

Improving Pipeline Integrity and Performance through Advance Leak Detection and Control Systems

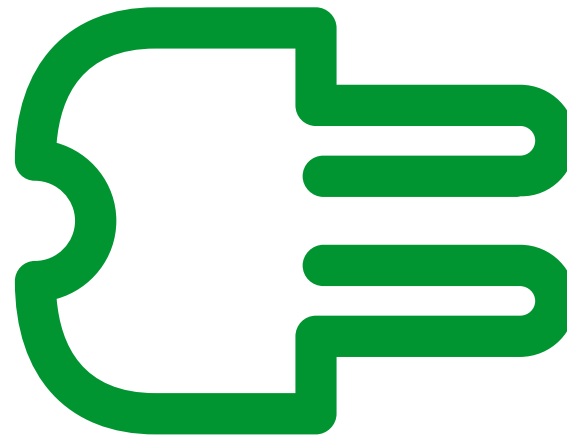
Claude Desormiers – Schneider Electric
Ralf Tetzner – Krohne Oil & Gas
GASTECH Abu Dhabi, May 2009



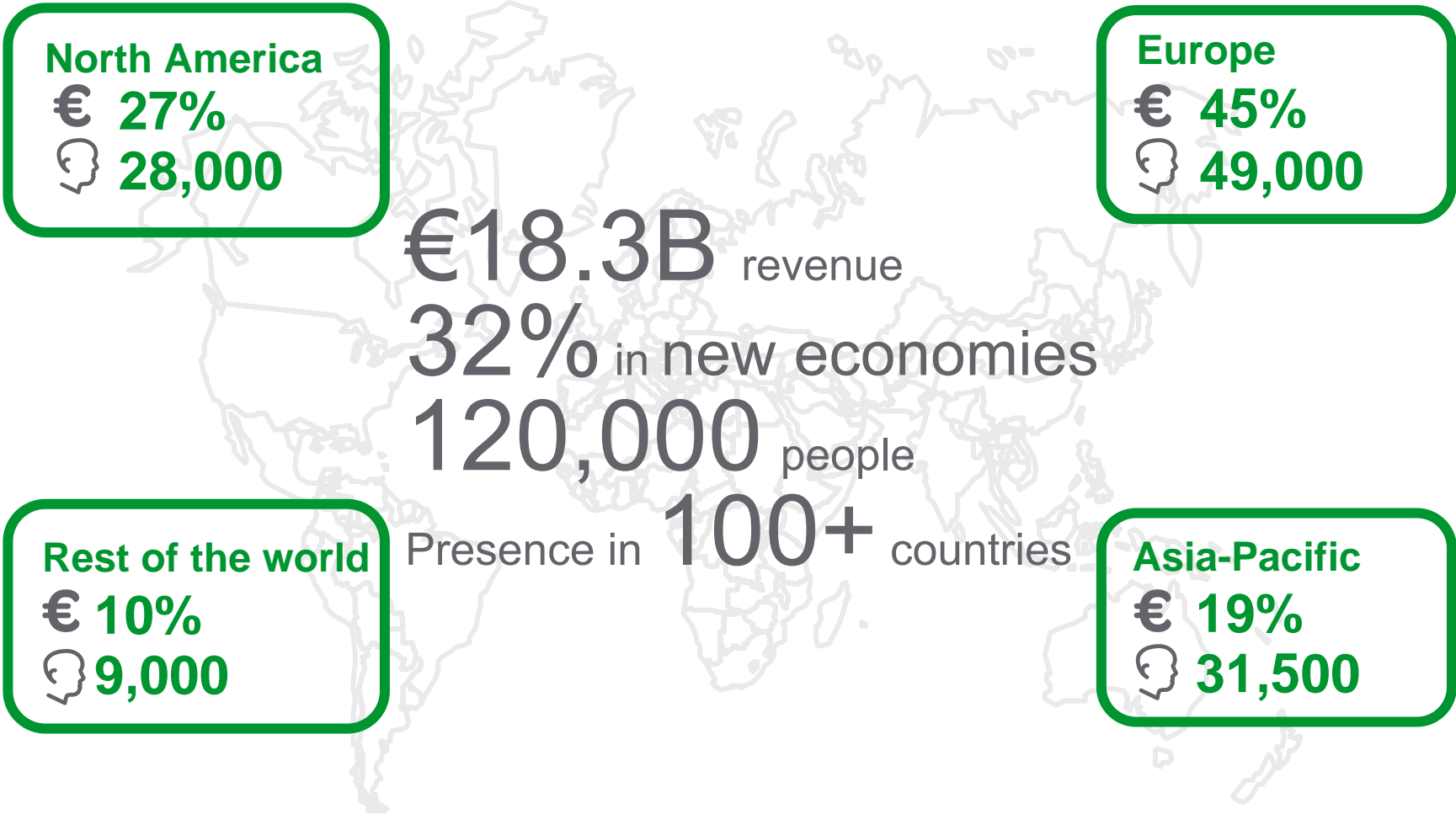
Agenda

- Introduction
 - Krohne - Schneider Electric Alliance
- Transport Pipeline
 - A focus on E-RTTM
- Q&A

The global specialist in
energy management



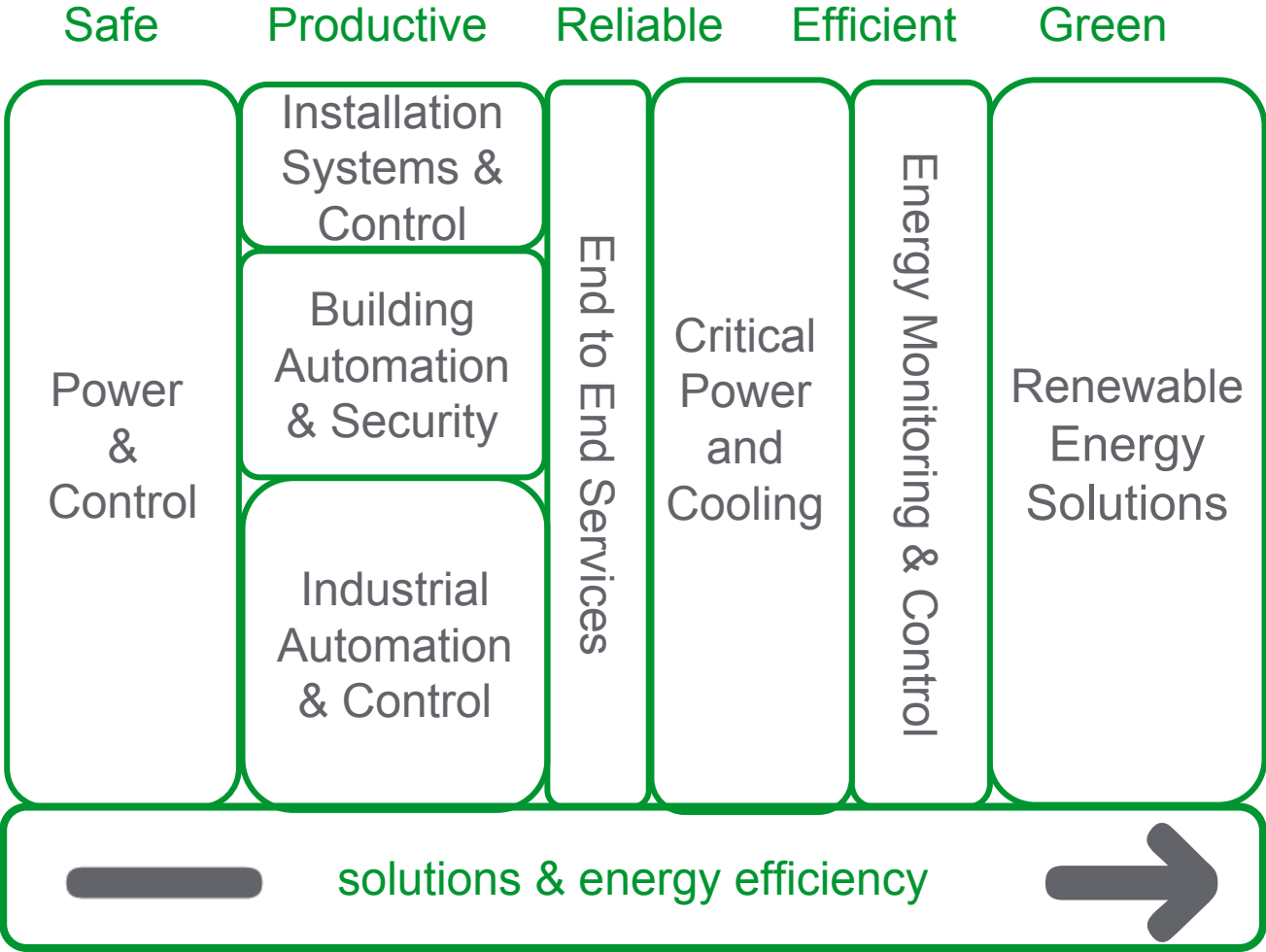
A global company



Building an integrated portfolio in energy management



Market



Building an integrated portfolio in energy management



Safe Productive Reliable Efficient Green

Market



Helping customers to
**focus on their core
business** with
integrated solutions in
energy management

- **KROHNE is present on all 5 continents**
 - 15 production facilities in 10 countries
 - 43 KROHNE-owned companies and joint ventures
 - 45 exclusive representatives
 - **Total Sales**
 - 289 Mio €
 - **No. of employees**
 - 2510
 - **Ownership**
 - KROHNE is 100% owned by the Rademacher-Dubbick family
 - **Corporate Management**
 - Michael Rademacher-Dubbick and Stephan Neuburger
- 

A light blue, semi-transparent world map is visible in the background of the slide, centered behind the main text box.

