Chevron Pipe Line's Leak Detection System Perspectives

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All acronym explanations can be found on the last slide.

Agenda, Key Messages & Desired Outcomes

Considerations

- Layers of Redundancy into overall LDS Strategy
- LDS Changes due to HL IMP Rule
- External, Environmental, & Operating Conditions impacts on LDS Technology / Performance
- Human Factors as it affects LDS Performance
- Pipeline shut-in time improved via valves, meters, and CPM
- False positives/negatives addressed with LDS
- CAPEX/OPEX LDS costs New vs. Old pipelines
- Pilots, Projects, and R & D efforts

Key Messages

- Topic summary/conclusions:
  - Non-conventional LDS redundancy is being piloted while conventional is maintained
  - To date, over 350 LDCE PAMM projects due to HL IMP Rule
  - Technology and performance do not necessarily align during these conditions
  - Both SMEs and Controllers can affect of the LDS Performance as there are many Human Factors involved besides fatigue
  - Shut-in improvement through Integrated Spill Management
  - Process and Protocol for CPM Tuning
  - Millions of dollars have been spent on Capital and Expense
  - All of the above approach: Pilots, Projects, and R & D efforts

Desired Outcomes

- Outline Company Perspectives and address PHMSA's meeting considerations

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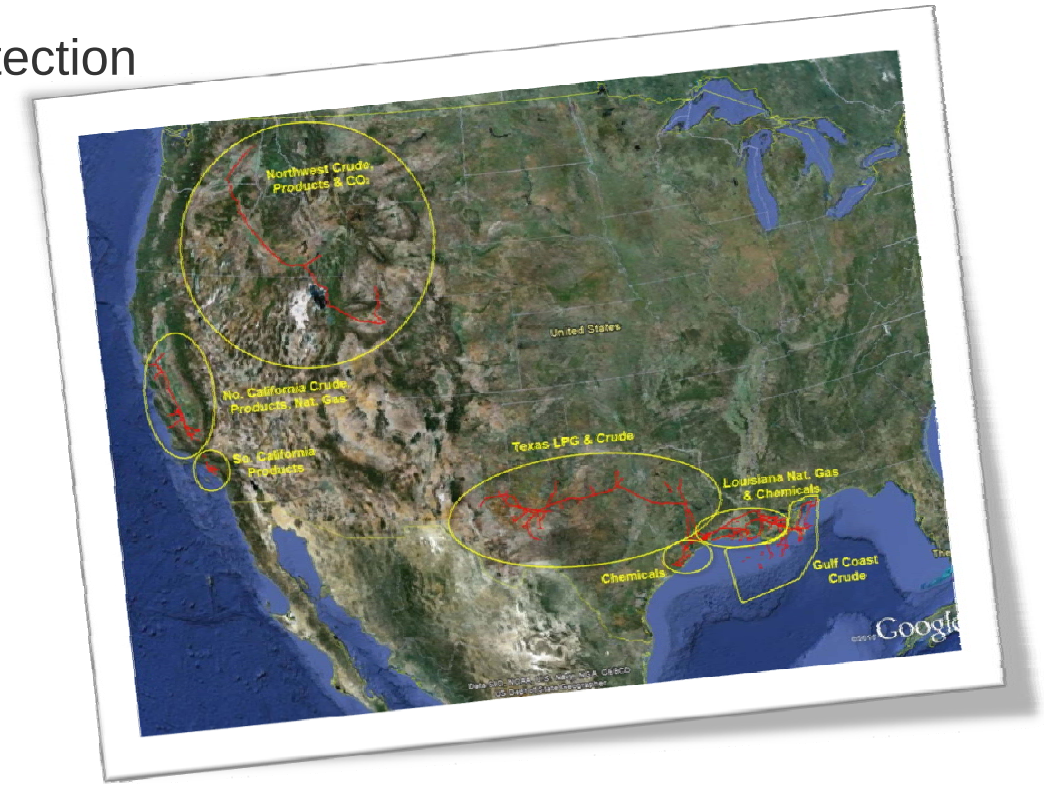
Briefly About Chevron Pipe Line Company

