Liquid Pipeline Leak Detection: Challenges to R&D

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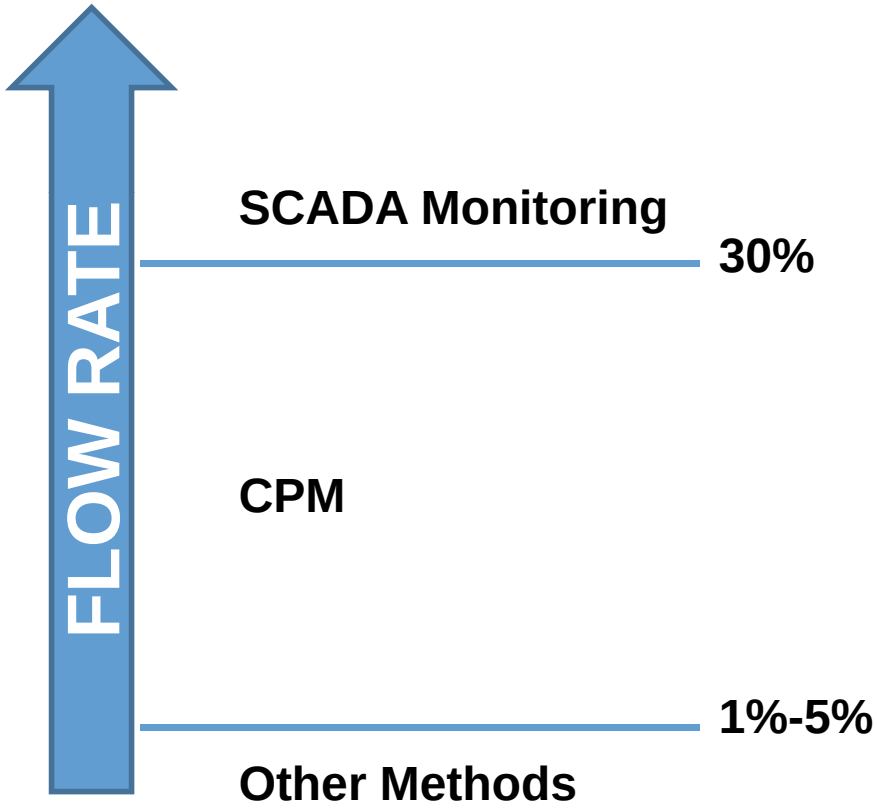
Types of Leak Detection

- Flyovers
- SCADA monitoring
- Computational pipeline monitoring (CPM)
- External
  - Distributed sensing (e.g. temperature or acoustic)
  - Dielectric cables
  - Vapor tubes
  - Acoustic emissions
  - Vegetation monitoring

Note: many pipelines employ complimentary systems

Leak Detection Application



Sample Performance Parameters

- Leak location
- Non-leak alarm rate
- Smallest detectable leak
- Response time
- Length of coverage
- Adaptability to different conditions
- Availability (e.g. 24/7 coverage)
- Ability to retrofit
- Lifespan

Research Areas

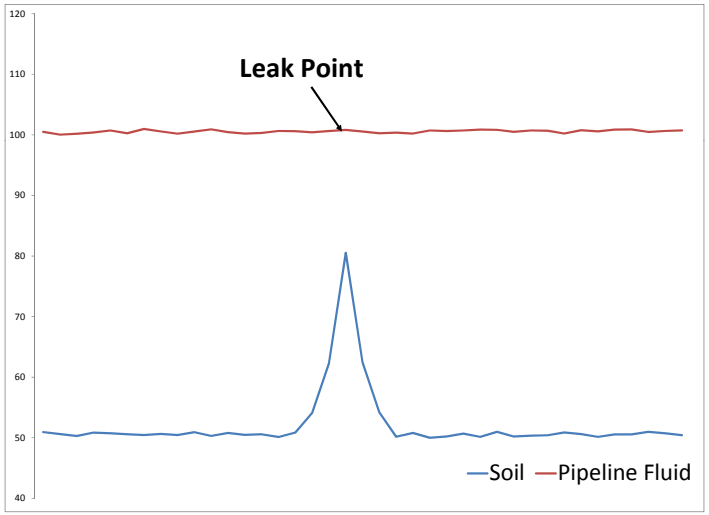
- Improvements in existing systems
  - Evaluation of performance
  - Non-leak alarm discrimination
  - Ease of implementation
- Physics of leaks
  - Hydraulic response
  - Discharged fluid propagation
  - Dynamic pressure within pipeline
- Driving down leak thresholds
  - CPM tuning
  - Novel technologies

Challenges to R&D and Testing

Perception	• No silver bullet technology • Not all leaks carry same detection challenges • Perception that any employed technology must find all leaks
Testing Approaches	• No one-size-fits-all test set up • Many systems must be tuned to each pipeline segment • Leak simulation may include actual fluid discharge
Markets	• Uncertainty in market stability • Small technology firms may not have resources for expansive testing
Benchmarks	• No standardization in requirements for research or testing • Mismatch between desired and available data

