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pipeline leak detection & prevention technologies

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technology focus items

Agenda

- introduction to pipeline technologies
- leak prevention methods
  - marine vessel encroachment protection
  - in-line inspections
- leak detection methods
  - Computational Pipeline Monitoring
    - Volume Balance
    - Real-Time Transient Modeling
  - video surveillance tools
- emergency response portal

"An Ounce of Prevention Is Worth a Pound of Cure"

Benjamin Franklin – February 4, 1735

Pennsylvania Gazette article addressing Fire Safety

available tools

Leak Detection (with connected nodes):
- Visual Inspections
- Log sheets
- Pressure and Flow Indicators
- Volume Balances
- Hydraulic Models
- Video Surveillance

Leak Prevention (with connected nodes):
- In-line Inspections
- Field Visual Verification
- Pressure Relief
- One Call System
- Marine Vessel Encroachment
- Cathodic Protection Monitoring

in-line inspection (ILI)

History

- Chevron Pipe Line has performed over 1500 inspections since 1968
- inspection method has not changed
- existing tools are being improved and new tools are continually being invented

Tool Types

- existing tool types from various vendors:
  - Cleaning – removes debris
  - Gauge – identifies dents or obstructions
  - Geometry – identifies and locates dents or ovalities
  - Magnetic Flux (MFL) – captures wall thinning
  - Ultrasonic – detects changes in the thickness of the wall (defect depth measurement)

- emerging tools: Ultrasonic Crack Detection; Electromagnetic Acoustic Transducer (EMAT); Cathodic protection system evaluation (CPCM)

ultrasonic tools
In-line High Resolution Axial Crack Detection and Sizing

The Need

Identify the presence of various types of cracking

The Solution – Ultrasonic Inspection

- accepted by the industry

- detects and measures crack features

- sensor carrier delivers high precision and resolution

Key Advantages

- sensitivity and data resolution

- full recording of the complete inspection raw data

- wide range of configurations addressing individual requirements

- available for large & small diameter pipelines

- service provider expertise
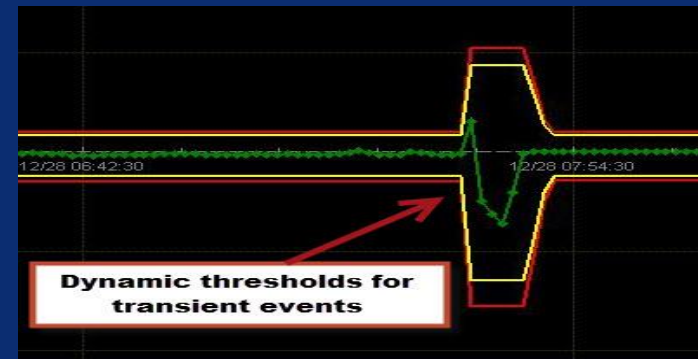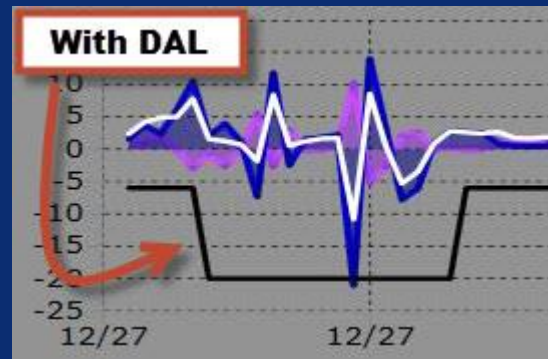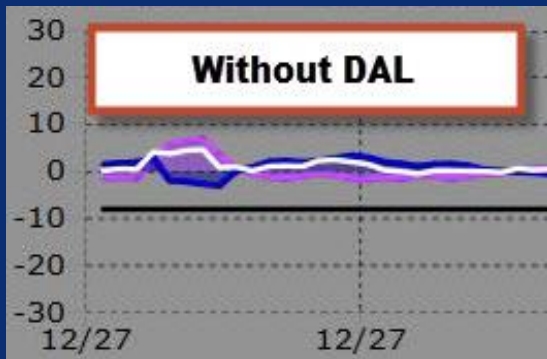
Computational Pipeline Monitoring

- Real-time operational data drives a set of algorithms to provide the basis for detection of a leak

- Multiple methods available in the industry

- CPL uses the following methods:
  - Volumetric Balance
  - Real Time Transient Model

Computational Pipeline Monitoring
Comparing the Methods

- Volumetric Balance
  - Static
  - Model Inputs
    - Volumetric rates in/out
    - Simplified line pack calculation
  - Systems:
    - Liquid and HVL

- Real Time Transient Modeling
  - Dynamic hydraulic model
  - Model inputs
    - Pressure, Temperature, Flow, and Fluid properties
  - Systems:
    - Liquid and HVL

Dynamic Thresholds and/or Alarm Limits can be used to reduce false indications from transient pipeline operating conditions.