- CPL is responsible for operating and maintaining Chevron Corporation's Common Carrier and Proprietary Pipeline Business in the U.S.A.
- Operates 9,673 miles of pipeline in the U.S.A. and the Gulf of Mexico
- 100+ Computerized Leak Detection Records
- Transports:
  - Crude
  - Petrochemicals
  - Refined Products
  - Carbon Dioxide
  - Liquefied Petroleum Gas
  - Natural Gas Liquids
  - Natural Gas



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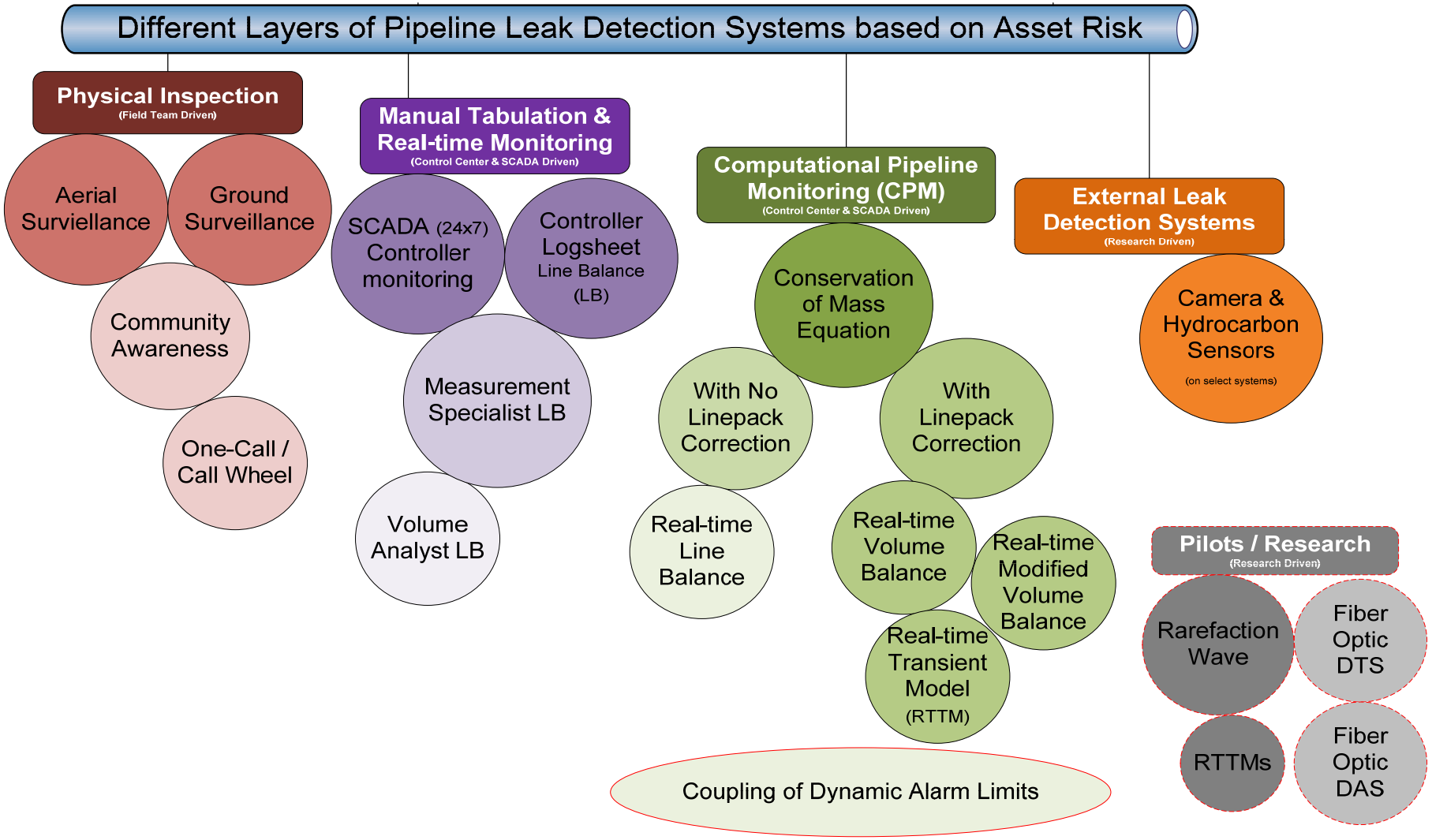
CPLs Overall LDS Redundancy Strategy



