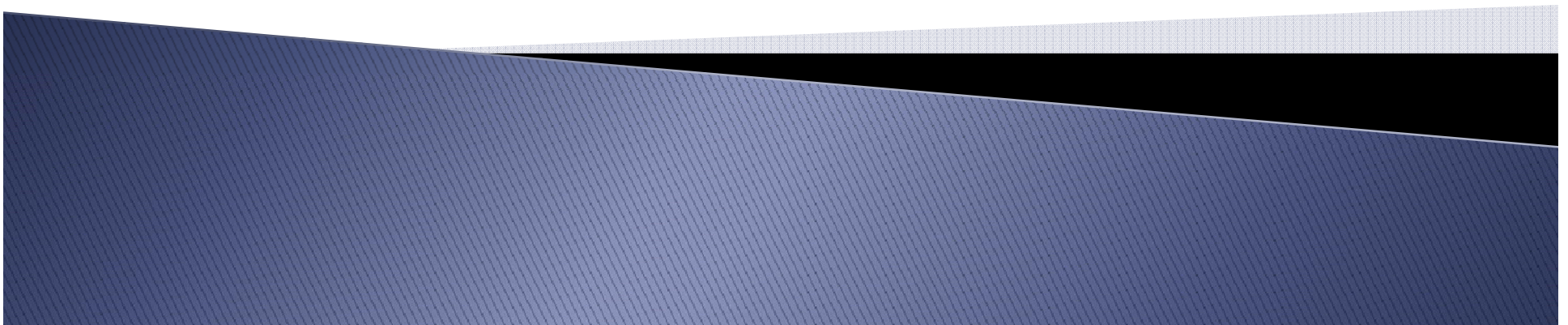


# Leak Detection Systems Capabilities and Research

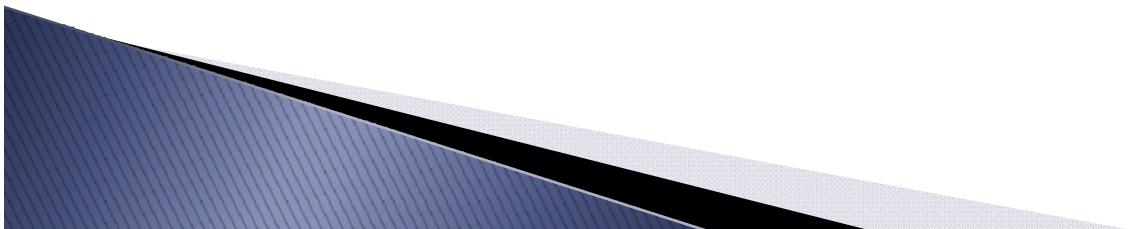
Hazardous Liquid Pipelines

PHMSA Webinar  
March 27, 2012



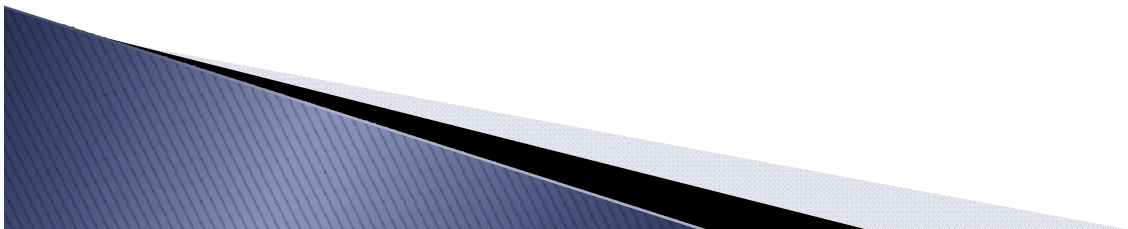
# State of the art liquids LDS

- Internal LDS
  - Deviations analysis
  - Statistics and DSP
  - Availability and accuracy of instrumentation
- External LDS
  - Environmental sensing: atmospheric, soil, water
  - Acoustic and pressure sensing
- Multiple complementary physical principles



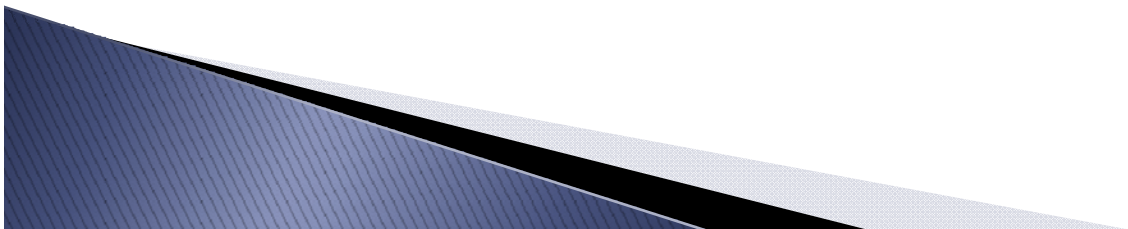
# Redundancy and backup

- Redundancy
  - Complimentary systems
  - Dual operational systems
- Backup
  - Failover systems
  - Visual / human inspections



