Investigation of Failures

49 CFR §192.617

§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.

FAILURE

- Omission of occurrence or performance
  - i.e. – failing to perform duty or expected action
- Inability to perform a normal function
- A falling short or deficiency

What is a FAILURE?

- **breakdown of something**: a breakdown or decline in the performance of something, or an occasion when something stops working or stops working adequately
- **something less than that required**: something that falls short of what is required or expected

What is a Failure?

- Failures can be catastrophic events
- A reportable incident or accident

What is a Failure?

- Whenever the carried product comes out of the carrier unintentionally
  - Leak
  - Third party damage

Leaks

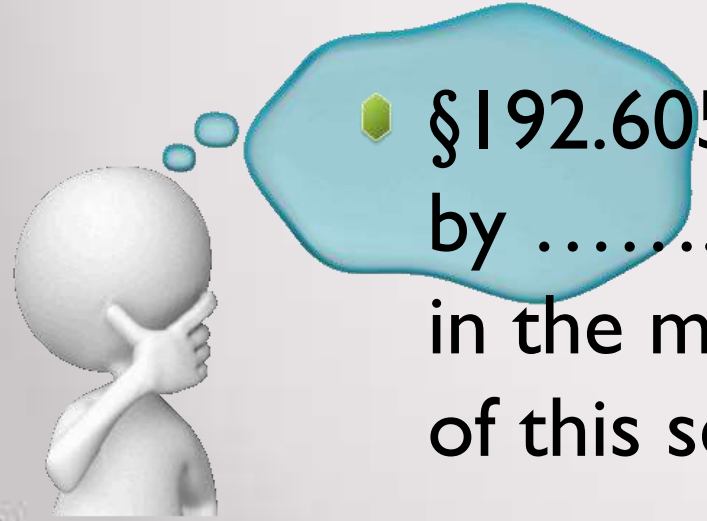
- Leak reports are in essence a failure report
- §§192.459 and 192.475 require metallic pipe inspection when exposed or cut
- New annual reports require reporting of leaks by 9 threat categories –
- Integrity Management requires failure identification of leaks

So, What is a Failure?

- Abnormal Operation or near miss
  - Regulator failure which causes an over pressurization
  - Systemic problem with equipment
- Other
- As determined by company or state regulators

So why investigate?

- §192.617 – Investigation of failures ……procedures for analyzing accidents and failures



- §192.605 (e) - The procedures required by …….. and §192.617 must be included in the manual required by paragraph (a) of this section

Investigate

- To observe or study by close examination and systematic inquiry.

- examination:
  - to inspect closely,
  - to test the condition of,
  - to inquire carefully

What to Investigate

- Do all failures, accidents, leaks or other events need to be investigated?

- Operator should specify in written procedures when investigations are needed as well as how detailed the investigation needs to be.

What to Investigate

- The events and actions that lead to the failure
- When did the failure occur
- Why did the failure occur
- How did the failure occur
- Where did the failure occur
- Who was involved/identified the failure
- How much could have been prevented
- What else was affected?

Typical Maintenance Goals in Response to Leaking Gas

- **CORRECT UNSAFE CONDITION;**
- **RESTORE SERVICE;**
- **DOCUMENT NEW INSTALLATION;**

Oh, and…….maybe

  - Determine cause of failure.

- Failure investigation is often secondary to the top three goals.

Pipeline Scene Investigation (PSI instead of CSI)

Take a forensic approach to investigating a failure, accident, or incident and follow basic root cause investigation techniques and rules

Follow the Basic Rules

- Use an investigation form to help prompt and remind you what to collect
- Document only the facts and never opinions
- Don't jump to conclusions
- Allow the evidence to direct the investigation
- Construct a time line of the events

Follow the Basic Rules

- Document surface conditions at point of failure
- Document weather and environmental conditions at time of failure, 24 hours before and after as available