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LDS Changes Due to the HL IMP Rule

- Identified over 350 LDCE PAMM projects, which ranged from:
  - More meter & instrumentation calibration / verification, accuracy improvements
  - Capital Investment replace equipment (or add new)
  - Improved tuning and alarming parameters
  - Add CPM
  - Add linepack compensation
  - Add more trending capabilities
  - More SME support activities

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External, Environmental, & Operating Conditions impacts on LDS Technology / Performance

- There is no one size fits all for every pipeline
  - The reason for different layers of pipeline leak detection systems based on asset risk
- CPL focuses on the factors and considerations outlined by the regulations and PHMSA FAQs as well as other significant factors not outlined
  - We assess the risk and deploy the appropriate tools needed to mitigate that risk
- Factors included in the assessment:
  - *49 CFR 195.452(i)(3)* {8}
  - *PHMSA FAQ 9.4* {9}
  - Measurement and instrumentation spacing
  - Meter proving (meter factor) errors
  - Online fluid property instrumentation, especially at inlets or intersections of pipe
  - Fluid temperature instrumentation or thermal modeling capabilities
  - Hours of operation
  - Slack line (channel-flow) operations / conditions
  - Startup transients
  - Communication outages and latency
  - Human Factors
    - Data availability and presentation,
    - Understanding of fluid behavior in pipeline operation,
    - Any fixed or manual entries for process variables
  - Frequency of pigging
  - Use of Drag Reduction Agents (DRA)

All acronym explanations can be found on the last slide.

Human Factors affecting LDS Performance

- CPL has implemented a CRMP process that encompasses all the factors outlined below that affect a Controller when monitoring the pipeline and leak detection system:
  - Fatigue mitigation,
  - Providing adequate information,
    - HMI graphics and transparency,
    - Ease of data availability,
  - Alarm management,
  - Change Management,
  - Operating Experience,
  - Training,
  - Confidence in systems

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Improving Shut-In times through Integrated Spill Management

- A spill quantification toolset has been developed to:
  - Provide a principled basis for analysis and quantification of pipeline spill impacts
  - Evaluation of the design, operational and spill response alternatives
  - Monitor and understand spill scenario evolution on a transient basis
  - It includes the CPM, valves, meters
- CPL has seen shut-in improvements by using this toolset
  - For example, shut-in from 2.5 hours to 30 minutes on one of our crude pipeline systems just by using this toolset

All acronym explanations can be found on the last slide.

Addressing false positives/negatives within LDS

- CPL has developed and implemented a CPM Tuning process
  - All CPM records are evaluated at least once a year
  - Documented per API 1130
  - There is a balance with each pipeline system of number of alarms versus sensitivity per averaging period
- All leak detection alarms are documented in the Controller Logbook, and/or annotations on the Trending
- Deviation monitoring, which includes leak alarms, are:
  - Documented for historical review by the Controller on duty
  - Reviewed daily with Console Operations Representative
  - Weekly with Console Supervisor
  - Monthly with a Control Center Leadership Team
- CPL has advanced analytical team to assist the Controller in addressing and analyzing the false positives/negatives within a LDS, both day and night
- Usual reasons for the false positives / negatives indications:
  - Measurement issue
  - Instrumentation problem
  - Communication issue
  - Operational issue
  - Software / application issue
  - PCN related issue
  - CPM Tuning issue

Industry Collaborations, Research, Testing, New Advances, and Other Focus Areas

- Industry Collaborations
  - API, PRCI, IPC, PSIG,
  - Vendor User Groups
- External Research
  - PRCI: PL-1-1 *Detection of Small Leaks*
  - PRCI: PL-1-2 *Enhancement to API 1149*
  - PRCI: DP-3-3 *Human Factor Impacts*
- Internal Research
  - Fiber Optic DTS and DAS tests
  - Statistical algorithms
- Pilot Testing
  - Rarefaction Wave
  - Two RTTMs head-to-head comparison
- New Advances
  - JIP: Subsea Leak Detection
- Other Focus Areas
  - Release Elimination Culture
  - Proactive and Repair project via Integrity Maintenance program
  - Equipment Reliability & Integrity Process
  - Control Center Visualization project
  - Alarm Objective Analysis across consoles
  - CRMP Plan improvements
  - SCADA & Communication system upgrade evaluations
  - Withdraw Test Protocol
  - Analytics relative to historical incidents
  - More Organizational Capability