Our Vision

‘We are the **competence** in process instrumentation and measurement solutions, serving key industrial market worldwide with **leading-edge** technology’

Our Alliance



•Our strengths

- Comprehensive PMS SCADA
 - leading edge technologies
 - pipelines process, power management & integral security
- Modular Integrated Pipeline Management Solution
 - facilities to delivery point
 - end– end supply and services
- Single Source
 - supply and responsibility



Ensure safe, reliable and efficient pipeline operations

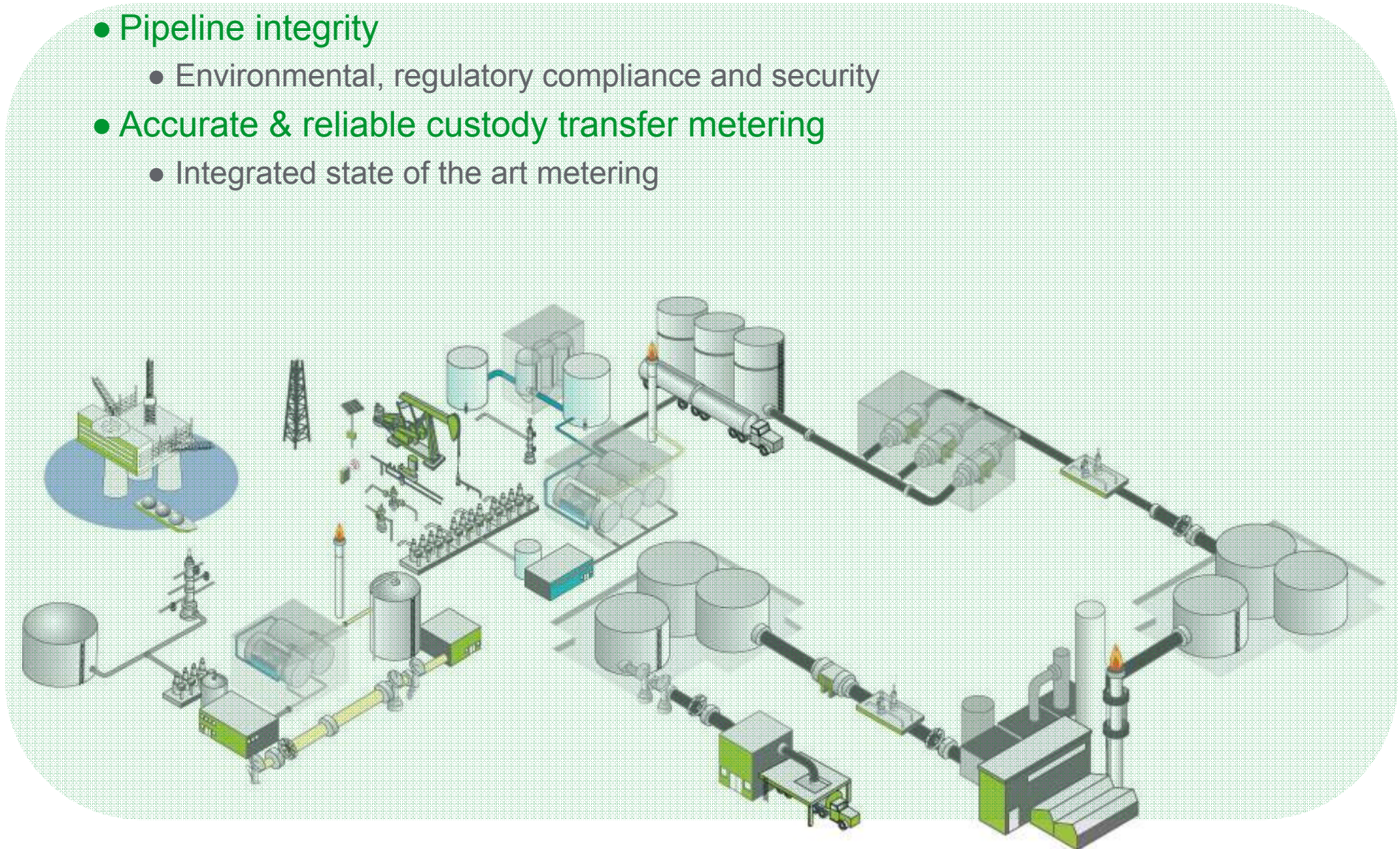
A unique solution from the Schneider Electric and Krohne alliance



Challenges

Ensure Safe, Reliable and Efficient Pipeline Management

- Pipeline integrity
 - Environmental, regulatory compliance and security
- Accurate & reliable custody transfer metering
 - Integrated state of the art metering



Enhancing Pipeline Integrity Management using Leak Detection System

- Accurate measurements
 - Pressure, Temperature and Flow
 - Associated infrastructure– Telemetry, RTU, Communication
- SCADA
 - Adapted for Pipeline Operations
- Leak Detection System
 - Mass-Balance
 - RTTM
 - others

Flow Measurement

- Performance Monitoring
 - Reflective chord designs
 - Wall build-up measurement
 - limitation of conventional parallel chord designs
 - Optimal solution
 - combines both technologies
- Unsurpassed Performance
 - Highest accuracy in custody transfer market segment
 - Swirl compensation in each plane
 - Reflection technology increases accuracy
 - doubling chord length



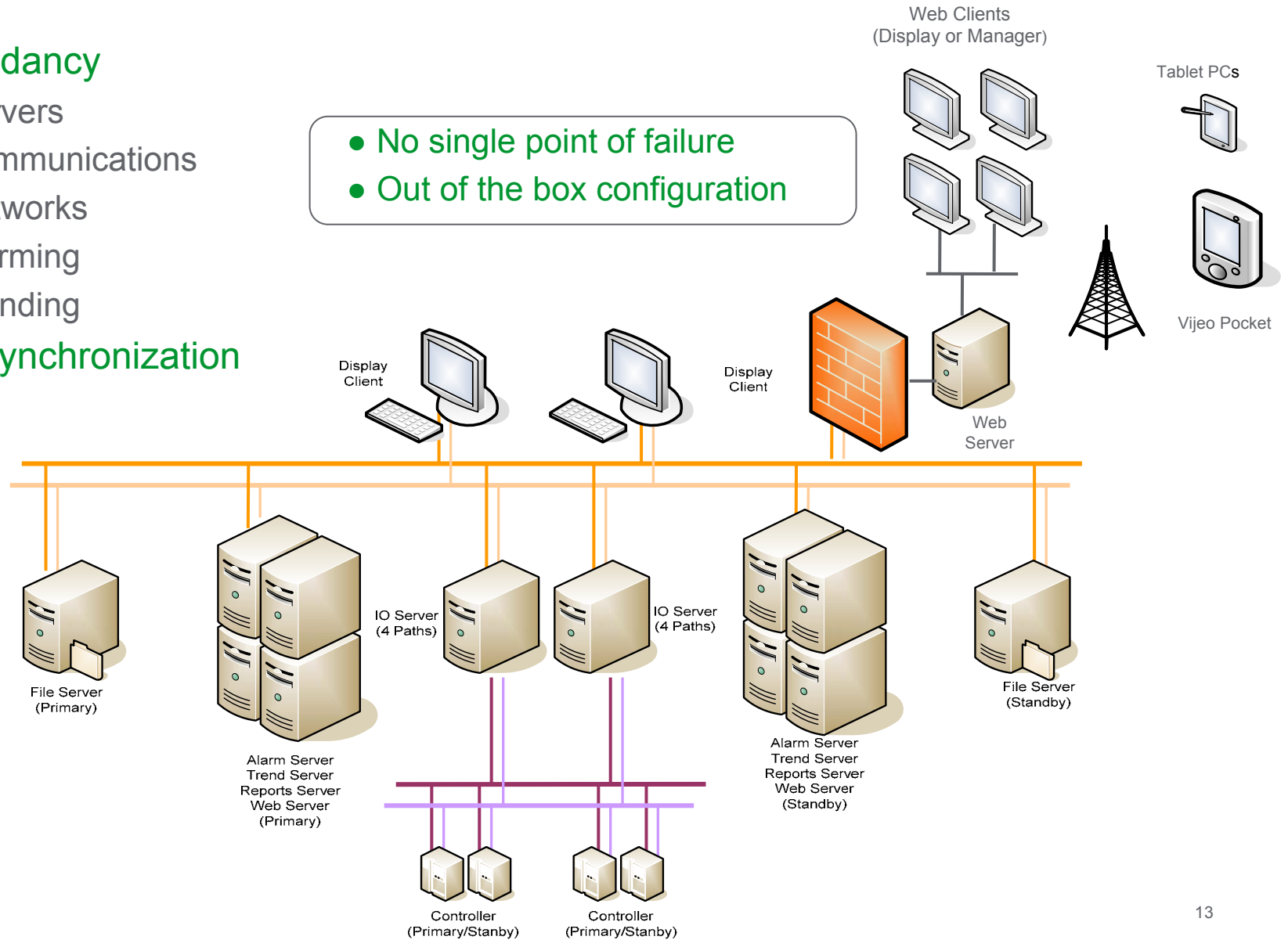
Citect SCADA Fully Redundant Architecture

- Redundancy

- Servers
- Communications
- Networks
- Alarming
- Trending

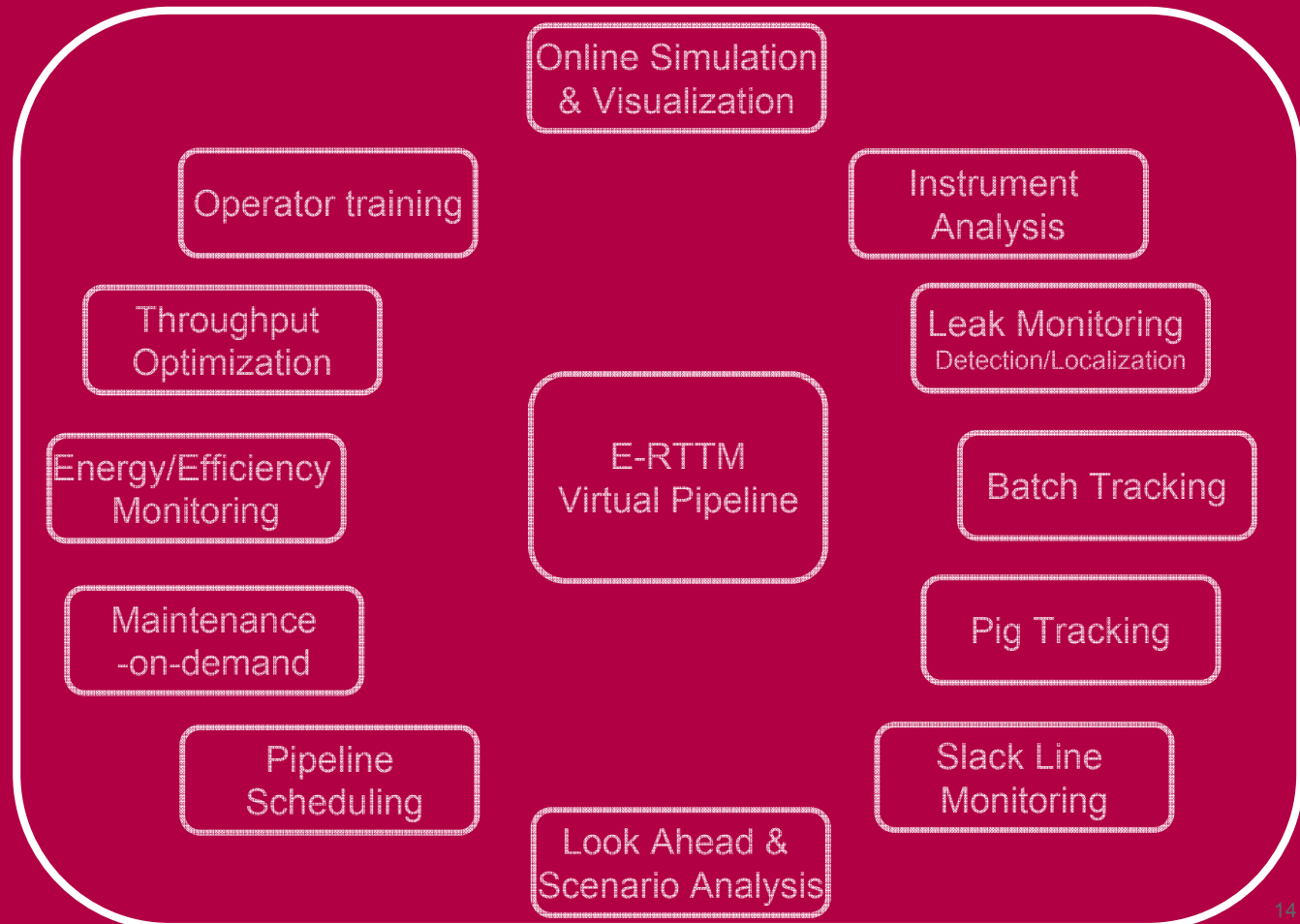
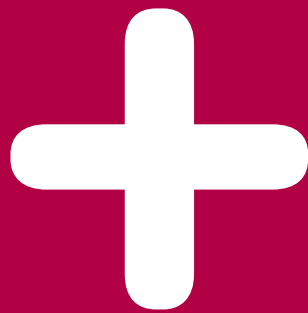
- Auto-synchronization

