

# Investigation of Gas Related Incidents

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ViaData LP

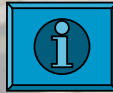
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# Introduction

- Incidents

- Kitchen Works



- A case study



# Incident, 191.3

- Incident means any of the following events:
  - (1) An event that involves a release of gas from a pipeline, or of liquefied natural gas, liquefied petroleum gas, refrigerant gas, or gas from an LNG facility, and that results in one or more of the following consequences:
    - (i) A death, or personal injury necessitating in-patient hospitalization;
    - (ii) Estimated property damage of \$50,000 or more, including loss to the operator and others, or both, but excluding cost of gas lost;
    - (iii) Unintentional estimated gas loss of three million cubic feet or more;

# Incident, 191.3

- (2) An event that results in an emergency shutdown of an LNG facility. Activation of an emergency shutdown system for reasons other than an actual emergency does not constitute an incident.
- (3) An event that is significant in the judgment of the operator, even though it did not meet the criteria of paragraphs (1) or (2) of this definition.
- (I 95 video)

# PHMSA Definitions for Data Analysis

- Serious pipeline incident: an event involving a fatality or injury requiring in-patient hospitalization.
- Significant Incidents: incidents reported by pipeline operators when any of the following conditions are met:
  1. fatality or injury requiring in-patient hospitalization
  2. \$50,000 or more in total costs, measured in 1984 dollars
  3. highly volatile liquid releases of 5 barrels or more or other liquid releases of 50 barrels or more
  4. liquid releases resulting in an unintentional fire or explosion



# Purpose of the Investigation

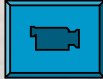
- Determine cause
  - Probable Cause – The likely scenario that brings together fuel, O<sub>2</sub> and ignition sources resulting in fire or explosion
- Determine compliance with standard practices
- Determine need to revise standards

# §192.617 Investigation of failures.

Each operator shall establish procedures for analyzing accidents and failures, including the selection of samples of the failed facility or equipment for laboratory examination, where appropriate, for the purpose of determining the causes of the failure and minimizing the possibility of a recurrence.

(GPTC Guidance)  
(enforcement guide)

# Reporting Incidents

- Reportable incident (Lafayette) 
- National Response Center
  - 800-424-8802
  - Report number, stays in system
- Incident report to OPS within 30 days
  - Supplemental reports



# GPTC Guidelines - Operator

- GM 192.617(4)
  - (a) Determination of the probable cause of the incident.
  - (b) Evaluation of the initial response to the incident.
  - (c) The need for system improvements if necessary.
  - (d) The need for improvements in response, management and investigation of incidents.

# Initial Response to an Incident

- Hazard?
- Extent?
- Life
- Property

# “Make Safe” Actions To Consider in an Emergency

- Implement company emergency plan
- Evacuate buildings
- Block-off area
- Reroute traffic
- Eliminate sources of ignition
- Ventilate
- Stop the flow of gas
- Notify police and fire departments

# Operator Response to an Incident

- Deploy supervisory personnel and customer service/maintenance crews
- Implement/continue make-safe operation
- Establish gas or product migration area
- Control gas/product flow
- Initial Observation of conditions

# Operator Response to an Incident

- Establish liaison with public and regulatory officials
- Initiate drug/alcohol testing
  - (drug 32 hr, alc 2 hr/8hr)
- Review of actions taken
- Initiate additional measures
- Recommendations



# The Operator's Investigation Team

- Legal
- Leak survey
- Pressure/measurement/odorization
- Safety
- Corrosion
- Codes and compliance

# The Operator's Investigation Team

- Public affairs
- Risk management/claims
- Technical services
- Customer service
- Construction/maintenance
- Outside experts

# Regulatory Preparedness

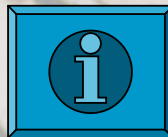
- Training
  - Regulations
  - Investigation techniques
- Reporting considerations
  - Visual – photo, video
  - Written – field notes
  - Audio – recording
- Communications procedures
  - Radio security
  - Cell phone