How to Investigate

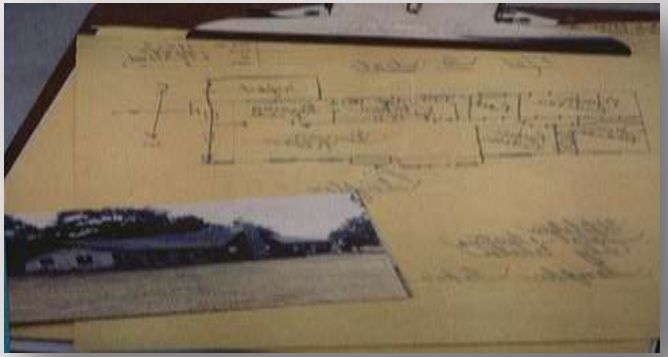
Always make sure the location is safe

Pipeline Scene Investigation

1. Photograph and Diagram the Scene
2. Interview Witnesses
3. Conduct a Migration Survey
4. Retrieve or Dig up the Facility, preserving failed equipment
5. Make Repairs
6. Test the Facility in Place
7. Run tests on failed equipment as needed
8. Additional system tests

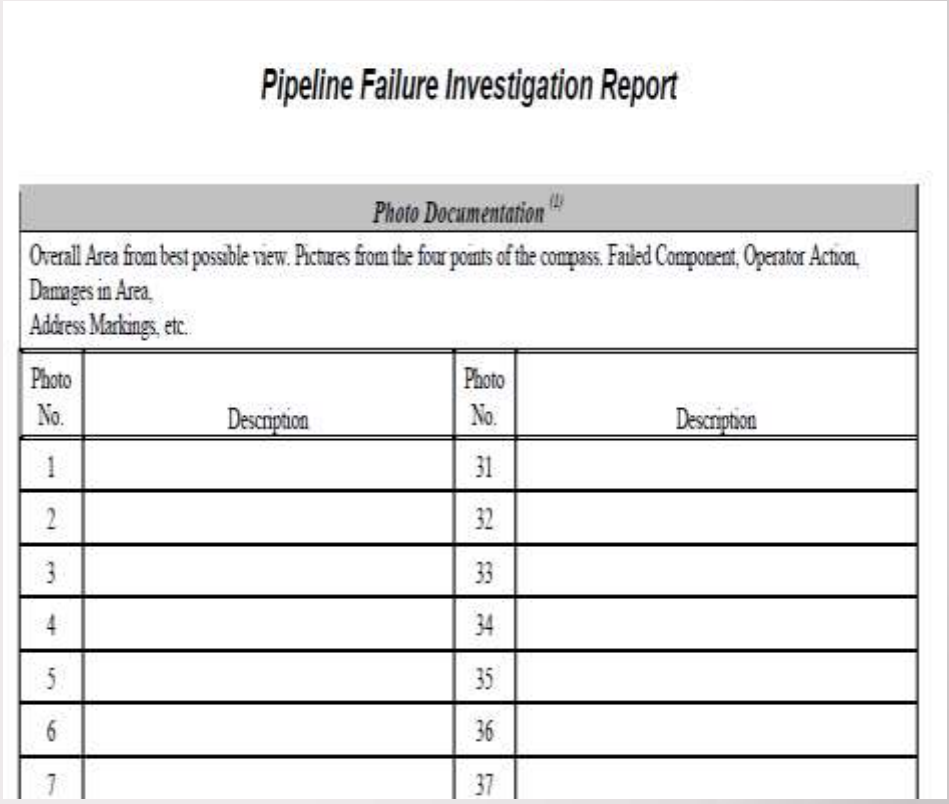
Photos and Diagrams of the Scene

- Photos are important throughout the procedure
  - Used to identify as found conditions
  - Location of debris, damage conditions
  - Preserve a chronology of actions
  - Additional photos during repair process or
  - as additional conditions
  - uncovered
  - Identify as left conditions