Computational Pipeline Monitoring
Pros and Cons

Pros

Cons

Volume Balance

- Simplified approach
- Straightforward implementation, maintenance, and utilization.

Transient Model

- Can enable leak location detection
- Shorter detection time based on leak size (% of total flow)

Volume Balance

- Shut in and slack conditions
- Transient conditions
- Small leaks may have long detection times
- Does not enable Location detection

Transient Model

- Complex and cost intensive
- Specialized model, configuration, tuning, maintenance.
- Data intensive

Pipeline Video Surveillance

- Real time leak detection and theft deterrence via video systems
- Types:
  - Gas Cloud Imaging/Thermography
  - Vehicle/personnel tracking with Pan/Tilt Zoom
- Benefits
  - Configurable analytics
  - Fit for purpose coverage
- Methods
  - Report by exception human interface

- Limitations:
  - Data quality and quantity restrictions
  - Small leaks may escape analytics
  - Maintenance and Tuning requirements
  - False Alarms that cannot be tuned out due to location.

Marine Vessel Encroachment Program

- Basis:
  - Vessel Automatic Information System (AIS) transponder data
  - Position identification system
  - Asset mapping overlay

- Enables timely vessel notification to relocate away from pipeline assets

- Challenges
  - Lack of/Limited existing vessel contact information
  - Commercial vessels only
  - Costly interface due to licensing requirements
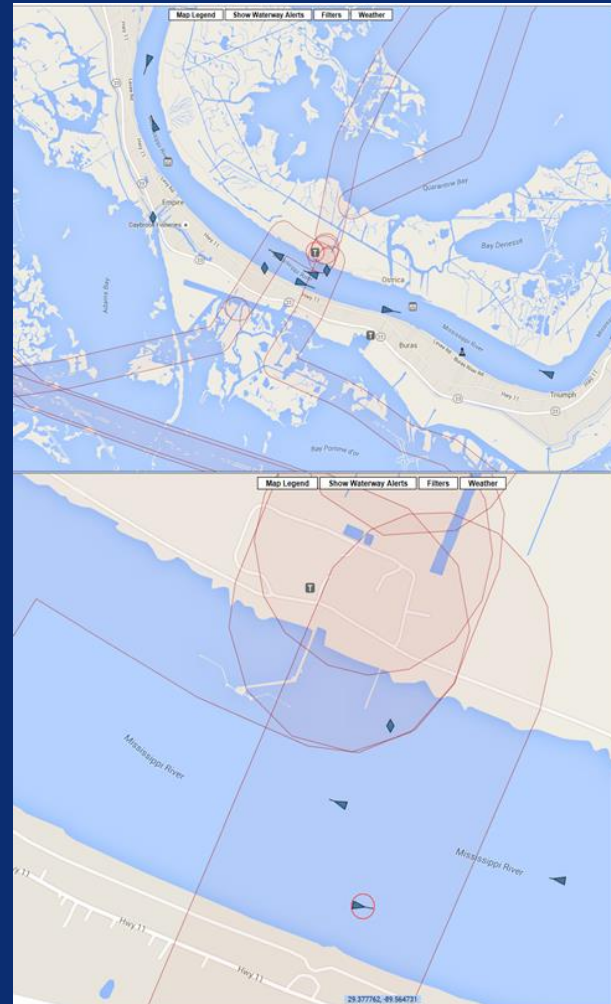
Chevron Pipe Line's
Emergency Response Portal

Developed to Provide Information to Emergency Responders

- Pipeline Maps
- Emergency Response Manuals and Plans
- Local Contact Information

Website Address

http://response-planning.com/ERPP/chevron#

- First time access will require an setting up an account
- Please provide feedback on the website

Questions

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