# Regulatory Preparedness

- Media relations
  - Media spokesperson
  - Prepared statements
- Review NTSB reports
- Review NFPA 921, "Guide for Fire and Explosion Investigations."
- Additional experts and assistance

# Agencies Involved

- Homeland Security
- Coast Guard
- ATF/FBI
- NTSB
- OPS/PHMSA
- State regulatory agency
- Local fire marshal





# Properties and Characteristics of Common Combustibles

- Properties of gases
- Specific gravity
- Ignition sources (surveillance video)
- Flammable limits
- Odorization



# Physical Properties of Gases

- Organic
- Hydrocarbon
- Flammable Limits
- Ignition Temperature
- BTU Value



# Characteristics of Natural Gas

- Non-Toxic
- Colorless
- Odorless
- Specific Gravity
- Combustible Range



## 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





# Physical Properties of Various Explosive Liquids and Gases

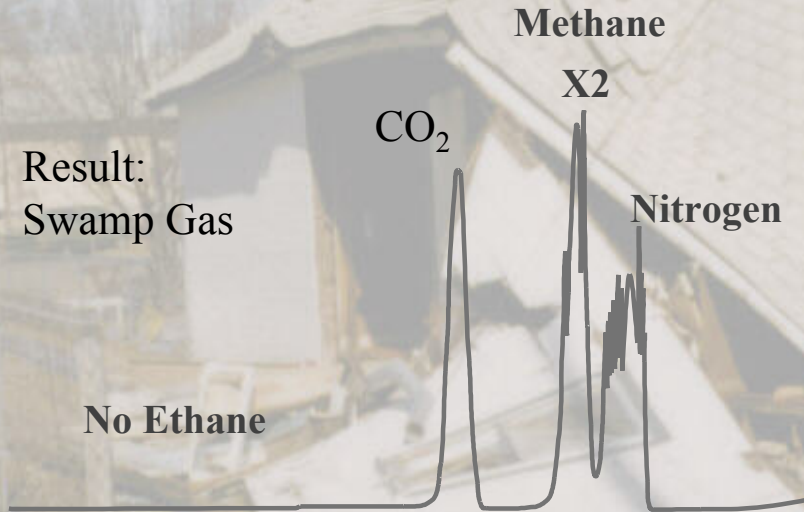
Material	Chemical Formula	Specific Gravity Air=1	Ignition Temp Deg. F in Air	Lower Expl. Limit (% gas)	Upper Expl. Limit (% gas)
Methane	CH <sub>4</sub>	.55	1193	5.3	15.0
Natural Gas	Blend	.65	1163	4.5	14.5
Ethane	C <sub>2</sub> H <sub>6</sub>	1.04	993-1101	3.0	12.5
Propane	C <sub>3</sub> H <sub>8</sub>	1.56	957-1090	2.2	9.5
Butane	C <sub>4</sub> H <sub>10</sub>	2.01	912-1056	1.9	8.5
Hexane	C <sub>6</sub> H <sub>14</sub>	3.0	437	1.1	7.5
Gasoline	Blend	3-4.0	632	1.4	7.6
Acetone	C <sub>3</sub> H <sub>6</sub> O	2.0	869	2.5	12.8
Benzene	C <sub>6</sub> H <sub>6</sub>	2.8	928	1.2	7.8
Carbon Monoxide	CO	1.0	1128	12.5	74.0
Hydrogen	H <sub>2</sub>	.1	932	4.0	75.0
Hydrogen Sulfide	H <sub>2</sub> S	1.2	500	4.0	44.0