Photos and Diagrams of the Scene

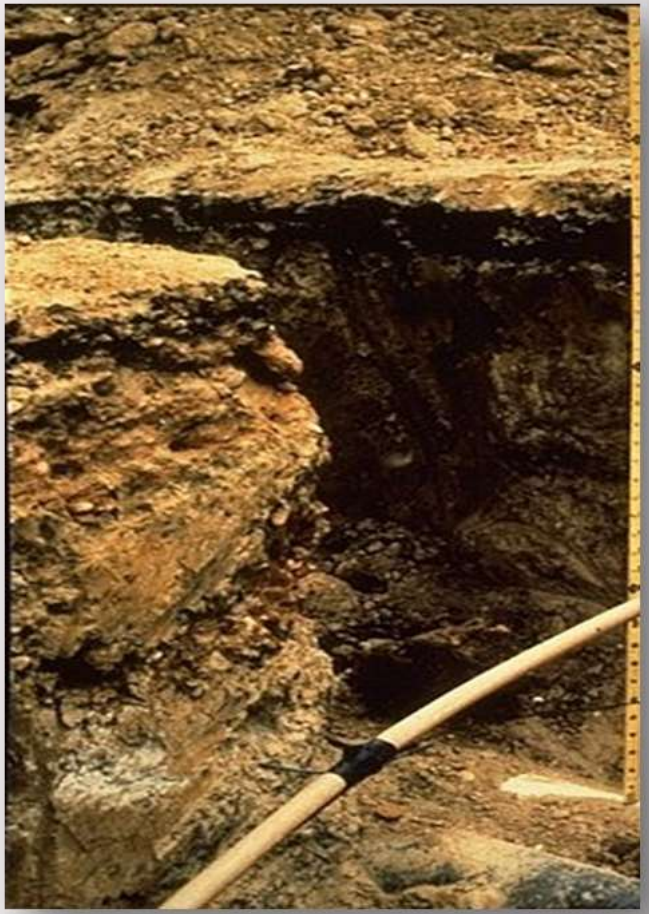
- Photographs from all angles, sides or views of the area
- Keep running list of photographs and locations for future reference
- Establish scale or perspective and dimension



Pipeline Failure Investigation Report

Photo Documentation [1]			
Overall Area from best possible view. Pictures from the four points of the compass. Failed Component, Operator Action, Damages in Area, Address Markings, etc.			
Photo No.	Description	Photo No.	Description
1		31	
2		32	
3		33	
4		34	
5		35	
6		36	
7		37	

