Improving Pipeline Leak Detection System Effectiveness
Sponsored By
PHMSA and National Association of Pipeline Safety Representatives
Hilton Washington DC, Rockville MD

Rex Miller
Director Automation Engineering
Kinder Morgan Energy Partners, L.P.

National Hazardous Liquid Perspective Presented by API

Rex Miller
Director Automation Engineering
Kinder Morgan Energy Partners, L.P.

Hazardous Liquid Perspective

- Leak Detection
- Current Regulations
- Industry Standards and Technical Guidance
- Technical Challenges
- Next Steps

Leak Detection

- LD is a first response system
- LD will not prevent a pipeline leak
- CPM is a subclass of all LD methods
- Methods
  - Patrol of pipeline right of way
  - Automated external monitoring systems
  - Reports from third parities along pipeline right of way
  - SCADA data analyzed by controllers
  - Volume accounting data analyzed by controllers
  - CPM systems

Current Regulations

- 195.134 Design Section
  - CPM systems must comply to API 1130 4.2
- 195.444 Operation & Maintenance Section
  - CPM systems must comply to API 1130
- 195.452 i(3) Integrity Management Section
  - Covered pipelines must have a method to detect leaks
- 195.446(c) Control Room Management Section
  - Provide adequate information
- 195.446(e) Control Room Management Section
  - Alarm Management

Industry Standards and Technical Guidance

- API Recommended Practices 1130
  - Computational Pipeline Monitoring for Liquid Pipelines
- API RP Recommended Practice 551
  - Process Measurement Instrumentation
- API Publication 1149
  - Pipeline Variable Uncertainties and Their Effects on Leak Detection
- API Recommended Practice 1165
  - Recommend Practice for Pipeline SCADA Displays
- API Standard 1160
  - Managing System Integrity for Hazardous Liquid Pipelines
- API Recommended Practice 1167
  - Pipeline SCADA Alarm Management
- API Manual on Petroleum Measurement Standards

Results

- API Survey indicates operator integrity management procedures are being applied to 83 % of all regulated pipeline miles.
- This would indicate that 83% of regulated pipelines have methods to detect pipeline leaks.

Technical Challenges

- Components of leak detection systems
  - Algorithms for data analysis
  - Infrastructure for gathering pipeline operating data
  - Procedures that explain how to interpret LD system results
  - Training for controllers to interpret alarms

Components of Leak Detection Systems

Algorithms for data analysis

Increase of the speed of a fluid occurs simultaneously with a decrease in pressure. The principle was first documented by Bernoulli in 1738.

From then to today hydraulic analysis has been about developing algorithms for quantifying all the factors that effect the flow pressure relation of a liquid in a full wet closed conduit.

(pressure, flow rate, pipe characteristics, liquid characteristics)

Quantifying requires assumptions, Bernoulli assumed inviscid flow and non compressible fluid, not good assumptions for HL pipelines.

Components of Leak Detection Systems

Algorithms for data analysis

PHMSA commissioned a report titled “Hazardous Liquid Leak Detection Techniques and Processes” produced by General Physics Corporation of Elkridge, Maryland.

The report is a good catalog of various leak detection methods.

From Section 9.0 Conclusions

“The same CPM system installed on two different pipelines will not have the same performance.“

Components of Leak Detection Systems

Infrastructure for gathering pipeline operating data

- Pipeline instruments (Pressure Cells, Meters, Densitometers etc…)
- PLC and RTU devices that collect local instrument data
- Communication systems to transmit data to a central location
- Central data processing systems to aggregate data
- Central data processing systems to execute LD algorithms
- Center SCADA systems to supply analysis results to personnel

Components of Leak Detection Systems

Procedures and Training

LD system documentation needs clear answers to basic question about the operation of the system. LD systems will not be effective until the personnel charged with monitoring the systems are trained to understand the results supplied by the system.

What does a leak alarm mean on a specific system?

What do the support alarms mean on a specific system?

Is the definition of an alarm in terms meaningful to the user?

Is it clear what the next step should be?

Technical Challenges

Recognizing when SCADA and LDS Indicate a Leak

Documented cases where systems are reporting a problem and personnel take the wrong action.

- Systems
  - Reduce false leak alarms by using the correct algorithms and the correct infrastructure
  - Account for each pipeline operating range in system design and training (startup, steady state flow, transit flow, shut down and closed in no flow)
  - Train personnel on what the LD system is reporting
  - Train personnel how to cross check data to look for failures

Technical Challenges

- Hydraulic Algorithms
  - Correct method for pipeline configuration
  - Method compatible with instrument configuration
- Infrastructure
  - Current quantity and quality of instruments
  - Balance of additional equipment against risk
- Procedures and Training
  - Correct information
  - Presented in a format that is meaningful to the controller

Technical Challenges

- Risk Easement of LD
  - Fitness of the hydraulic algorithms
    - Accuracy versus operating range
  - Compatibility of hydraulic algorithms to infrastructure
    - Type, location and quantity of instruments
  - Infrastructure
    - Current quantity and quality of instruments
    - More components (sites, computers, PLCs, etc….)
  - Procedures and Training
    - Quantity of documentation versus usefulness
    - Over selling the system capabilities
    - Information flooding

Next Steps

Gather Data

- PHMSA has updated incident reporting forms to gather data relating actual pipeline leaks to leak detection methods.
- API has added questions about leak detection methods to the Pipeline Performance Tracking System (PPTS).
- Observe the effect on LD systems as the new CRM rule is implemented by pipeline operators.

Next Steps

Action

- Industry should continue implementing existing standards to deploy effective leak detection systems.
- Regulators should continue to monitor operators to confirm compliance with existing regulations.

Questions?