# CHROMATOGRAPHIC ANALYSIS: SWAMP GAS

Barhole Sample

Result:  
Swamp Gas

No Ethane



# CHROMATOGRAPHIC ANALYSIS: NATURAL GAS

Barhole Sample

Result:  
Natural Gas

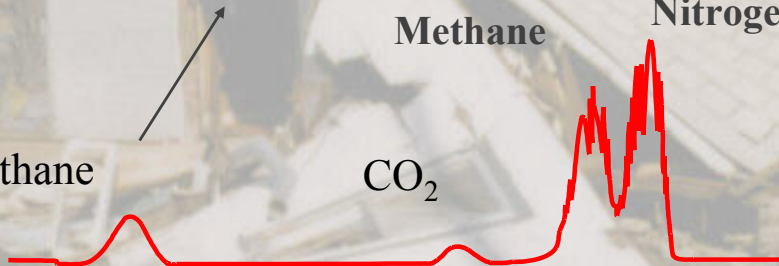
Indicates Natural Gas

Ethane

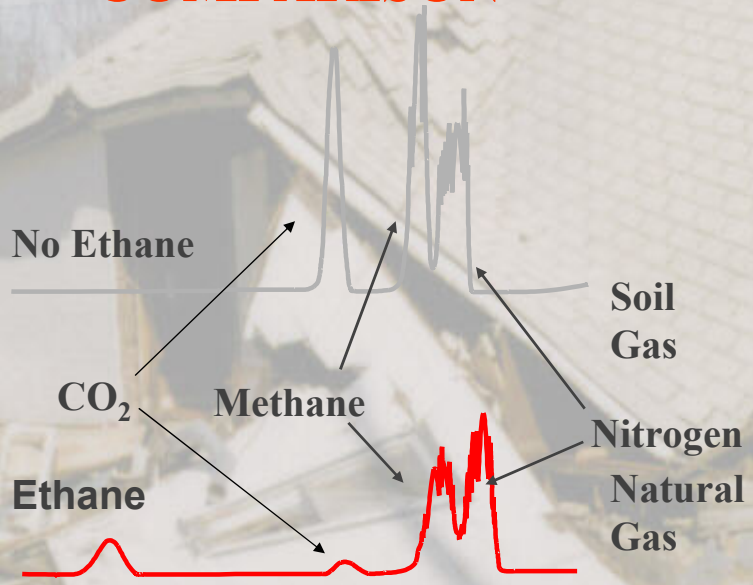
CO<sub>2</sub>

Methane

Nitrogen



# CHROMATOGRAPHIC ANALYSIS: COMPARISON



## Sources of Combustible Vapors

- Natural Gas - Methane, Ethane
- Gasoline - C5's and heavy HC's
- Soil and Landfill Gas - Methane, CO<sub>2</sub>
- Gases in Sewers - Solvents, Alcohol
- Sewer Gas - Methane, CO<sub>2</sub>, H<sub>2</sub>S



There  
is  
NO  
Such  
Thing  
as  
Sewer Gas!



# Factors Which Affect Odorant Quantity

- n Odorizer Shut-Down
- n Contaminants in Odorizer
- n Natural Occurring Sulfurs
- n Distillates in Pipeline
- n Pipewall Adsorption
- n Oxidation in Pipeline

