ttc
power of solution

PipeMan



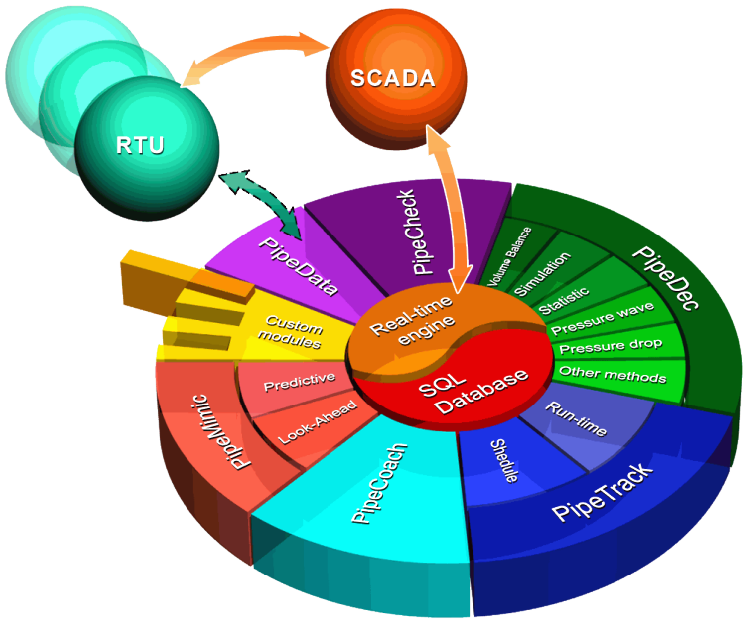
PipeMan
pipeline management system
System overview

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Tax Registration 314 281 85

PipeMan solution

PipeMan is a globally trusted pipeline application software, designed to ensure the safe, efficient, and cost-effective operation of liquid pipelines. Proven across the industry, PipeMan enhances operational reliability while seamlessly integrating with SCADA systems.



Comprehensive Pipeline Management

PipeMan offers a full suite of industry-standard online and offline modules, including:

- **Leak Detection & Location** – Rapid and accurate leak identification
- **Over/Under Pressure Protection** – Prevents system failures and hazards
- **Parcel/Batch Tracking** – Monitors and manages product movement
- **Pig Tracking** – Ensures efficient scraper operations
- **Custody Transfer** – Guarantees accurate measurement and documentation
- **Batch Scheduler** – Automates and optimizes batch planning
- **Offline Training Simulator** – Enhances operator skills with real-world scenarios
- **Offline Pipeline Simulator** – Enables hydraulic modeling and analysis
- **Historical Data Collection** – Provides valuable insights for long-term optimization
- **Content Management System** – Offers intuitive monitoring and control

Built for Flexibility and Seamless Integration
All PipeMan modules adhere to global industry standards and support a wide range of operating conditions with customizable parameters.

The latest PipeMan version is designed for maximum adaptability, allowing for the easy addition of custom-built modules. It also ensures seamless integration with any SCADA system, enabling smooth and efficient operations.

Redundancy is natively built-in into PipeMan servers. This allows to run the servers in single mode or as a redundant pair.

PipeMan Online Modules - Smart Integration with SCADA Systems

Optimize Your Operations with Real-Time Data Processing
PipeMan online modules (e.g., Batch Tracking, LDS) perform accurate calculations based on real-time data. The data source can be a SCADA system, an OPC server, or a direct connection to PLCs/RTUs.

Reliability and Safety First
The PipeMan platform supports full-duty/standby operation with automatic failover in case of hardware or network failure, ensuring uninterrupted performance.

Designed for SCADA Engineers
The latest PipeMan system has been developed with SCADA engineers in mind. Its configuration and tuning are designed to be as close as possible to SCADA systems, making integration smooth and intuitive.
SCADA systems regularly acquire data from RTUs/PLCs, while PipeMan processes this information via available data interfaces (native API, OPC, ODBC).

