Leak Detection

US Department of Transportation

Pipeline and Hazardous Materials Safety Administration

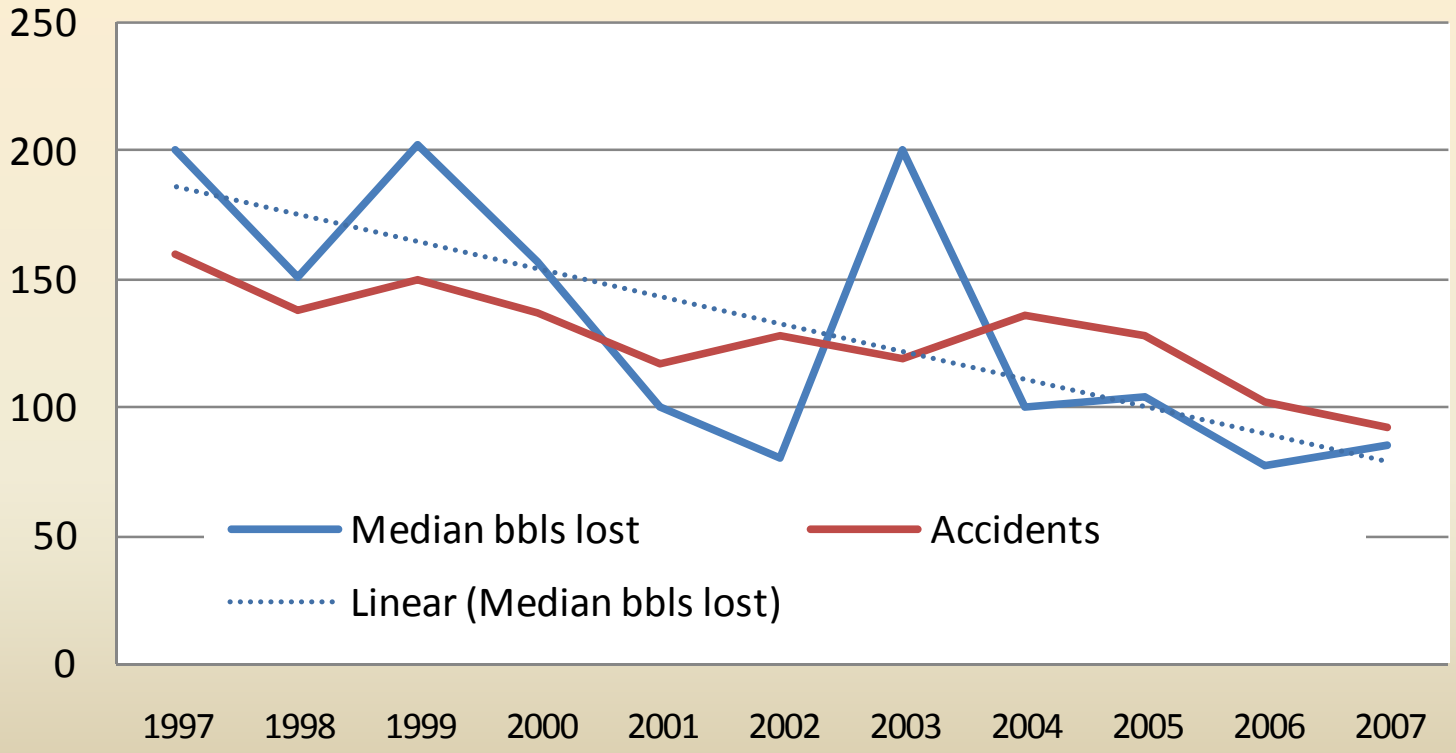
Byron Coy, PE

PHMSA Regions

Leak Detection

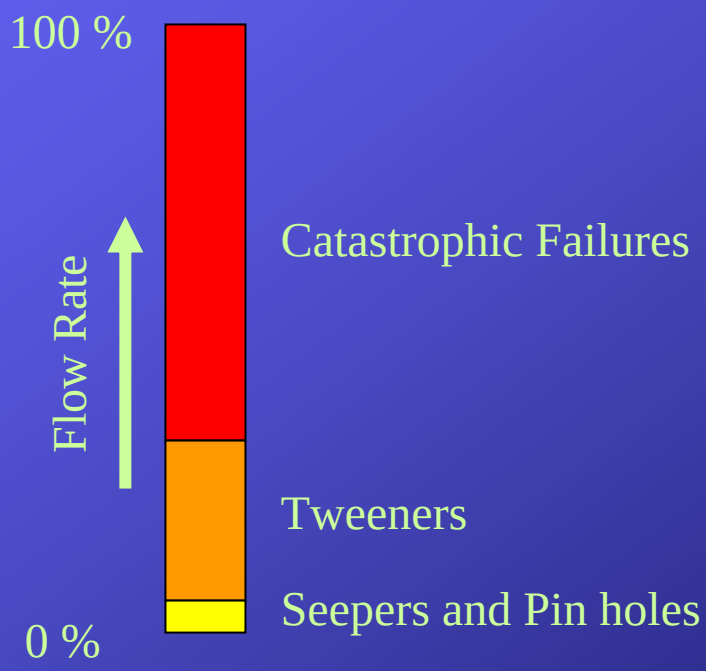
- Congressional Report
- API Information Resources
- Regulations
- Implementation Considerations

Hazardous Liquid Accidents 1997-2007
Median Volume Lost (Barrels)

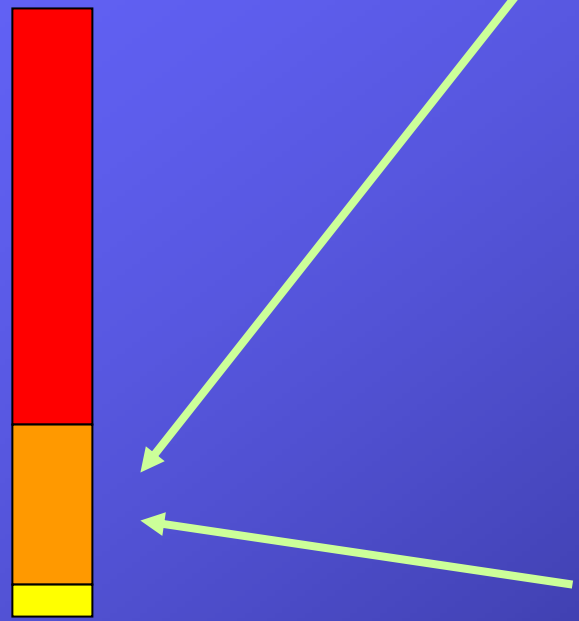


Source: DOT/PHMSA accident data, as of Dec. 21, 2007
(accidents meeting quantitative reporting criteria; 50 bbls or more)

Leak Characterization



Leak Detection



PIPES Act of 2006, Section 21
Congressional Report

- Capabilities and Limitations
- Leak Volume Statistics
- Other Factors impacting Leak Volume
- Regulatory Requirements
- Inspection Findings
- Fostering Improvements

Emphasis on Prevention

Congressional Report

- Surveillance
- Cathodic Protection
- Pressure Control
- Relief Systems
- Damage Prevention
  - Line Marking
  - One-Call Systems
  - Public Awareness
  - Common Ground Alliance
- Pipelines and Informed Planning Alliance - PIPA

Pipeline Characteristics

Congressional Report

- Pipe Spec's, Vintage, History
- Coatings
- Operating Parameters
- Transported Commodities
- Climatic Conditions
- Geologic Factors
- High Consequence Areas