Photographs Without Scale



Photographs Showing Scale

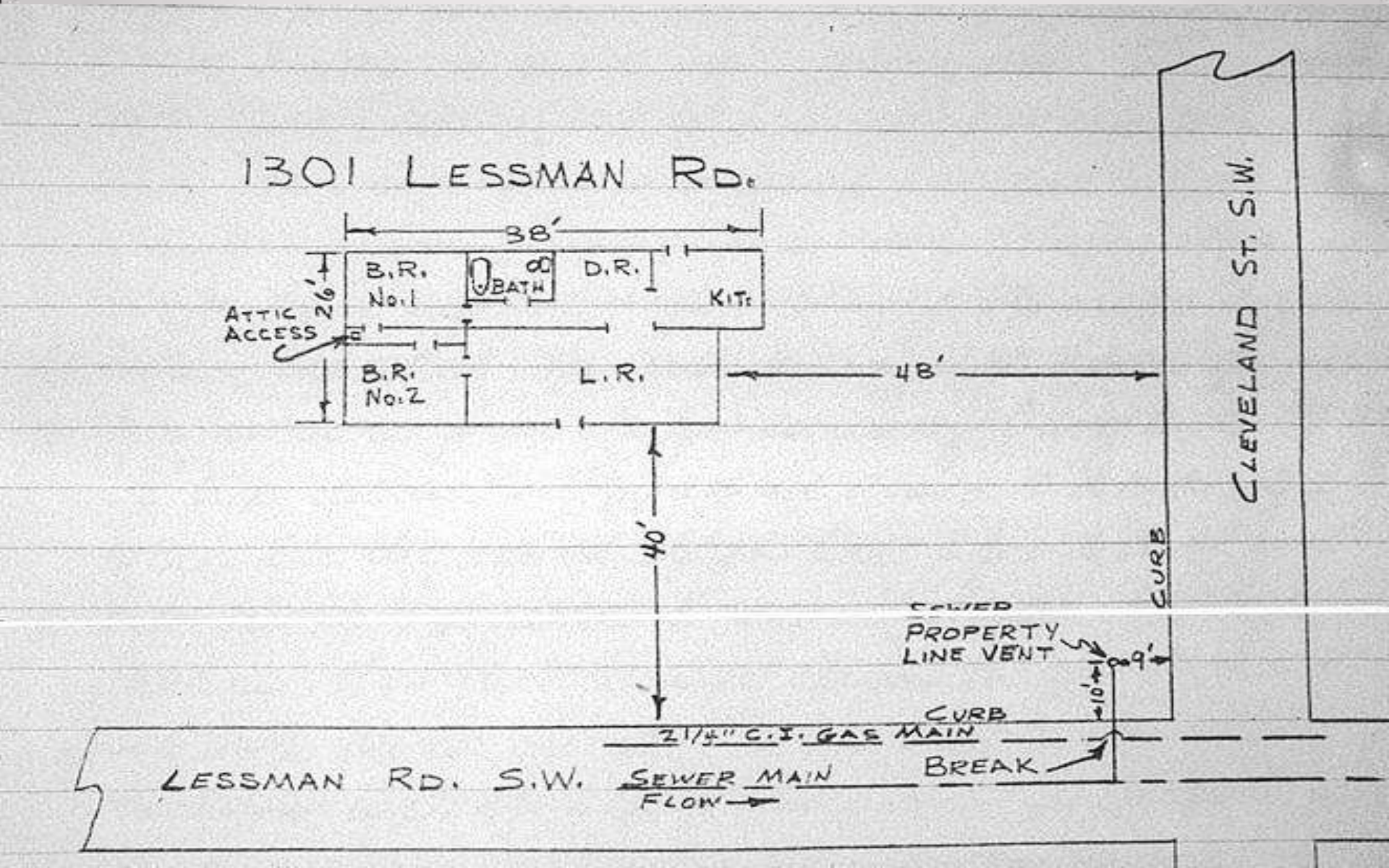
CREATIVE PHOTOGRAPHY

Photos and Diagrams of the Scene

- Video
  - Video may be useful tool
  - Video without the microphone on
  - Helps document actions taken by all parties

Photos and Diagrams of the Scene

- Diagram location with measurements as possible
  - Location of debris may help investigation and timeline of events
  - GPS locations instead of measurements still allow mapping
  - Witness can use copies of diagrams during interviews


1301 LESSMAN RD.
38'
B.R. No.1
BATH
D.R.
KIT.
ATTIC ACCESS
26'
B.R. No.2
L.R.
48'
40'
CLEVELAND ST. S.W.
CURB
PROPERTY LINE VENT
9'
10'
CURB
2 1/4" C.I. GAS MAIN
BREAK
LESSMAN RD. S.W.
SEWER MAIN
FLOW

Survey the Scene

- Is there evidence of recent soil disturbance
- Has the site had previous or recent maintenance
- Is there evidence that natural forces may have disturbed the area
  - Washout
  - Settlement
  - Movement
  - Vandalism