# Factors Which Affect Odor Quality

- n Physical Ailments
- n Soil Adsorption
- n Masking
- n Distraction



# Combustion Explosions

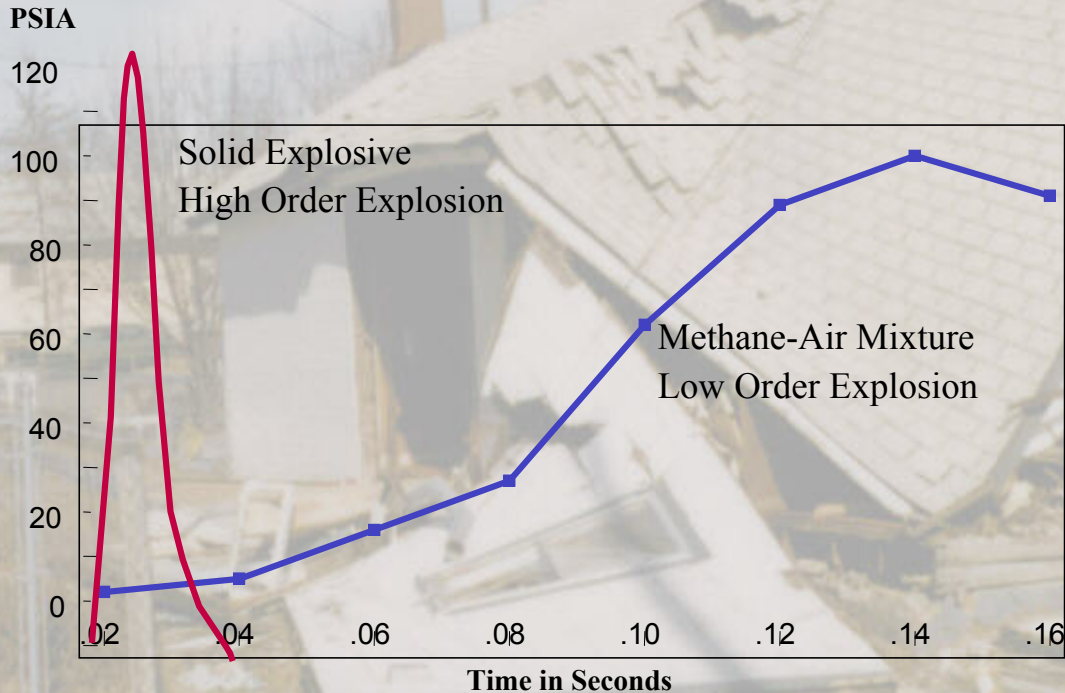
- A rapid burning of fuel and production of combustion by-products and heated gases causes elevated pressures
- Deflagration – combustion reactions where velocity of the reaction is less than the speed of sound in the fuel
- Detonation – reaction is greater than the speed of sound

# Combustion Explosions

- Flammable gases
- Vapors of flammable/combustible liquids
- Dusts
- Low explosives (deflagration)
- High explosives (detonation)
- Smoke, products of incomplete combustion (backdrafts)



# Explosion Pressures

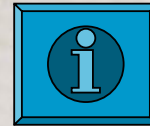


# Explosion Damage

- Low order
  - Walls moved or bulged
  - Walls laid down
  - Roofs lifted and set down
  - Windows moved, glass may not break
  - Debris, large chunks, thrown short distance
- Slow pressure rise

# Explosion Damage

- High order (Canada 2)
  - Shattering of structure
  - Pulverized debris
  - Walls, roofs splintered
  - Building demolished
  - Debris thrown great distance
- Rapid pressure rise



# Conducting the Investigation

- Secure the scene
- Initial assessment
- Detailed assessment
- Determine origin
- Determine fuel
- Determine ignition source
- Establish cause
- Time Line Analysis

# The Six Steps

- Preliminary investigation
  - Secure the Scene
  - Initial Assessment
- Detailed Assessment
  - Determine Origin
  - Determine Fuel
  - Determine Ignition Source



# The Six Steps

- Collect data
  - Records
  - Sample collection
  - Documentation
- Analyze data
  - Analysis of facts

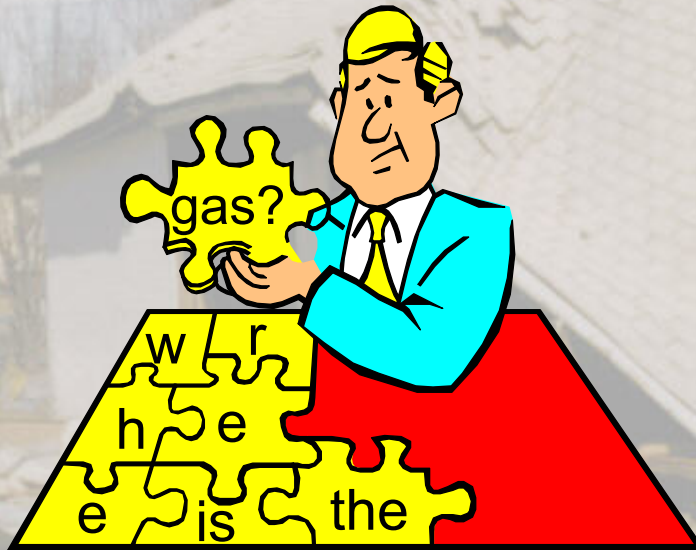
# The Six Steps

- Develop hypothesis
  - Establish Cause
- Test hypothesis
  - Time Line Analysis