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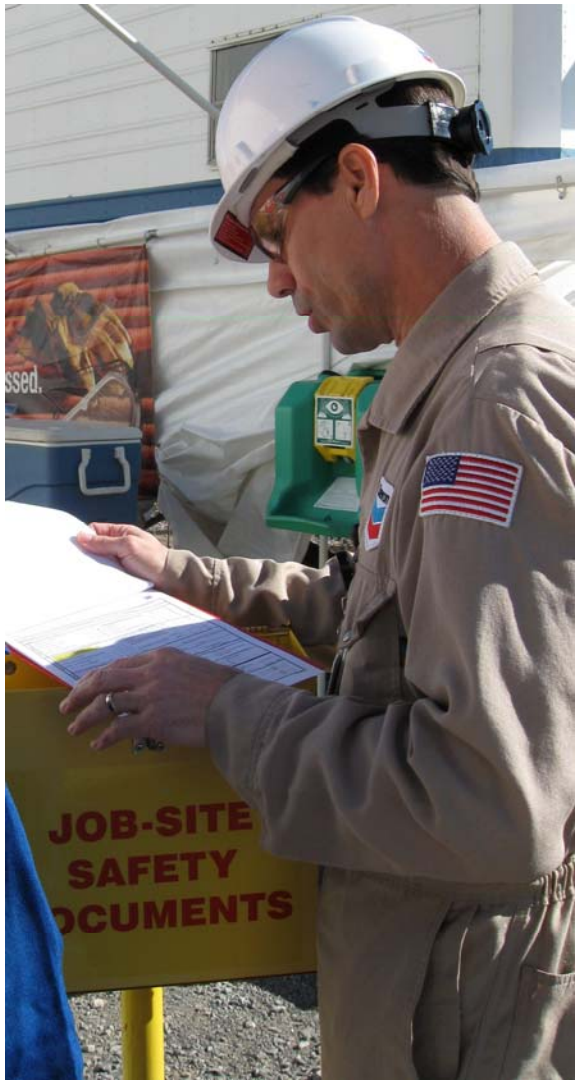
CPL Culture Shift: Release Elimination



- Chevron's priority is spill prevention
- Apply same focus as Safety
  - Zero Is Attainable
  - Zero Tolerance Climate
  - "Always" Manage the Risk
- Coordination of all release elimination activities (Repairs, Proactive, Mitigative)
- Reinforce Leadership Accountability
  - Tone at the top
  - Individual commitment
  - Scorecard metrics
- Share Lessons Learned (CPL & beyond)
  - Common Themes

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Thank You.

- Acronyms:
  - CPL—Chevron Pipe Line
  - LDCE – Leak Detection Capability Evaluation
  - CPM – Computational Pipeline Monitoring
  - PAMM– Preventative and Mitigative Measure
  - HL IMP – Hazardous Liquid Integrity Management Plan
  - LDS– Leak Detection System
  - LD—Leak Detection
  - LB—Line Balance
  - RTTM—Real-time Transient Model
  - CAPEX –Capital Expenditure
  - OPEX –Operational Expenditure
  - SCADA—Supervisory Control and Data Acquisition
  - PHMSA—Pipeline Hazardous Material Safety Administration
  - SME—Subject Matter Expert
  - R & D—Research and Development
  - DTS—Distributed Temperature Sensing
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  - API—American Petroleum Institute
  - PRCI—Pipeline Research Council Incorporated
  - PSIG—Pipeline Simulation Interest Group
  - IPC –International Pipeline Conference
  - JIP—Joint Industry Project
  - FAQ—Frequently Asked Questions
  - CRMP—Control Room Management Plan
  - HMI—Human Machine Interface
  - DRA—Drag Reducing Agent
  - PCN—Process Control Network

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