● No single point of failure
● Out of the box configuration



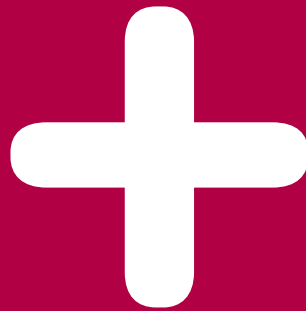
Citect PipePatrol Pipeline Management System (PMS)

- All SCADA Functionalities

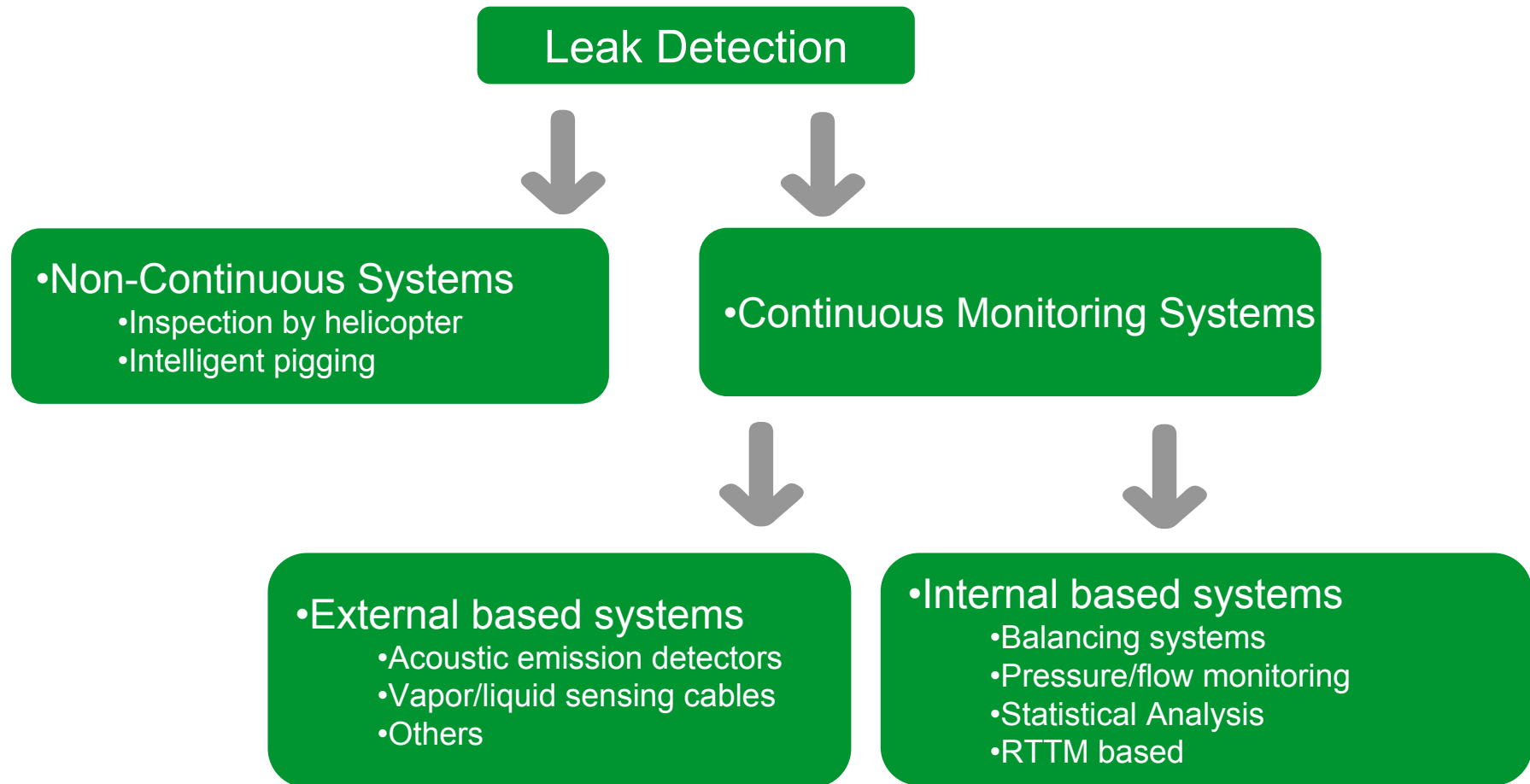


Citect PipePatrol Pipeline Management System (PMS)

- E-RTTM Virtual Pipeline
 - Leak Detection



Different Leak Detection Systems



Citect-PipePatrol E-RTTM

Performance Criteria according to API 1155

Sensitivity

- Detect small leaks fast
 - Typical smallest detectable leak rate approx. 0.5% / 1.0% (Nom. Flow)
 - Very fast detection time, typically < 3 min. / < 15 min. (liquid/gas)

Reliability

- Produce no false alarms
 - < 2 per year guarantee
 - Reliable detection of smallest leaks

Robustness

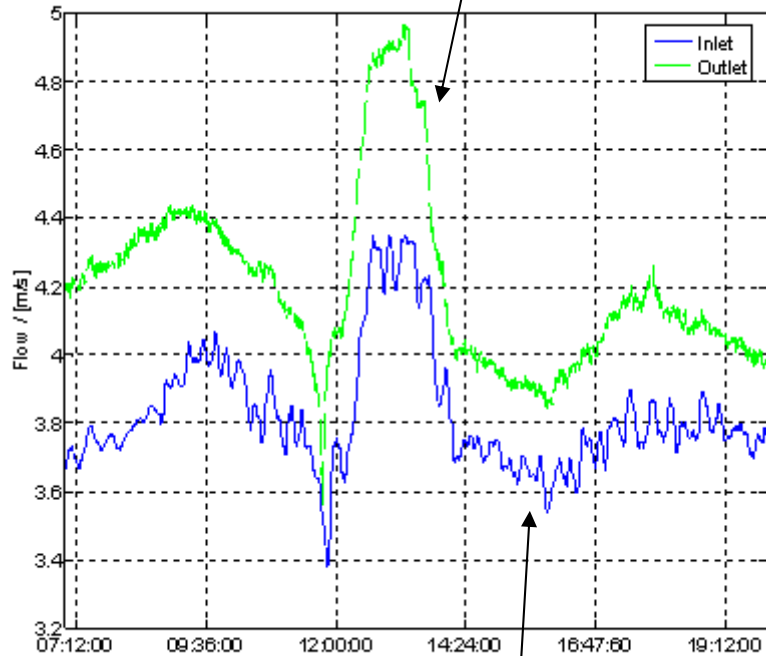
- No need to shut down leak detection due to component failure
 - Redundancy option combine with robust hardware
 - Fall back strategy upon sensor failure

Accuracy

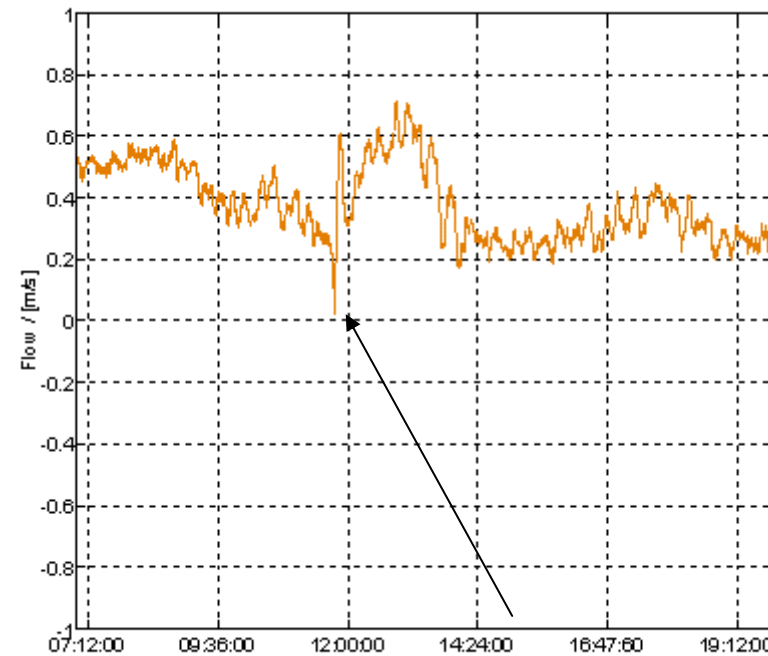
- Calculate accurate leak rate and position
 - Leak localization accuracy typically between 1-2% of segment length