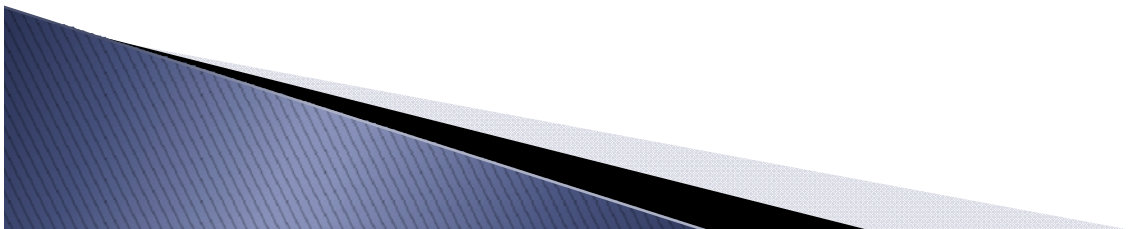
## Installing/maintaining on new vs. retrofit

- Almost all of the best LDS *can* be retrofitted or upgraded
- CAPEX vs. OPEX. No direct financial benefit.
- What is the lifecycle of an LDS?
  - What is “good enough” performance?
  - Technology now goes from R&D to field in a few years
  - Continual improvement



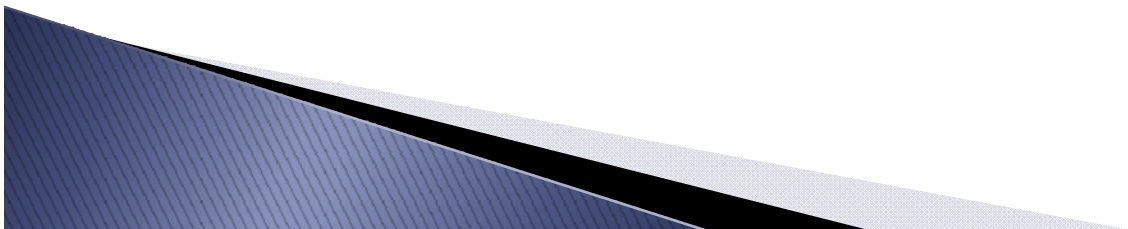
## Handling false alarms / misses

- In theory, one serious miss is worth a thousand false alarms
- In practice, a thousand false alarms equals an LDS that *will* be switched off. It is important to engineer tolerances carefully to avoid this.
- Green – yellow – red alarms:
  - Statistical likelihood rather than thresholds
  - Multiple sources of information
  - Very fast to yellow, very certain to red



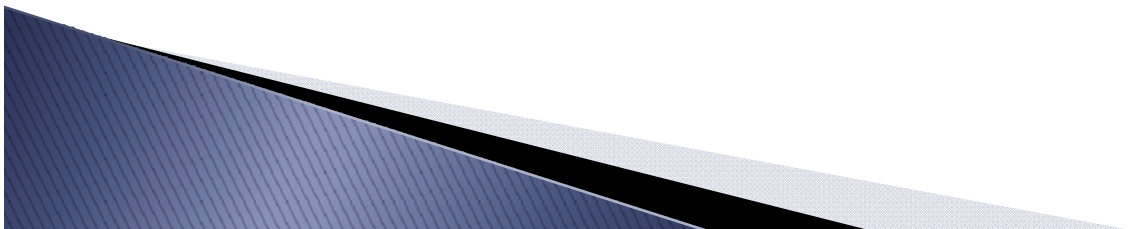
# Human factors in LDS performance

- Confidence
  - Operators – false alarms, orientation and training
  - Owners – historical legacy
  - Public – pipeline disasters
- Who owns the LDS?
  - Part of the IM “as–new – failure – remedy – as–new” cycle
  - Rarely considered as IM by an operator: sometimes engineering, sometimes instrumentation & control, sometimes IT / compliance



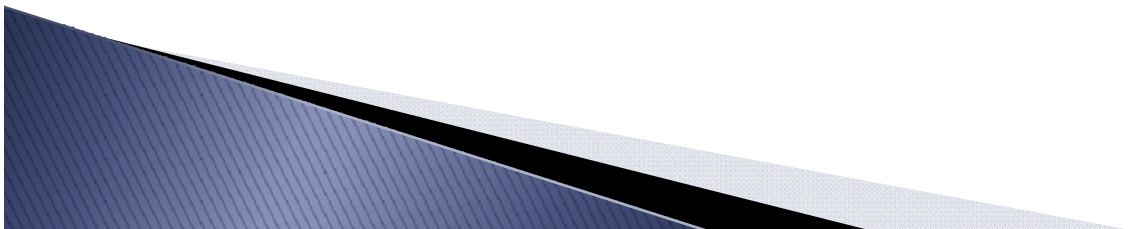
# Environmental / operational impact

- Operational:
  - Transient operations make LDS much more difficult.
- Environmental
  - Remote operations / poor communications
  - Very “crowded” environments (e.g. upstream operations)



## Emerging technologies / current gaps

- Atmospheric, soil and liquid sensor technologies
- Sensor vehicles – drones, satellites
- Very high performance, lower cost instrumentation
- DSP / pattern recognition (acoustic)
- Multi-phase metering
  
- Gaps:
  - Upstream
  - Transient operations, shut-in lines, etc.
  - Very small persistent leaks, pre-existing leaks





**Thank You**