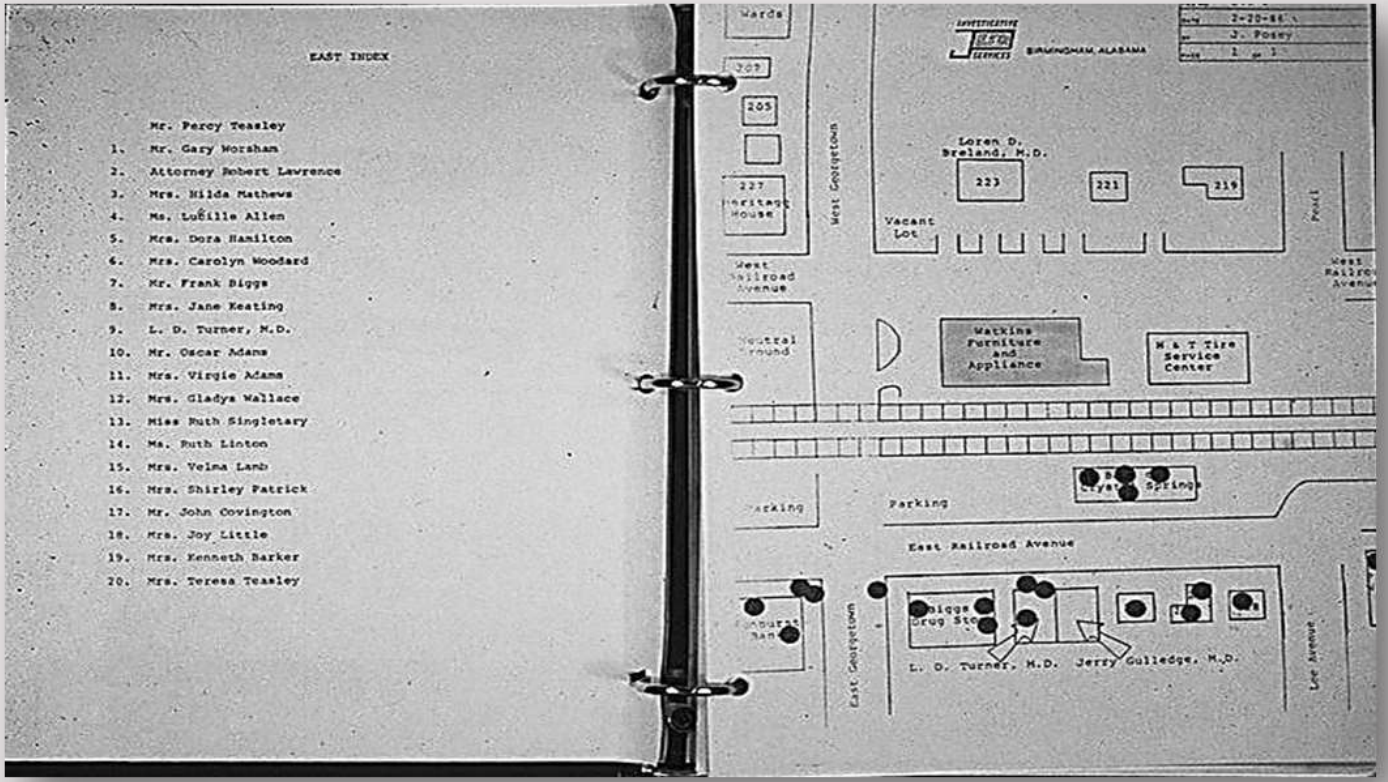
Interviews

- Interview witnesses
  - May need multiple interviews
- Use diagrams
- Develop list of question before interview

Witness Interviews

- Company personnel
  - On site personnel
  - First responders
  - Control room
- Contractor personnel
- Public
- Media
- Emergency response personnel

Plot location of Witnesses



Plotting witnesses locations can help determine if they had line of site of the failure scene