Conventional Leak Detection System

Outlet flow, measured by flowmeter



Inlet flow, measured by flowmeter



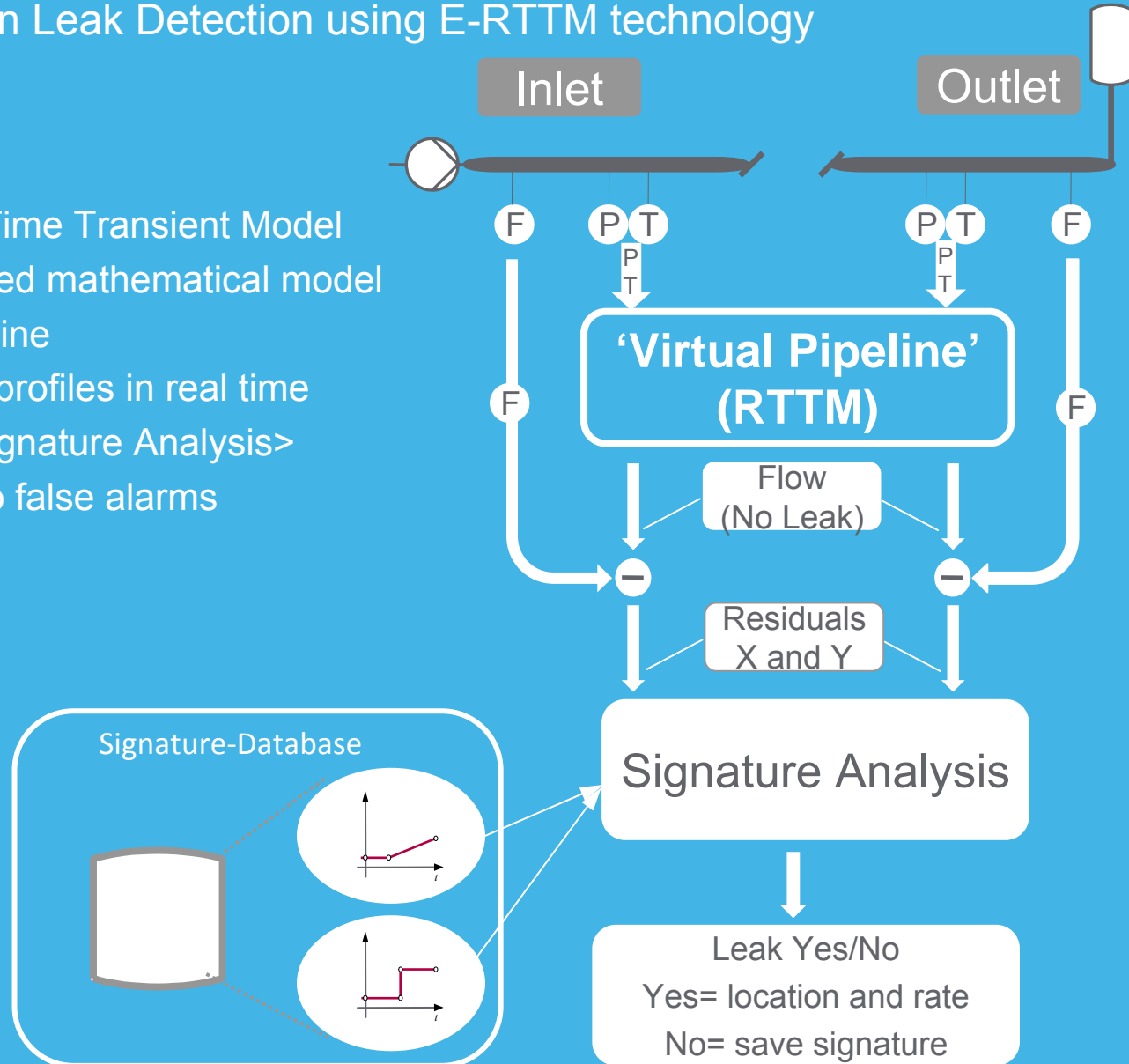
Difference between inlet and outlet flow, not zero due to transient pipeline behaviour

Citect PipePatrol E-RTTM Principle

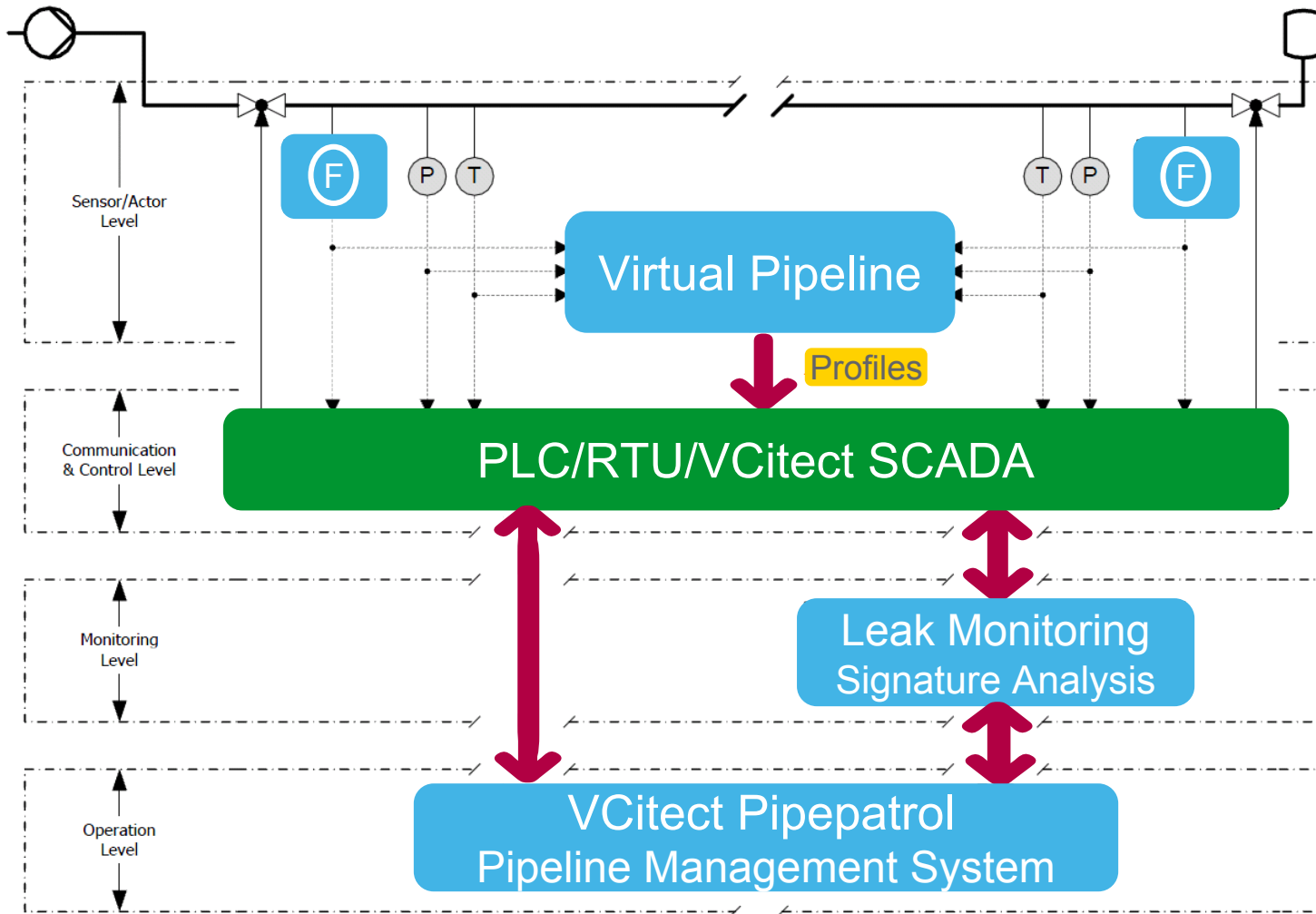
Reliable and Proven Leak Detection using E-RTTM technology

● E-RTTM

- Extended Real-Time Transient Model
- Uses sophisticated mathematical model
 - Virtual Pipeline
- Calculates local profiles in real time
- Extended by <Signature Analysis>
 - archive zero false alarms

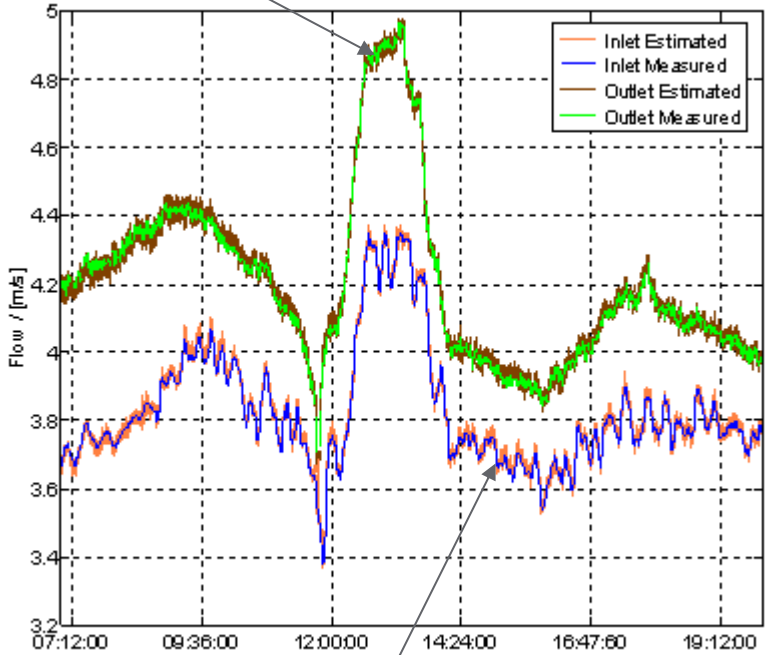


Block Diagram – Virtual Pipeline Leak Monitoring



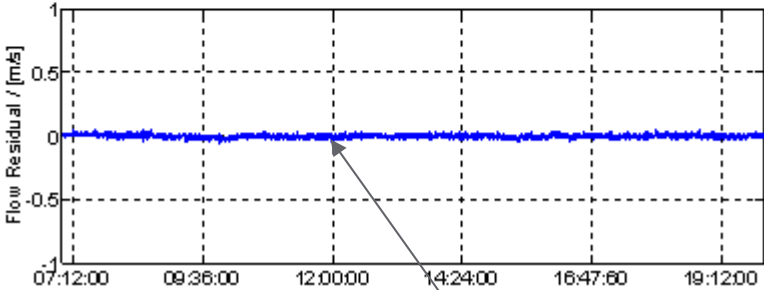
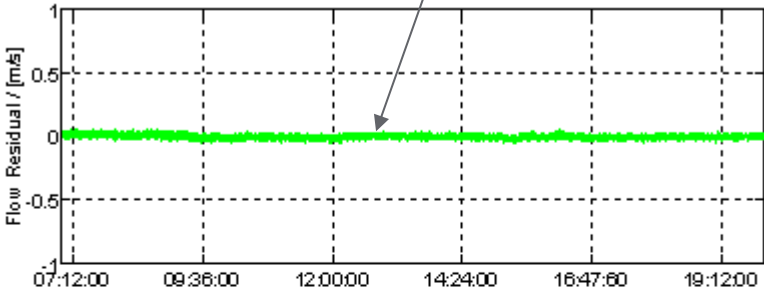
Citect PipePatrol E-RTTM

Outlet flow,
Measured by flowmeter (green)
Calculated by RTTM (brown)