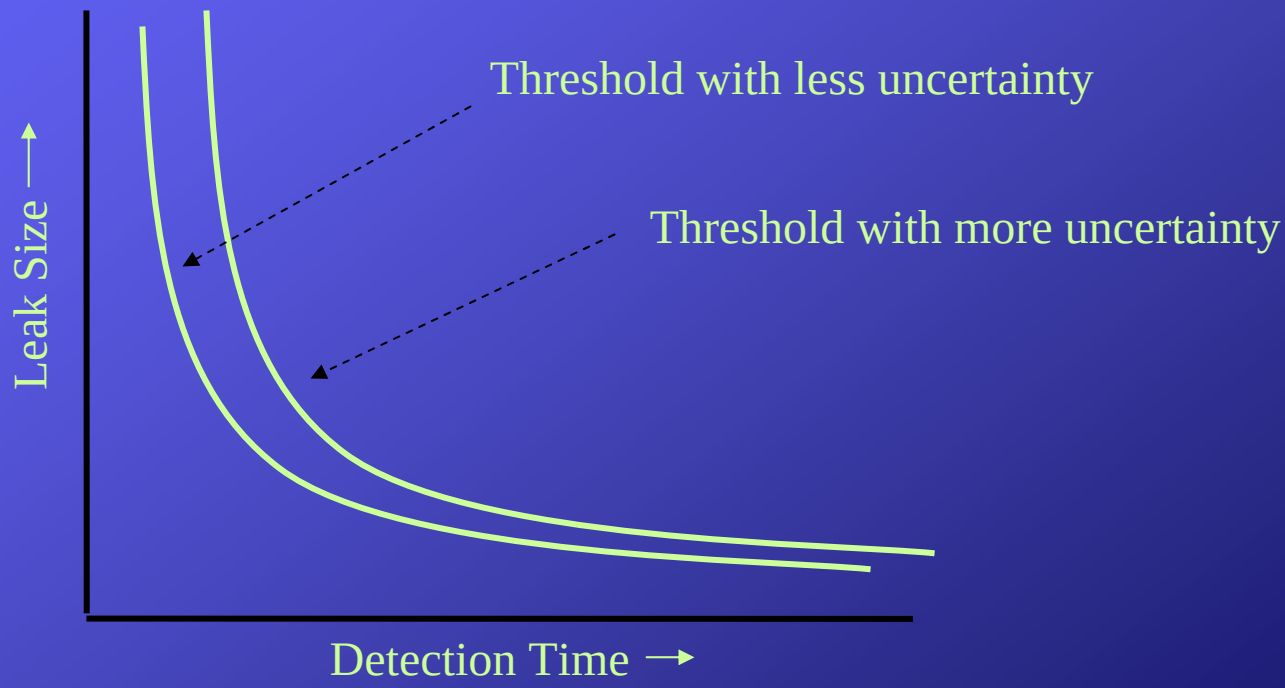
Leak Detection Methodologies

Congressional Report

- Visual Inspection / Observation
- Internal Instrumentation
- External Instrumentation