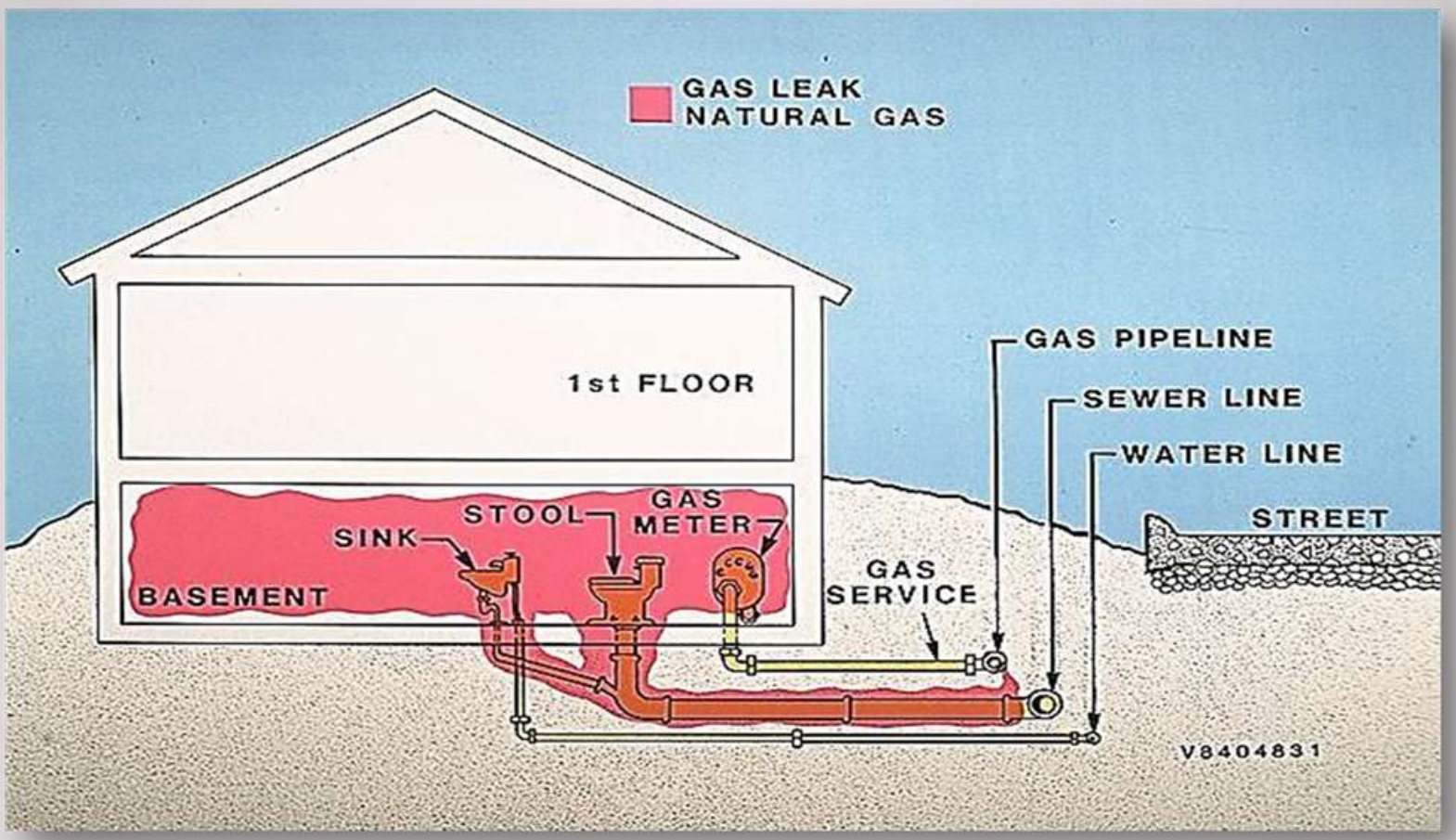
Migration Survey

- Determines where the gas came from and where it went.
- Confirms that there are no additional hazardous areas (i.e. gas up against an adjacent house)
- Checks for collateral damage