Key data for PipeMan Processing
Depending on deployed modules and methods following data are important for PipeMan:

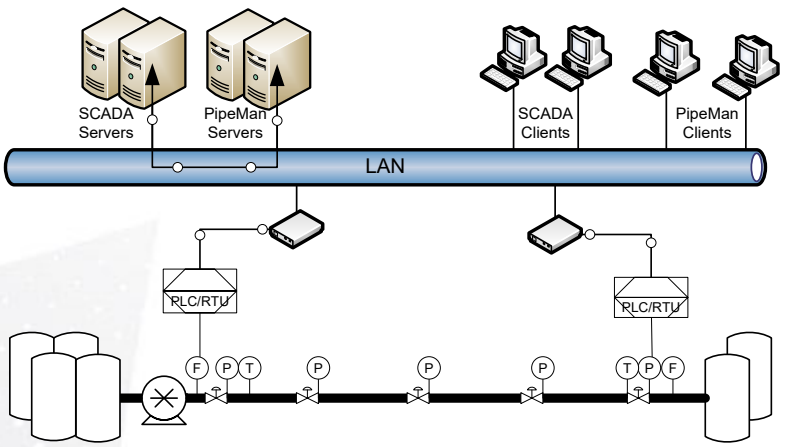
- Pressures
- Flow rates, volume totals
- Temperatures
- Densities
- Valve states (isolating or control valve position)
- Pump states (and pump rpm if available)
- Tank levels (if required)

Seamless Two-Way Integration with SCADA
PipeMan calculation results can be fed back into the SCADA system using the same interface. By default, only critical alarms and events are transferred to SCADA and processed according to standard SCADA workflows.

Modern Web-Based Interface
PipeMan offers a web-based user interface that is:

- Fully compatible with HTML5
- Easily integrated into SCADA mimics
- Accessible from any workstation
- Usable on mobile devices via a web browse

Compatible with Leading SCADA Systems
PipeMan is already prepared for seamless integration with SCADA solutions from top industry vendors and SCADA systems that support the OPC standard.



PipeMan online architecture with redundant servers

PipeDec - Leak detection and location module

PipeMan leak detection and location module called PipeDec was built with experiences acquired on many projects and from hundreds of testing leaks in the real world conditions. All these experiences make PipeMan not only more sensitive, accurate, but also very reliable and stable without losing a flexibility

The module relies on several leak detection techniques suitable for different conditions and using different instruments. The following methods can be plugged into PipeMan server:

- Pressure wave method
- Dynamic simulation method
- Volume balance method
- Pressure drop method