Example: Distributed Temperature Sensing

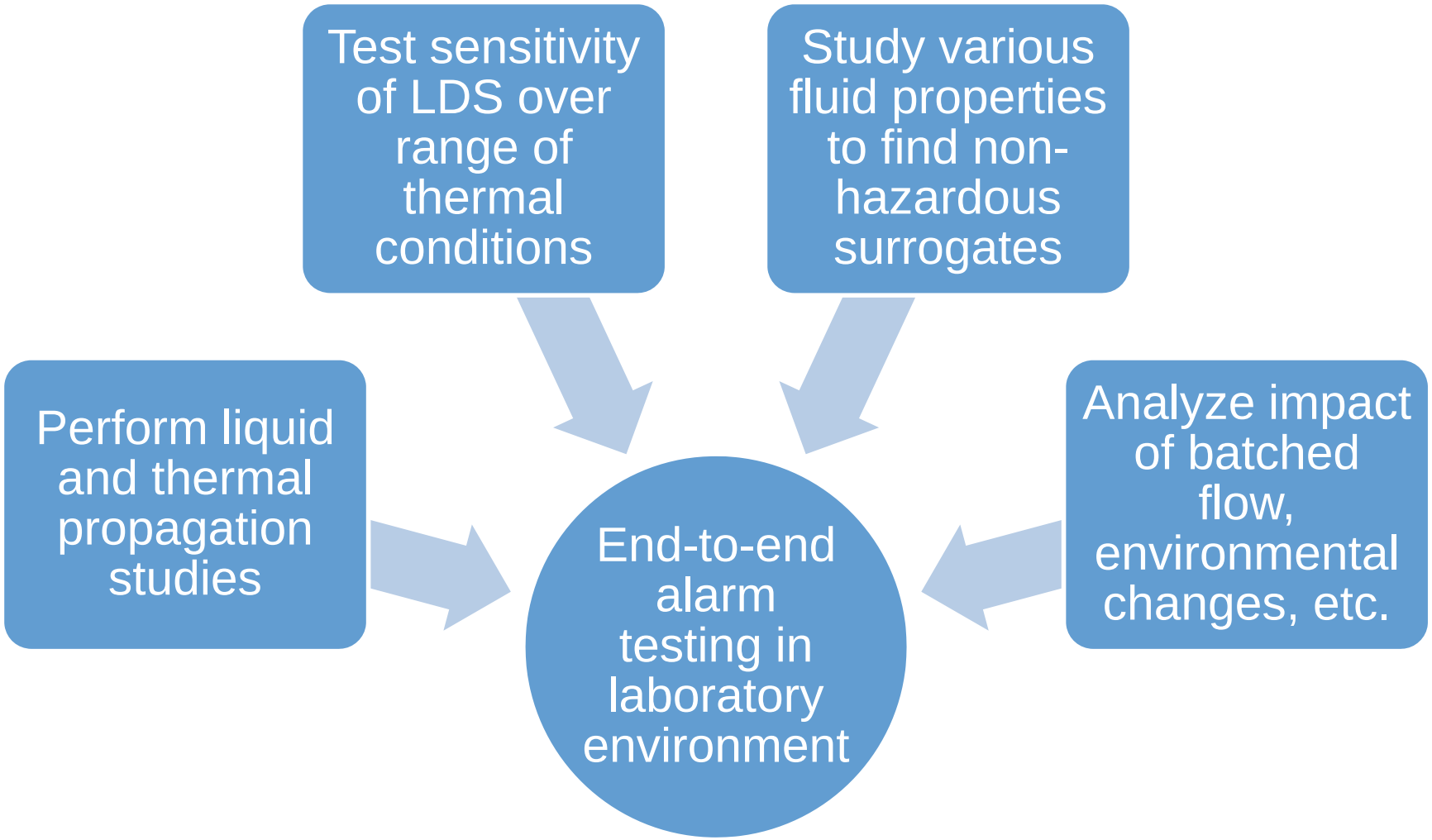
- Distributed temperature sensing utilizes a fiber-optic cable as a continuous (spatial and temporal) temperature transmitter
- Can detect leaks by monitoring localized temperature change (if pipeline fluid discharge temperature is different from soil)
- Not impacted by transient operations (e.g. shut-in, pump start)



The Challenge

- How to test whether or not system can detect small leaks?
- Some challenges:
  - Discharge of actual fluid
  - Non-usability of test bed for subsequent runs
  - Testing long lengths (10’s of miles)
  - Unknown drivers of leaks
  - Varying unit configurations

Solution – Separate Independent Tasks



Addressing Challenges

Discharge of actual fluid	Find surrogate fluids (e.g. match viscosity)
Re-use of test bed	Determine displaced volume for optimization
Long lengths	Bare fiber spools for optical loss
Unknown drivers	Comprehensive review of technical drivers
Unit configurations	Laboratory runs for high permutation count

Leak Detection Gaps

Perception of Performance	• Education of public and of pipeline community • Development of performance and selection guidelines
Absence of Data on Leaks	• Sharing of non-proprietary information to help determine needs • Evaluation of types of leaks (corrosion pin hole, crack, third-party damage, etc.)
Gaps in Standards	• Development of performance guidelines for non-CPM systems • Development of instrument selection guidelines • Development of guidelines for common alarm interfaces
Market Stability	• Joint-industry collaboration • Develop benchmarks • Sharing of testing results

Thank you.

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