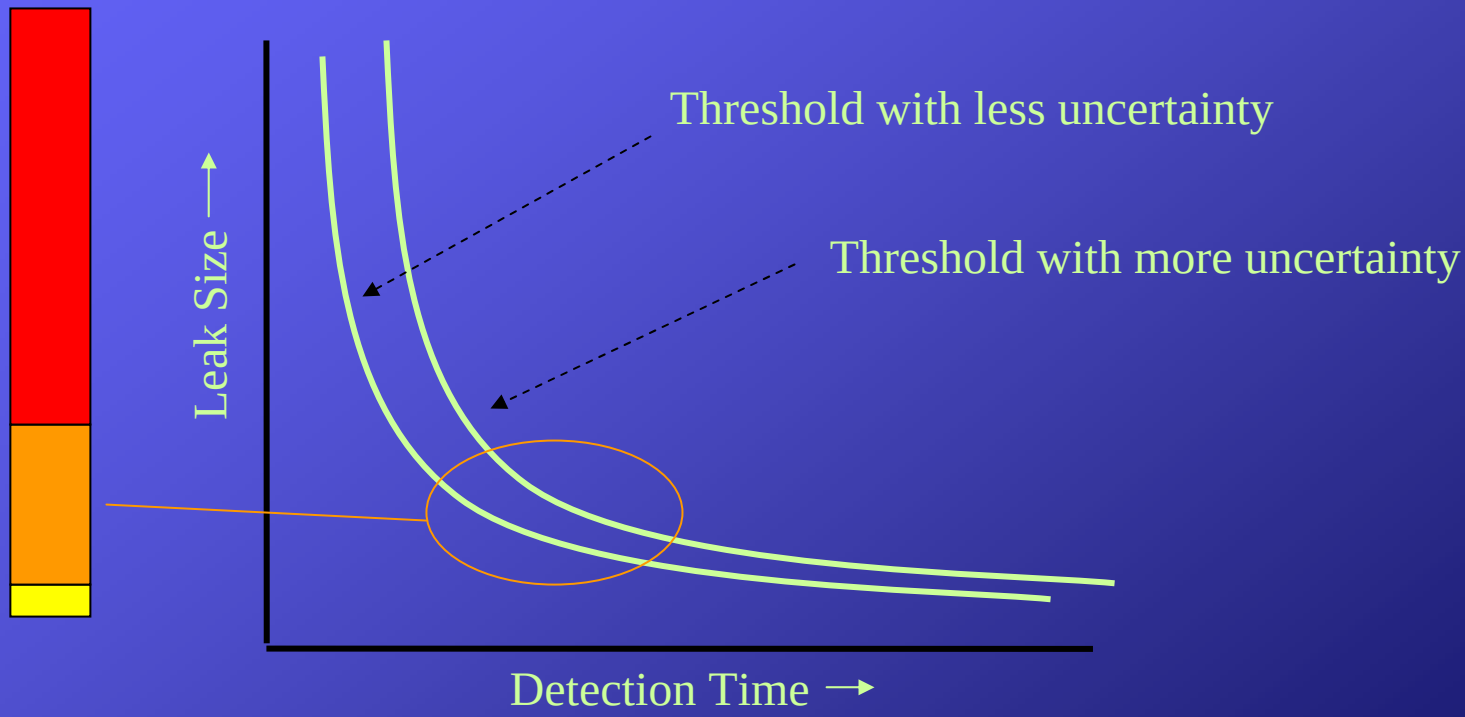
General Relationships

Congressional Report



General Relationships

Congressional Report



Considerations for Evaluating Adequacy
Congressional Report

- Rate of Invalid (False) Alarms and Miss-calls
- Instrument Accuracy & System Robustness
- Personnel Training and Qualification Criteria
- Pipeline Size, Complexity, Batch Parameters
- Leak Size / Flow Rate
- Response Time Components
- Leak Volume and Location Estimation
- Detecting Pre-existing Leaks
- Shut-in Pipeline Segments
- Slack Line and Transients
- Multiphase Flow
- Adaptability (Retrofit) Feasibility
- Testing Regimes
- Cost & Maintenance

API Publication 1149

- Pipeline Variable Uncertainties and Their Effects on Leak Detectability
- Quantification of factors such as:
  - Pipeline Configuration and Operating Regimes
  - Instrumentation Placement
  - Metering
  - Data Collection and Handling
- Impacts:
  - Feasibility Studies
  - Project Justification
  - Prioritization of Budgeted Changes
  - Instrument Density and Placement

API RP-1130

- CPM (Computational Pipeline Monitoring) Systems
- Assist in identifying issues relevant to:
  - Design
  - Selection
  - Implementation
  - Operation
  - Testing
- Directly Referenced in 49 CFR 195 Regulations

49 CFR Parts 195.134 / 444
Design and O&M

- 195.134
  - Design Criteria for CPM Systems
  - API RP-1130
- 195.444
  - Operations and Maintenance
  - Testing
  - Record Keeping
  - Controller Training
  - API RP-1130

49 CFR Part 195.402
Procedures

- (c)(2): Gathering data …. reporting accidents
- (c)(9): Facilities that control receipt or delivery, detecting abnormal operating conditions ….transmitting this data to an attended location
- (d)(1): Responding to, investigating, and correcting …. deviation from normal ….
- (e)(4): Taking necessary action …. to minimize the volume released

49 CFR 195.452(i)(1)

What preventive and mitigative measures must an operator take to protect the high consequence area?

General Requirements …

- An operator must take measures to prevent and mitigate the consequences of a pipeline failure that could affect a high consequence area (HCA)
- These measures include conducting a risk analysis of the pipeline segment to identify additional actions to enhance public safety and/or protecting the environment
- Actions like modifying the processes or systems for monitoring pressure and detect leaks

49 CFR 195.452(i)(2)

What preventive and mitigative measures must an operator take to protect the high consequence area?