Inlet flow,
Measured by flowmeter (blue)
Calculated by RTTM (orange)

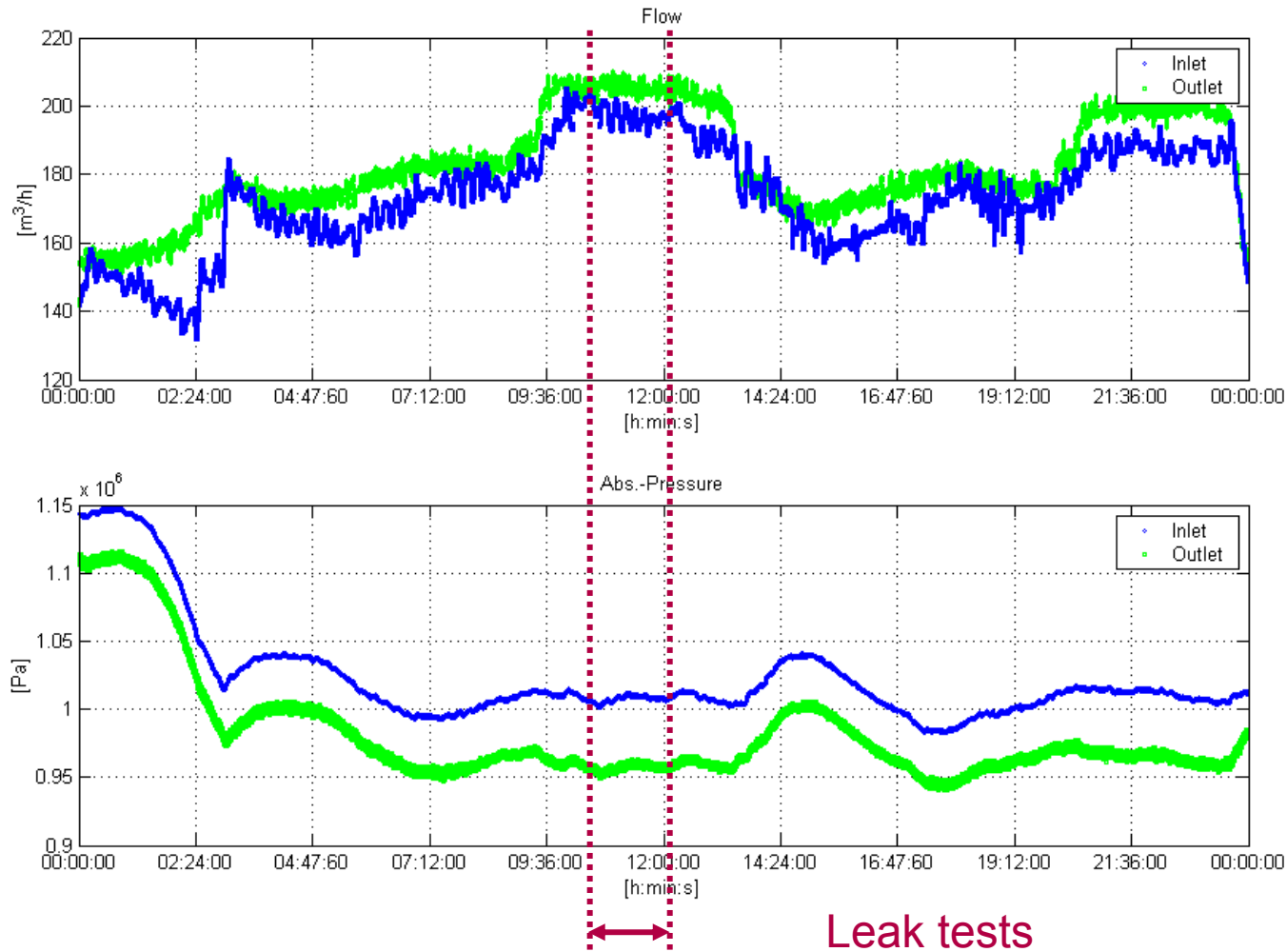
Outlet flow residual,
Difference between calculated
and measured flow