Migration Survey

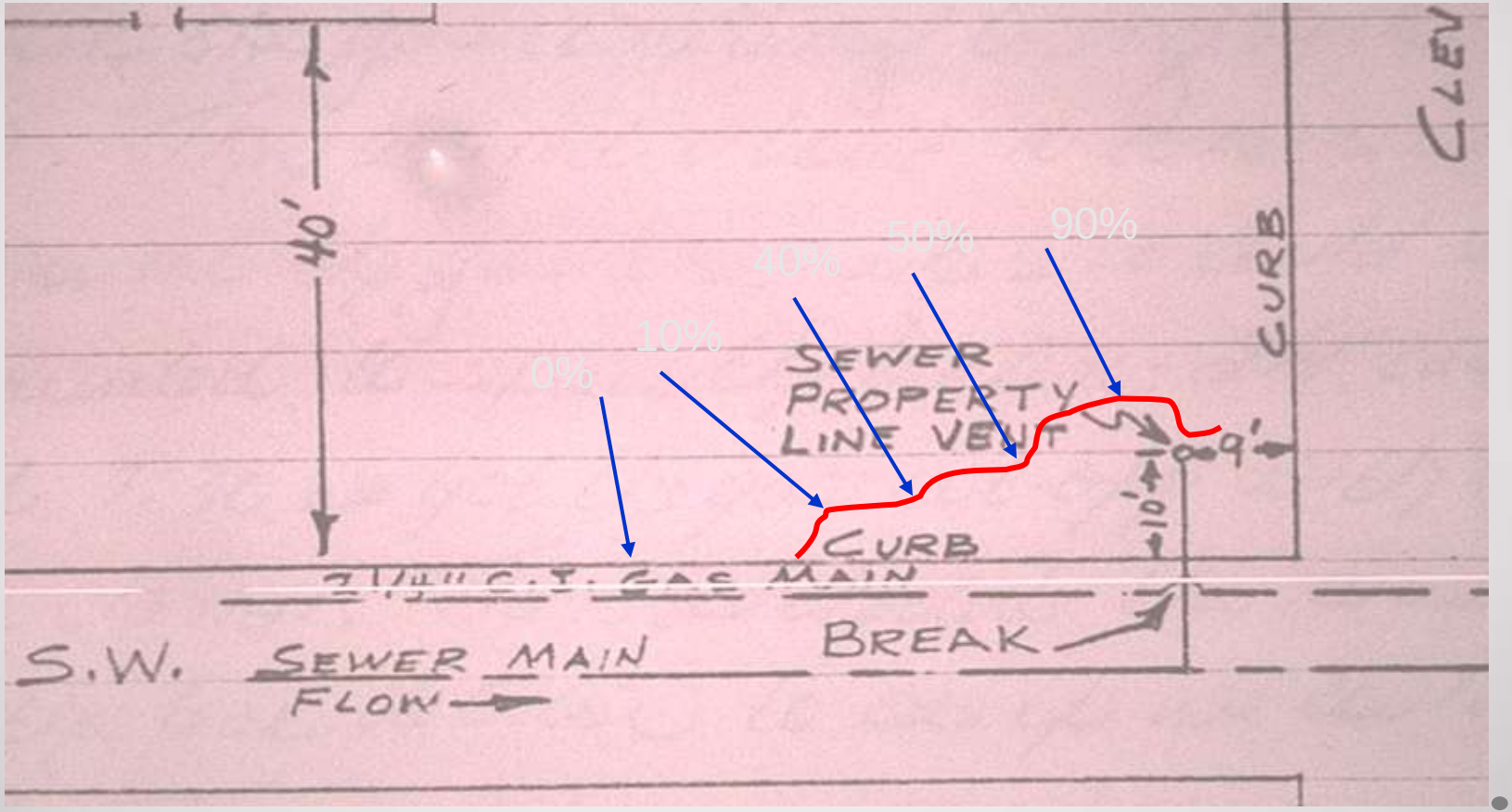
- Understand the properties of the gas
  - Natural Gas
    - Lighter than Air
    - Flammability ranges from 4% - 15%
  - Propane
    - Heavier than air
    - Flammability ranges from 2% - 9%