Risk analysis criteria …

- In identifying the need for additional measures, an operator must evaluate the likelihood of a pipeline release occurring and how a release could affect HCAs
- This determination must consider all relevant risk factors, including, but not limited to:
  - Terrain surrounding the pipeline segment
  - Elevation profile
  - Characteristics of the product transported
  - Amount of product that could be released
  - Possibility of a spillage using terrestrial conducts
  - Roadside ditches along the pipeline
  - Exposure of the pipeline to pressures exceeding MOP

49 CFR 195.452(i)(3)

What preventive and mitigative measures must an operator take to protect the high consequence area?

Leak Detection Provisions …

- An operator must have a means to detect leaks on its pipeline system
- An operator must evaluate the capability of its leak detection means and modify, as necessary, to protect the high consequence area
- An operator's evaluation must (at least) consider, the following factors:
  - Length and size of the pipeline
  - Type of product carried
  - The pipeline's proximity to HCAs
  - The swiftness of leak detection
  - Nearest response personnel, leak history and risk assessment results
- Leak detection analysis should include the impact of sudden significant failures, as well as smaller leaks that may take longer to detect

49 CFR 195.452(i)(4)

What preventive and mitigative measures must an operator take to protect the high consequence area?

Emergency Flow Restricting Devices (EFRD) …

- If an operator determines that an EFRD is needed on a pipeline segment to protect a high consequence area in the event of a hazardous liquid pipeline release, an operator must install the EFRD
- In making this determination, an operator must, at least, consider the following factors:
  - Swiftness of leak detection and pipeline shutdown capabilities
  - Type of commodity carried
  - Rate of potential leakage, the volume that can be released, topography, profile, ignition, proximity to power sources, nearest response personnel, specific terrain between the pipeline segment and HCAs and benefits expected by reducing the spill size

Preventive & Mitigative Measures for Leak Detection and EFRDs

Assessment …

- Documented, systematic process to identify, evaluate, and implement additional preventive and mitigative measures
- Review of the effectiveness of current processes and systems
- Consideration of alternative modes of operation
- Consideration, or documented exclusion, of all risk factors in (i)(2)
- Priority in schedule and scope for additional actions on the highest risk lines
- Documentation of candidate measures, even those not implemented

Leak Detection Capability

Evaluation …

- If all required factors (i)(3) are not considered, a documented basis for the exclusion of certain listed factors
- Consideration of additional evaluation factors such as:
  - Current leak detection method for the HCA areas
  - Use of SCADA
  - Thresholds for leak detection
  - Flow and pressure measurement
  - Specific procedures for lines that are idle but still is use
  - Additional LD provisions for proximity to sole source water supplies
  - Testing of leak detection (such as physical removal of product)

Leak Detection Capability

Capability Provisions …

- Sufficient spectrum of leak scenarios to determine system effectiveness (e.g., “most likely” & “maximum possible”)
- Line operations including slack line, idled line, and static conditions
- Performance during transient conditions, and a strategy to manage any short-term reduced performance
- Operational availability and reliability of the leak detection systems, and the operator’s process to manage system outages
- Enhancements to existing leak detection capability, consistent application of a risk-based decision-making process for leak detection
- Consideration of computational pipeline monitoring and API-1130

Leak Detection Capability

Controller/Operator Actions and Reactions …

- Actions should be based on documented work practices and/or covered in guidance or training material
- Integration of emergency response procedures
- Assurance for the restoration of any mute/disable functions that are used during certain operational modes
- If procedures require such contact before action, assurance that any required supervision is always promptly available for contact
- Adequate guidance in documented work processes: authority and responsibility
  - Corporate directive or policy on authority and responsibility

Enhancing Leak Detection for HCAs

- More frequent visual surveillance or patrolling
- Automating data collection for segment over-short analysis
- Integrating alarm and status information between connected pipelines
- Use of, or more frequent, operational shut-in tests
- Addition and/or the relocation of instrumentation
- Application or tighter parameters on pressure/flow deviation monitoring
- Higher degree of data integration between operations support applications
- Establishing or shortening test intervals, to validate expected performance levels