Inlet flow residual,
Difference between calculated
and measured flow

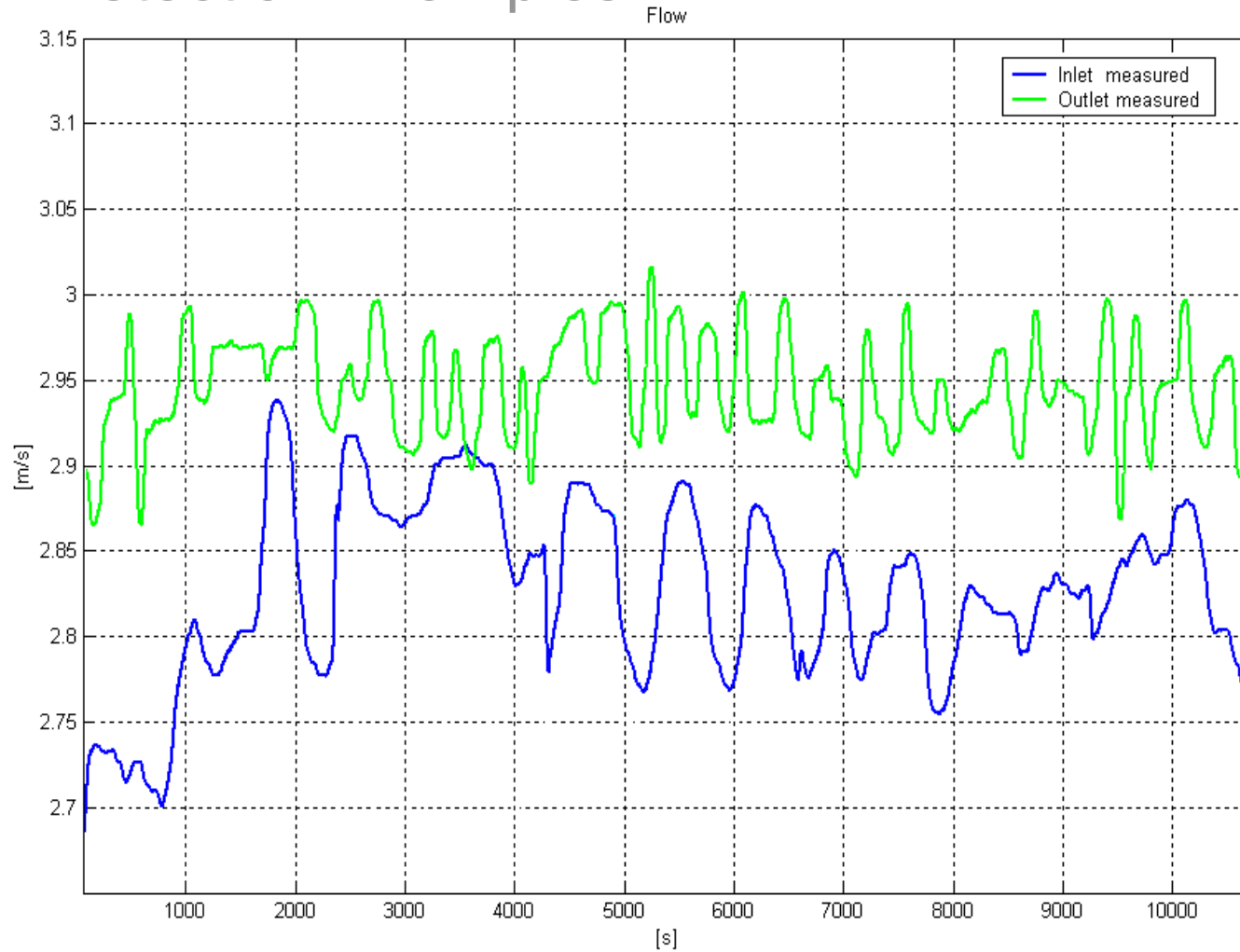
Daily Flow and Pressure Measurements

Leak Detection Examples



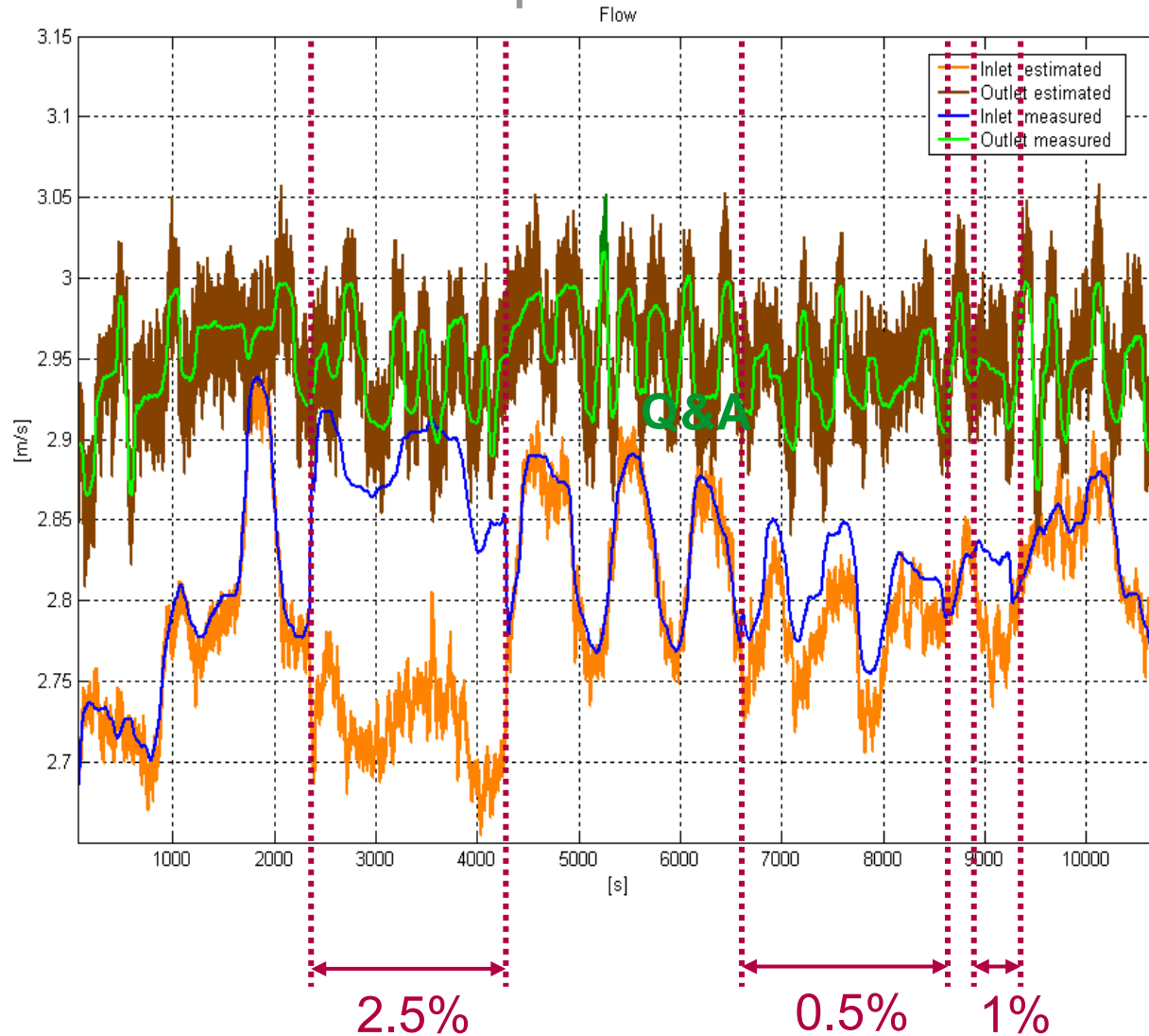
Detailed Flow Measurement Activities

Leak Detection Examples



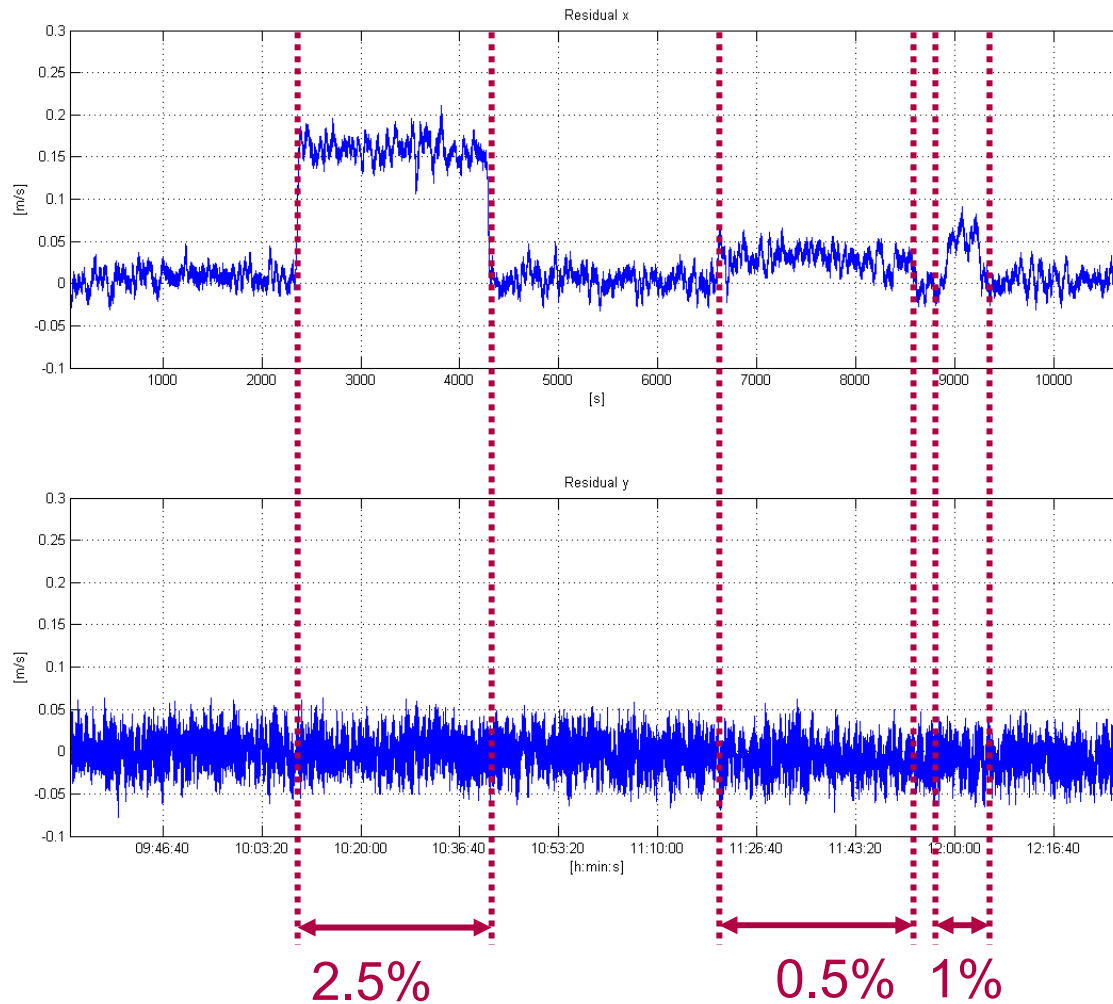
Measured and calculated flow

Leak Detection Examples



Residuals X and Y

Leak Detection Examples



Leak Localization

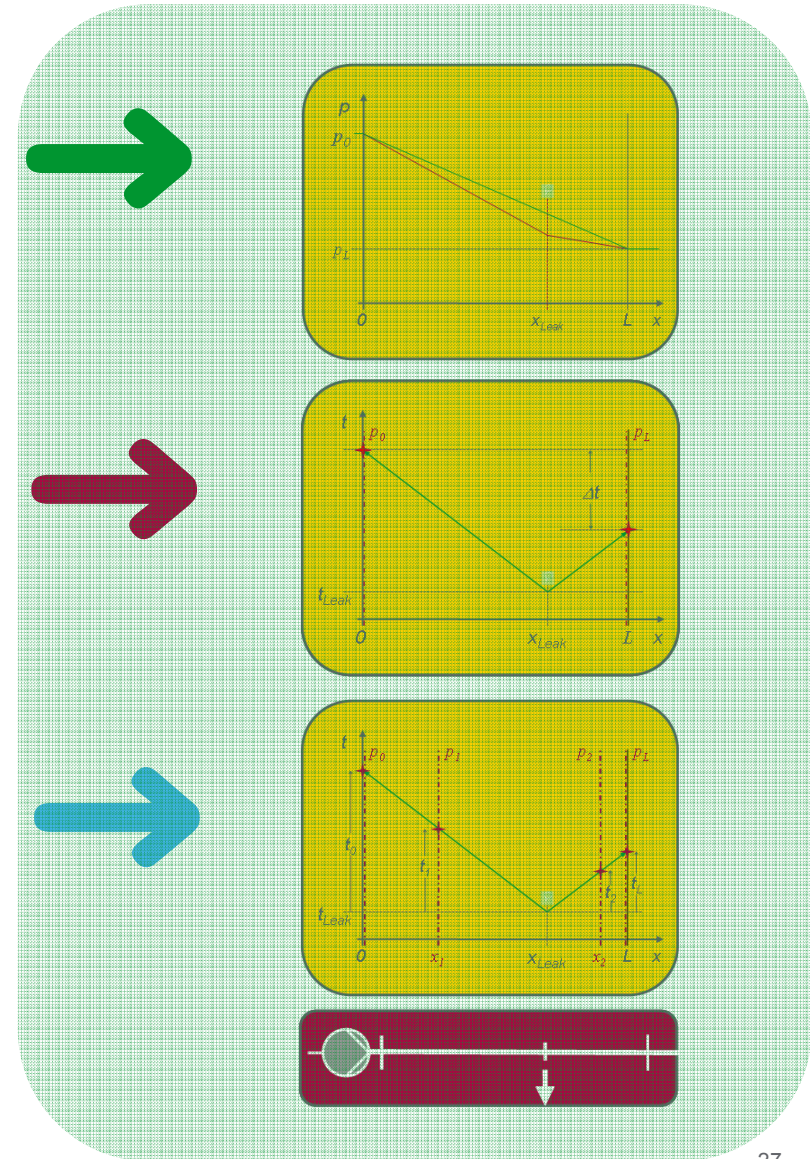
- Three simultaneous algorithms
 - Gradient Intersection Method
 - Wave Propagation Method (Time of Flight)
 - Extended Time-of-Flight
- Ensure accurate results under all operating conditions

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E-RTTM Leak Localization Principle

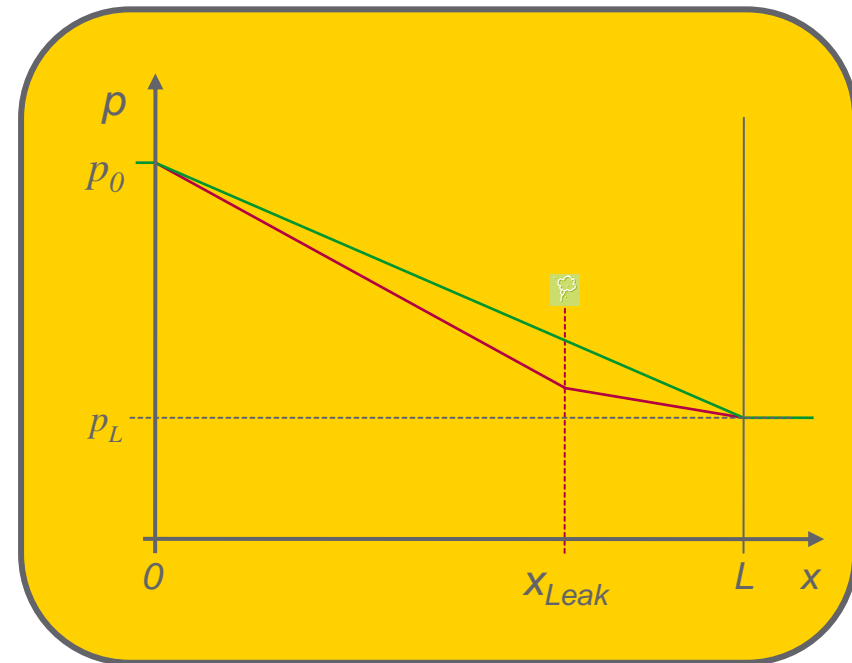
- Providing Accuracy

- Simultaneous calculation of leak position with three different methods
 - Gradient Intersection
 - Time-of-Flight
 - Extended Time-of-Flight
- Main advantages
 - Combines strengths, avoids weaknesses
 - Provides excellent overall accuracy