# The Preliminary Investigation

- Perimeter testing
- Testing of adjacent gas mains and services
  - Leak survey
  - Pressure test
- Establish when gas not present
- Other sources of combustibles
- Avoid early opinions of fault

# WHERE is the Gas?



# The Cure

**W** here is the gas ?

**H** ow much is there?

**E** xtent of hazard (migration)

**R** elation to other structures

**E** valuate/Evacuate



## Sources of Combustible Vapors

- n Natural Gas -  
Methane, Ethane
- n Gasoline -  
C5's and heavy HC's
- n Soil and Landfill Gas -  
Methane, CO<sub>2</sub>
- n Gases in Sewers -  
Solvents, Alcohols
- n Sewer Gas -  
Methane, CO<sub>2</sub>, H<sub>2</sub>S



# The Preliminary Investigation

- Expanding technique
- Log of investigation
- Record test results
- Photographic documentation
- Cooperate with public officials

# The Preliminary Investigation

- Liaison procedures
- Witnesses
- Statements
- Documentation

# Initial Analysis of Situation

- Review and document action taken
- Review records
- Who to involve

# Initial Analysis of Situation

- Outside specialists
- Future investigation
- Odorant level test
- Appoint one coordinator for case



# Conducting the Complete Investigation

- What was the combustible?
- Where did it come from?
- How did it get to the site?
- Sample collection and analysis
- Natural gas vs. Other combustibles

# Conducting the Complete Investigation

- Sewer system
- Combustible liquids and vapors
- Prepare drawings
- Plot all utilities
- Floor plans

# Conducting the Complete Investigation

- Prepare plans for all gas piping and controls
- Field actions vs. O&M procedures

# Records of an Incident

- Maps of area
- Establish workable scale
- Secure original reports

# Photographic Record of an Incident

- Detailed list of necessary photographs
  - All sides of structure
  - All equipment
  - Start far away, move in
  - Relative scale, comparison
  - Watch backgrounds
- Overhead photographs if possible



# The Value of Good Documentation

- Need for documentation
- Need for straightforward reporting
- A picture is worth a thousand words
- Notes and field sketches
- Site drawings for all investigators

# The Value of Good Documentation

- Document facts not opinions
- Incoming calls
- Service orders
- Repair/maintenance records
- Leak control records

# The Value of Good Documentation

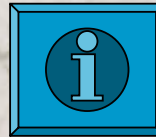
- Construction records
- Corrosion control records (steel)
- Odor tests
- Locating records
- Meter reader records

# Analysis of Facts

- Review historical data
- Witnesses' statements
- Observations
- Test results
- Laboratory analysis
- Experts' reports and evidence gathering

# Time Line Analysis

- Pre-incident events
- Incident
- Post-incident events
  
- (Too little too late)





# Handling Lab Analysis

- Samples
- Security
- Location
- Time
- Witnesses

# Data Prior to Incident

- Floor plans, drawings, photos
- Utility layouts
- Aerial photos
- Additional data - (employees /neighbors)

# Handling Statements From Witnesses

- Obtain soon after incident
- Signature/full address

# The Use of Outside Experts

- Choose them in advance
- Know their areas of expertise
- Lawyers familiar with gas distribution
- More than one for availability

# Demonstrations, Test Procedures and Instruments

- Models
- Maps, charts, diagrams
- Sewer examinations



# Security of Evidence

- Preserving the scene
- Securing the evidence
- [Chain of custody documentation](#)
- Secure storage area
- Documentation

# Accident Response Kit

- Gas detection equipment (CGI)
- Plunger bar
- Sample collection equipment
- Safety gear, ID card
- Latex gloves
- Company manuals
- Call out lists

# Accident Response Kit

- Report forms (all types)
- Camera and film
- Ruler/measuring tape
- Drawing tools
- Paper, pens, pencils
- Tape recorder
- Marking flags/paint
- Batteries
- Flashlight
- Power strip inverter

# Wrap-up

- Conclusions
- Session evaluations