Enhancing Pipeline Integrity

- Often a combination of strategies may be appropriate
- Retained analytical reports can help an operator demonstrate effort, even if the project is not implemented
- Enhancements should not be at the expense of leak detection measures in non-HCA areas

Frequently Asked Questions

- http://primis.rspa.dot.gov/iim/faqs.htm#7
- 9.4 : Criteria for consideration of leak detection enhancements
- 9.5 : Minimally acceptable leak detection for compliance
- 9.6 : Application of CPM systems
- 9.11 : Leak detection applied to the entire pipeline

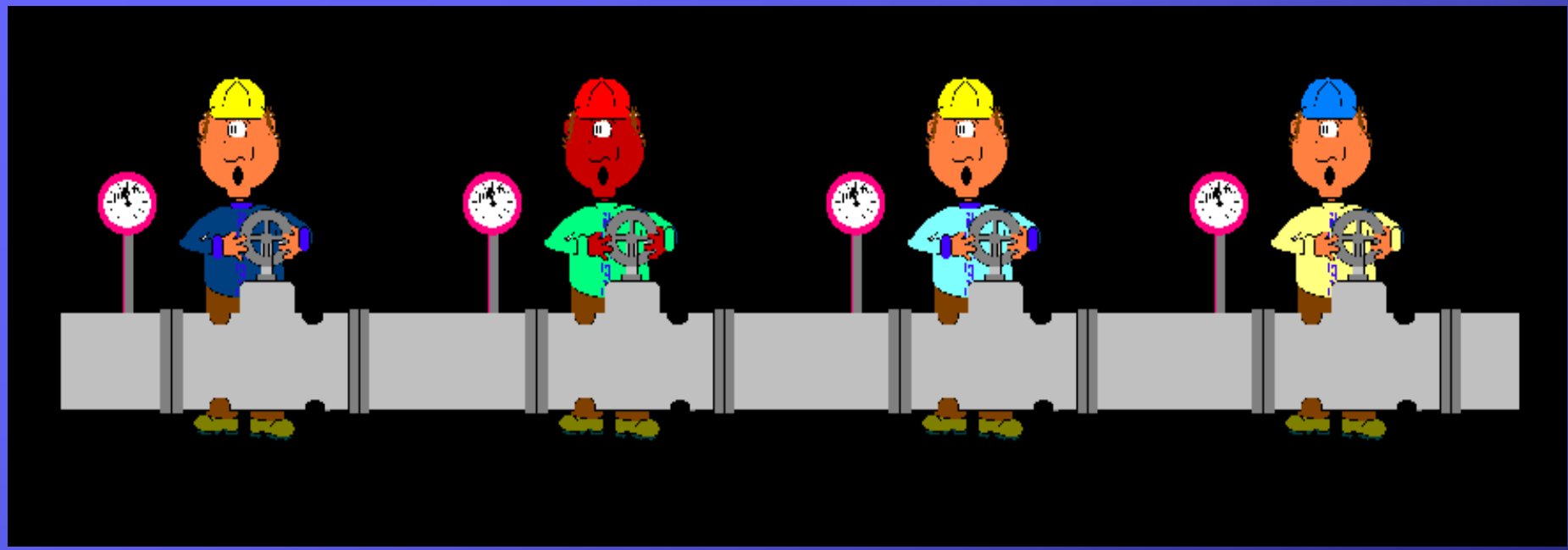
Alignment with Resources

- Leak detection system complexity or high cost does not directly translate to better performance
- One size does not necessarily fit all
- Design choices need to be balanced with available and committed operating and maintenance resources
- After implementation, field crews will likely be impacted by a need for more instrument maintenance
- Controllers need to know the expected performance thresholds and operating window of applied leak detection system

Application Note

- Reconciling Hourly Line Balance
- 3 Inbound and 5 Outbound Lines
- 15 Minute Process
- Is once/hour adequate ?

Information - Knowledge



One has to have access to the right information

and the ability to understand it, before safety can be maximized.

The responsibility to react, without having adequate and structured knowledge, adds little safety value.

In fact - it can create a false sense of security.

Leak Detection

USDOT / Pipeline and Hazardous Materials Safety Administration

Byron Coy, PE
Dir., Eastern Region

byron.coy@dot.gov
609.989.2180