Citect PipePatrol E-RTTM LDS Principle

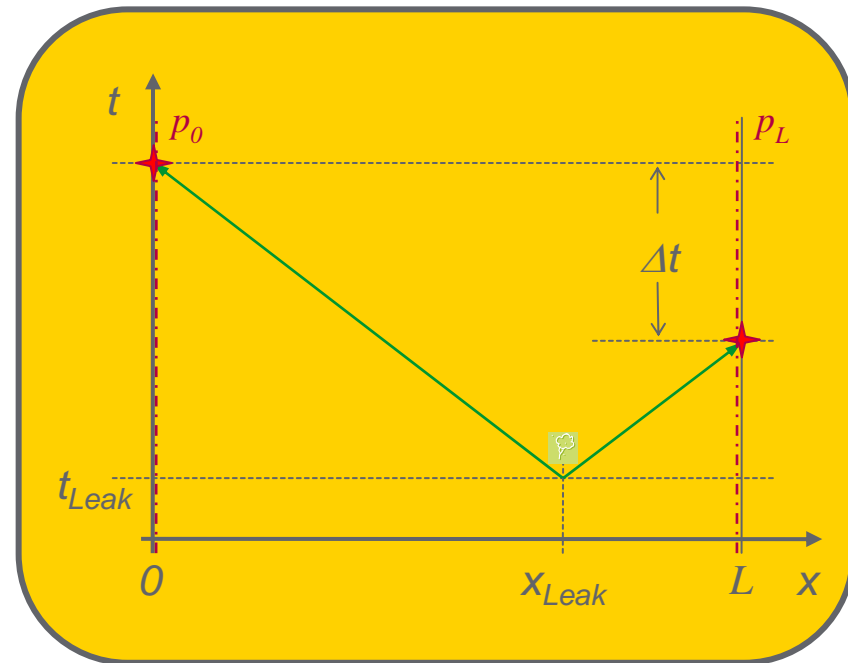
- Gradient Intersection Method
 - RTTM technology: No need of additional pressure sensors
- Pros
 - Good accuracy during stationary conditions
 - Independent of leak characteristic (spontaneous, creeping)
- Cons
 - Accuracy based on whole pipeline length L
 - Poor accuracy during transient conditions



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E-RTTM LDS Principle

- Time-of-Flight-Method
 - RTTM technology reduces influences of transients significantly
- Pros
 - Good accuracy during stationary and transient conditions for appropriate leak characteristics
- Cons
 - Accuracy based on whole pipeline length L
 - Not applicable for small and/or creeping leaks
 - Requires fast sampling



Citect PipePatrol E-RTTM LDS Principle

- Extended Time-of-Flight-Method

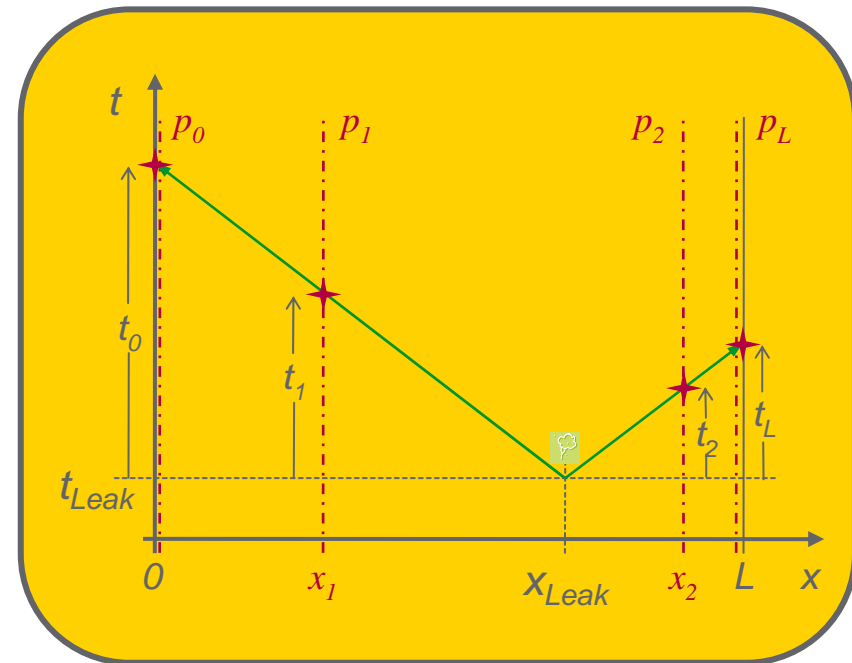
- RTTM-based technology with additional pressure sensors

- Pros

- Accuracy based on reduced segment length Δx_i
- Significantly improves accuracy versus simple Time-of-Flight
- Suitable for small leaks

- Cons

- Not applicable for creeping leaks
- Requires fast sampling



E-RTTM performance

Leak Detection and Localization

- Liquid Pipeline

- Smallest detectable leak flow typically $\leq 0.5\%$
- Fast leak detection typically $\leq 3\text{min}$
 - Metering consideration
- Accurate leak localization
 - Typical accuracy $\leq \pm 1\%$ of segment length

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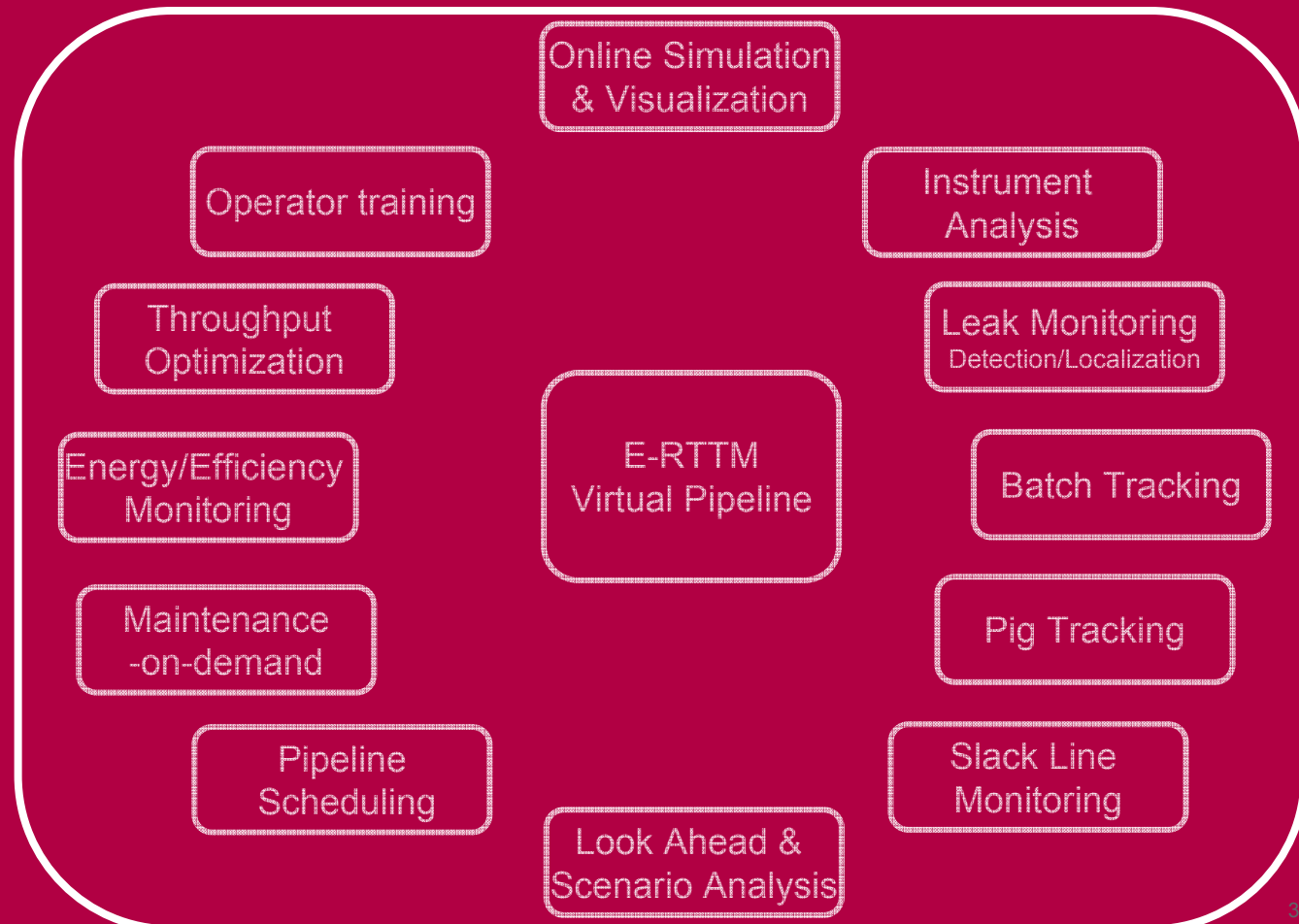
- Gas Pipeline

- Smallest detectable leak rate between 1.0% - 2.0 %
- Detection time typically ≤ 15 minutes
 - Length, volume and metering consideration
- Accurate leak localization
 - Typical accuracy $\leq \pm 2.0\%$ of segment length

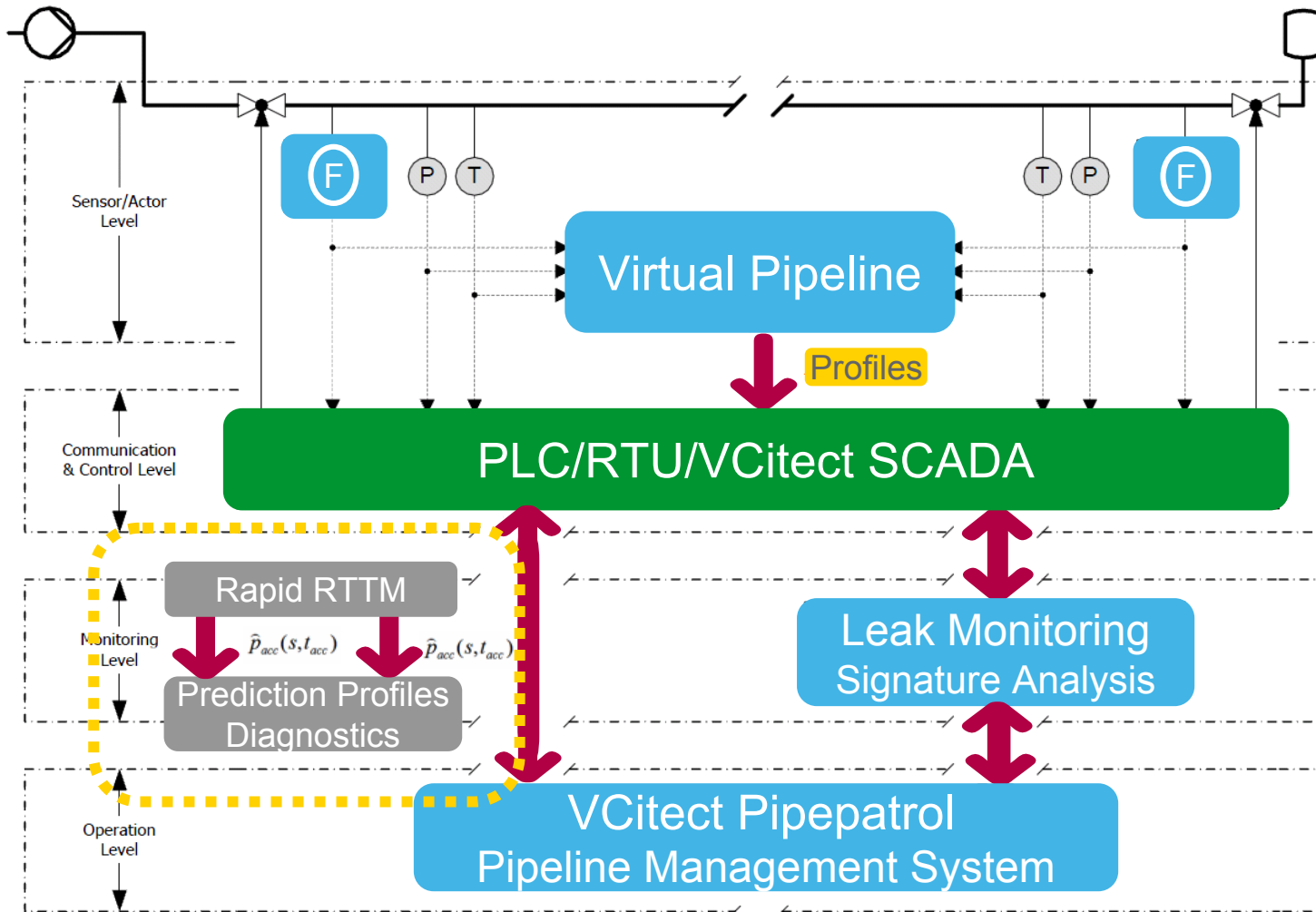
- False Alarm Rate < 2 per year

Citect PipePatrol Pipeline Management System (PMS)

