside experts as site investigators; they must be contacted immediately
4. Obtain complete floor plans
5. Documentation of the investigation; must be concise and accurate
6. NFPA 921 (reference, but use it only as a guide)

Evidence

What to Search for and Document



1. Damage

Structural

Extent of fire
damage/burn pattern

Distribution of
debris/epicenter

• Condition

All appliances

Customer fuel lines

Meter, regulator,
service

Electrical system

Sewer system, traps,
vents

1. Evidence

Over-pressures

Code violations

Stored flammable
liquids

Combustible
vapors/volume

Evidence *Security*

1. Preserving the scene
2. Securing the evidence
3. Chain of custody forms
4. Secure storage area
5. Documentation



Handling Physical Evidence

1. Meters & Regulators

- These are your property; if possible maintain custody. If not possible, insure a chain of custody and protect your right of access.

2. Pressure Testing

- Conduct integrity testing, not strength testing. This testing should only be performed by trained individuals with the proper equipment. It must be a non-destructive test. This test should be witnessed and documented.

3. Customer Piping

- If possible, recover and reconstruct the interior piping system. Watch for missing piping and clean threads. Test with monometer at operating pressure (ounces) or 2lb for 2lb systems.

Exercise caution when testing piping exposed to fire/heat

Dealing with the Media at the Scene

1. Gas company should have one person whose responsibility is to deal with the media at the scene; this person should be easily accessible
2. Miranda warning – “anything you say can and will be used against you”
3. Public’s initial perception will carry forward
4. A “no comment” statement vs. “the matter is still being investigated”

Internal Evidence Control

Verbal

Instructions to personnel

- Don't talk to strangers
- Don't talk unless necessary
- Don't speculate
- Be professional
- Stay calm

Radio vs. cell phone – Radio is recorded

Debriefing First Responders

1. Debrief initial responders as soon as possible
2. Conduct debriefing in a relaxed atmosphere
3. Express the importance of honest and accurate information
4. Question responders about what they **personally** saw and did at the scene and during the time frame. They should not speculate on the cause or actions of others at the scene
5. Document their responses
6. Verify instrument calibration



Initial Analysis of the Situation

1. Gas company employee meeting
2. Review and document actions taken
3. Review records
4. Establish level of the investigation
5. Identify company policies/practices that may be pertinent
6. Review time line based on debriefing – dispatch records

Typical Evidential Documents

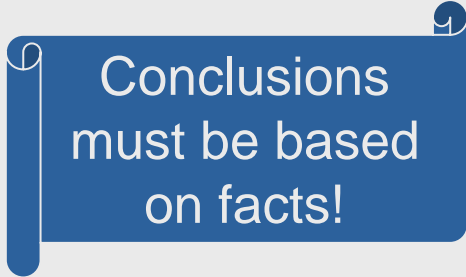
1. Reports of incoming calls
2. Service orders and reports
3. “One call” records
4. Repair orders and reports
5. Employee training records
6. Engineering records
7. Leakage survey records and reports
8. Pressure testing records of line in question
9. Maps and valve location records
10. Employee/contractor qualification
11. Odorant tests and injection records
12. Instrument calibration records



Analysis of Facts

Based on:

- Test results
- Observations
- Statements of witnesses
- Photographic evidence
- Statements of employees
- Laboratory analysis
- Reports (verbal or written) of outside experts

A blue callout box with a scroll-like top edge, containing the text "Conclusions must be based on facts!".

Conclusions
must be based
on facts!



**AEGIS Insurance Services, Inc.
Heath Consultants Inc.**

Thank You

Please visit our website @

www.aegislink.com

www.heathus.com