Understand the Flammable Range

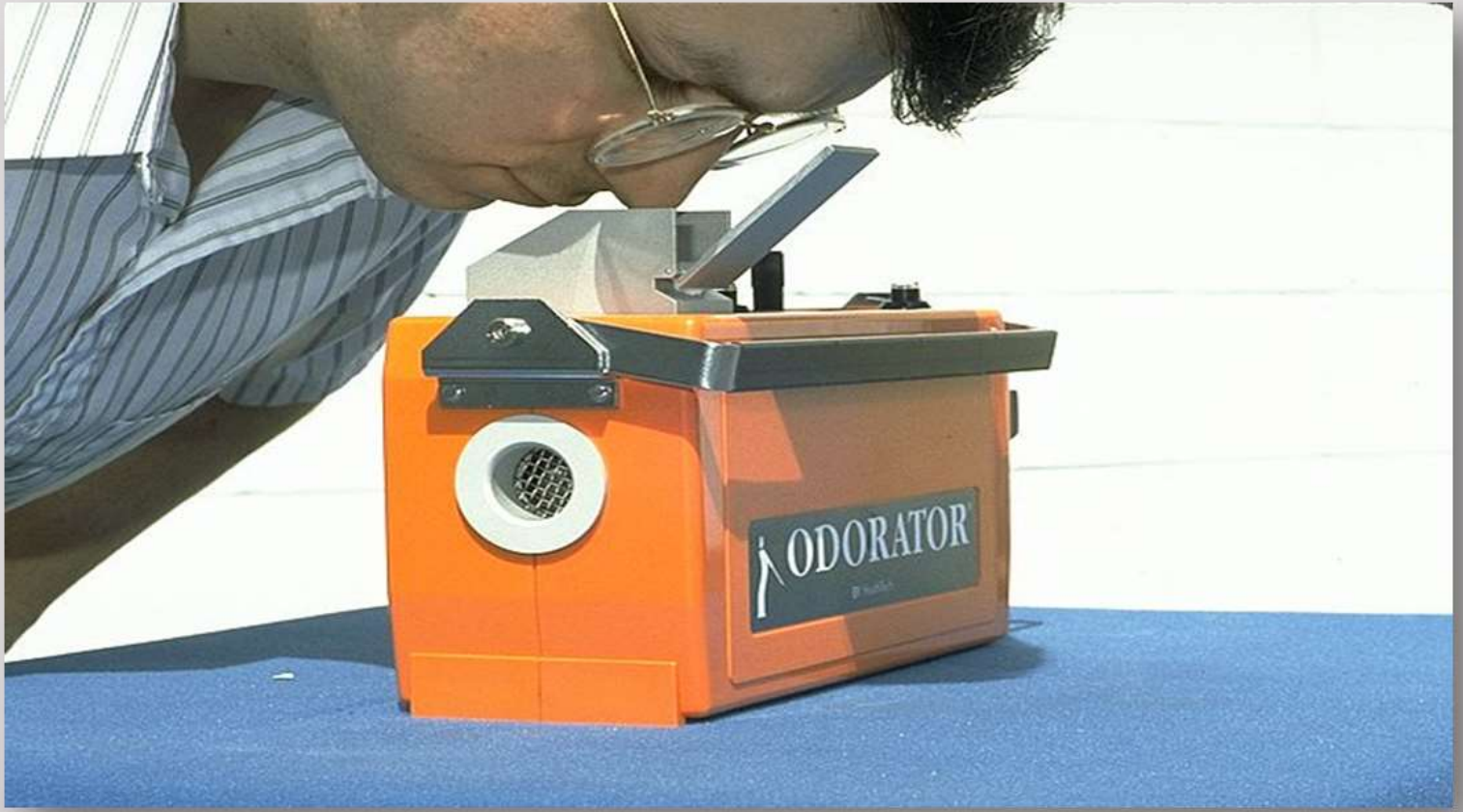


Check all available paths of least resistance to understand the gas migration

Plot Gas Migration



Odorant Concentration Verification



Recover Damaged Facility

- Treat digging and recovery of equipment as archeological dig
- Take pictures and make diagrams as needed

Recover Damaged Facility

- Recover all pieces of failed equipment
  - Label all pieces
    - Include equipment orientation
    - Direction of gas flow
  - Follow a chain of custody for all pieces.
    - Maintains integrity of evidence
    - Protects company

Recover Damaged Facility

- **Don't touch fracture surfaces**
- Don't clean fracture surfaces or pieces
- Wrap in bubble-wrap or similar product
- Secure in shipping container

Depending on Material

- Indicate if there is evidence of external corrosion
- Take and record CP readings at grade and at pipe elevation before and after repairs
- Other sampling such as soil pH, water, solid samples
- Visually indicate the type and condition of any coating
- Indicate if the pipe and components are above or below ground/water/surface
- Follow O&M Procedures

Repairs

- Document repairs
  - Why that particular repair was used
  - Repairs suitable for MAOP
  - Testing was done to ensure the integrity of the system before returning it to service
  - Identify other areas of the facilities that may be affected by the conditions of this failure/incident/accident

Pressure Testing

Pressure Testing

- Pressure test only to the operating pressure at the time of the failure.
- Ensure that the test equipment is calibrated.
- Ensure test is done in accordance with O&M procedure

Basic Information

- Historical data
  - Pipe or equipment information
  - Date of installation and installation method
  - Normal operating pressure and test records
  - Operating pressure at time of failure
  - Copies of photos of excavation
  - Soil samples
  - Cathodic protection data
  - Gas samples
  - Pipe inspection information

Additional System Tests

- Check System for additional problems or collateral damage
  - Pull outs, leaks, and other damage
  - May also need investigation

Additional Considerations

- Don't forget to consider:
  - Drug and alcohol testing
  - Operator Qualification
  - Control Room

Prevent Recurrence

- §192.617 – Investigation of failures …….procedures for analyzing accidents and failures…… to minimize the possibility of a recurrence

Prevent Recurrence

- Information circulated to appropriate personnel
- Procedure Review
- Data storage for future reference
- May be months to years before another type failure
- Allows comparisons to previous failures

Procedure Review

- Emergency response procedures
- O&M Procedures
- Operator Qualification
- Integrity Management
- Construction
- Purchasing

Data Driven

- Cost of Collecting data
- Need to get it right the first time!

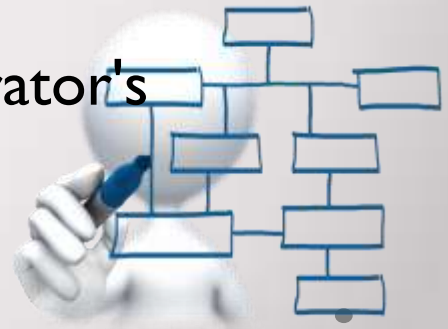
Training of front line repair crews on failure analysis!

Root Cause Analysis

- Proper Investigations take time
- Rarely is there only one Root Cause to a Failure!!
- May be failures where the cause cannot be determined

General Process For Performing Root-Cause Analysis

- Assemble the review team.
- Define the problem and gather data and documentation.
- Identify factors that contributed to the problem (i.e., causal factors).
- Find the root cause for each causal factor, such as people, equipment, material, process, or outside influence.
- Develop and assign recommendations.
- Distribute recommendations and review the operator's procedures.
- Implement the recommendations.



Additional Information

- PHMSA Form 11 –
  - Pipeline Failure Investigation Report

www.phmsa.dot.gov/pipeline/library/forms

Questions?

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