- E-RTTM Virtual Pipeline
 - Real-time line packing



Block Diagram – Virtual Pipeline Look Ahead & Scenario Analysis



Murphy Oil Malaysia Typical Application

- Product

- Dehydrated Gas

- Pipeline

- Length 138 km
- Depth 1350m
- Sub sea
- On demand gas re-injection into reservoir

- Instrumentation

- Inlet and outlet flow (turbine)
- Inlet and outlet pressure
- Inlet and outlet product temperature

- Flow

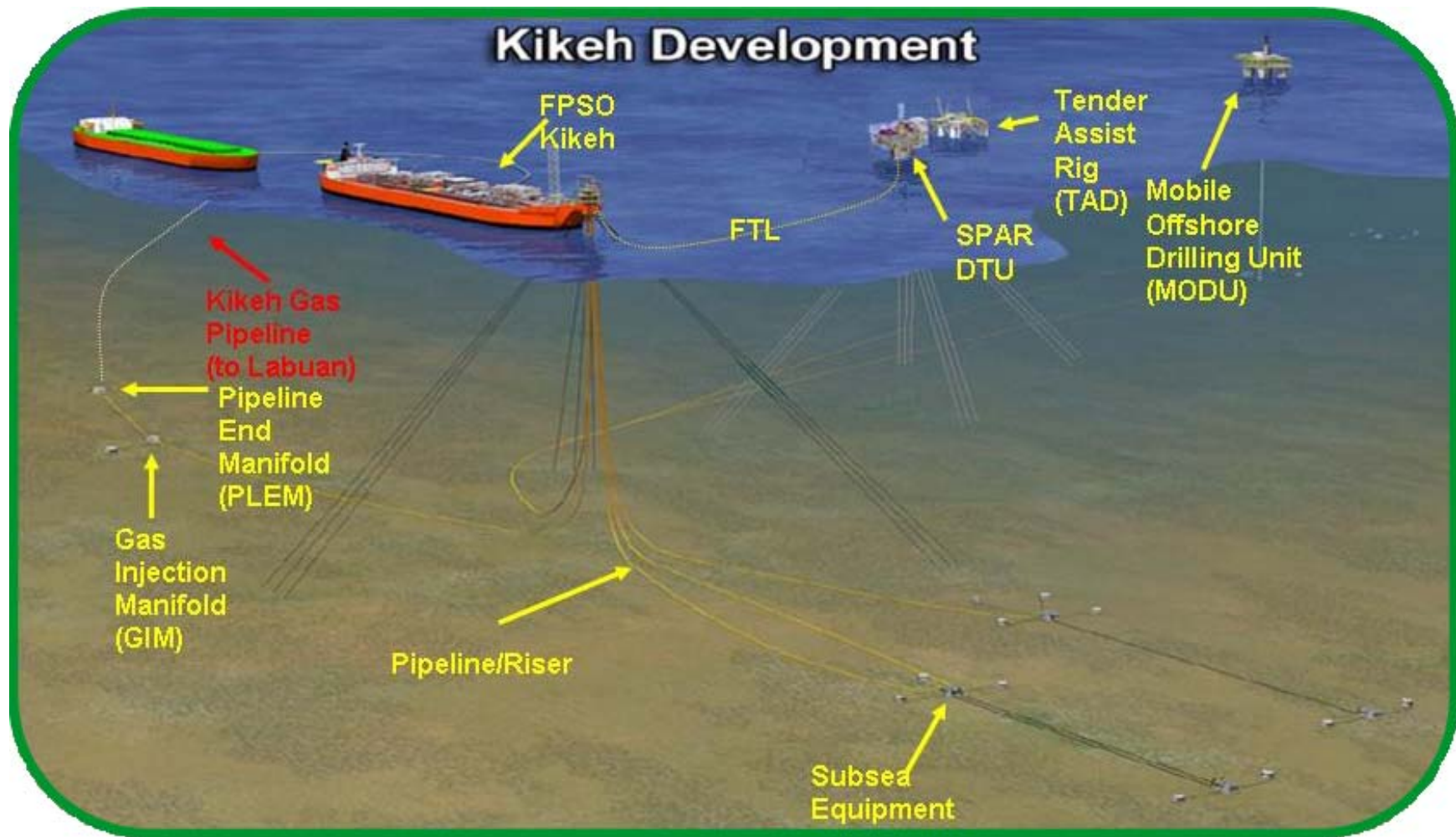
- Design flow 5.66 MMSCMD
- Design pressure 357 bar
- Always transient

Leak Detection and Location

Look Ahead & Scenario Analysis



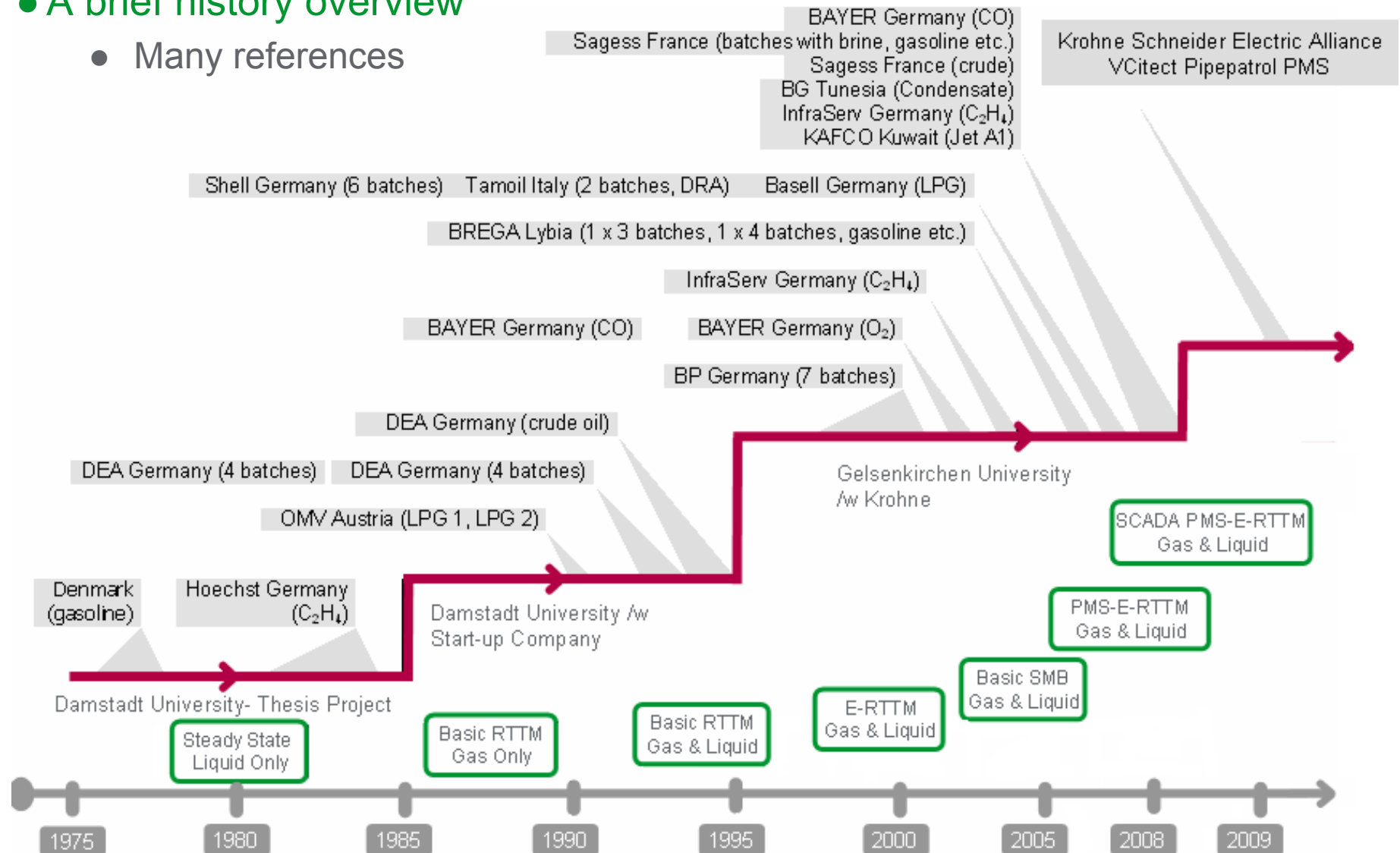
Murphy Oil Malaysia Typical Application



Citect PipePatrol PMS

- A brief history overview

- Many references



Ensure safe, reliable and efficient pipeline operations

A unique solution from the Schneider Electric and Krohne alliance



Concerns

How can I...

- ensure safe and reliable operations 24/7?
- manage my assets with a system that will minimise my opex?
- mitigate risks and alleviate my environmental concerns?
- be able to react immediately to leaks, accidents, and other external hazards?
- secure communications and power availability?



Solutions

- > Pipeline management system
- > Energy management
- > Custody transfer flow metering & pipeline instrumentation
- > Integral security
- > Leak detection, cathodic protection
- > Asset management

Benefits

- Improved pipeline management enhances overall performance and safety
- Energy and process management ensures maximum efficiency
- Improved security reduces operational risk and costs
- Real-time monitoring enables rapid response to leaks and accidents
- Heightened availability allows for safe, reliable operations



Q&A
Thank You !



Make the most of your energy