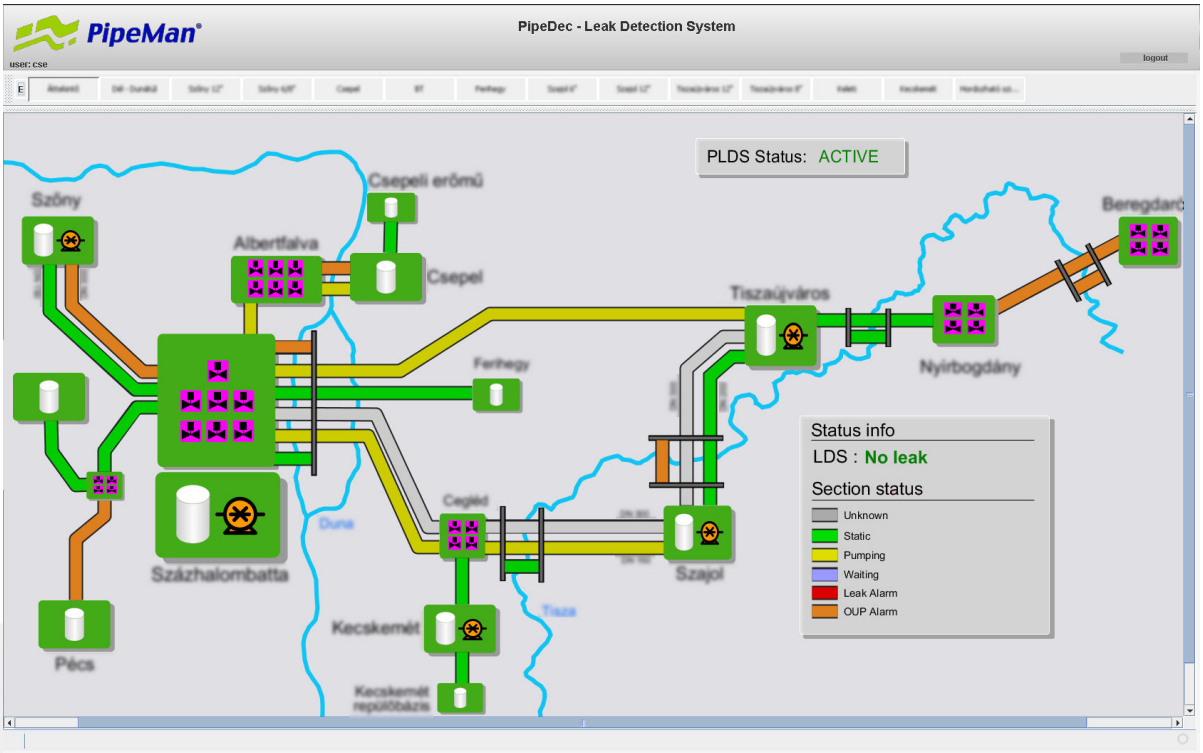


Example of PipeMan starting screen - PipeDesk

The system has its own UI running on the web or as a desktop application and it supports all main operating systems because it is Java based. If preferred, leak detection can easily be integrated with SCADA and use only its mimics.

Alarm, event viewer and various reports are included by default. If pipeline coordinates are available, PipeDec can display the leak location on the map.

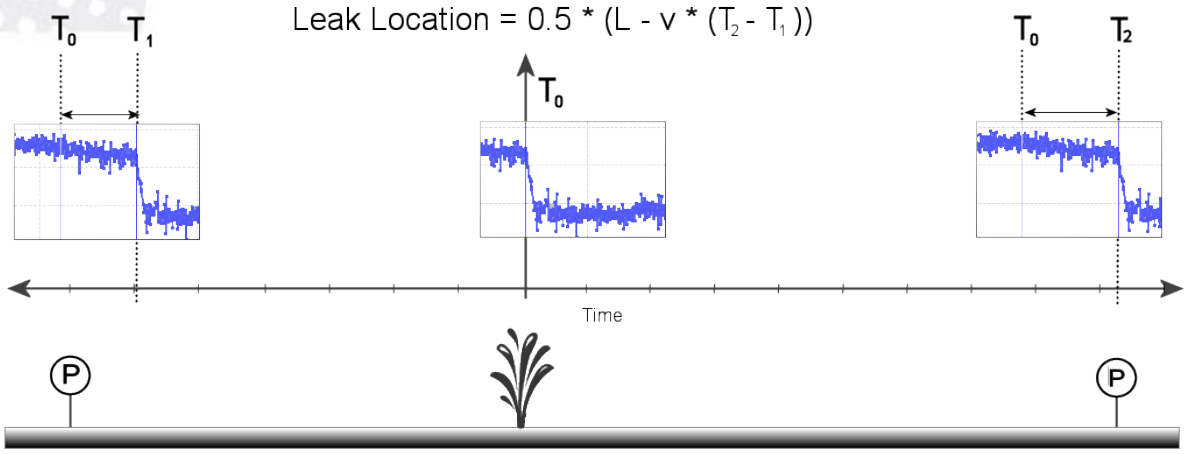
New method arbiter in PipeMan 5.0 collects results from all methods, analyses them and presents to the user processed data with statistical analysis of leak probability.



Example of UI - PipeDec overview mimic

Pressure wave detection (PWM)

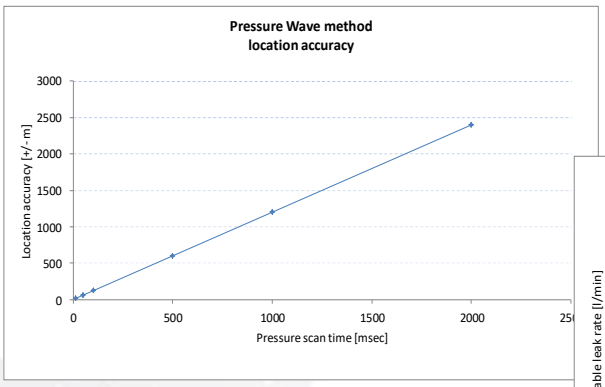
When the leak appears, the pressure wave propagates from its origin towards both ends of the pipeline branch. The application software detects this wave and analyses it.

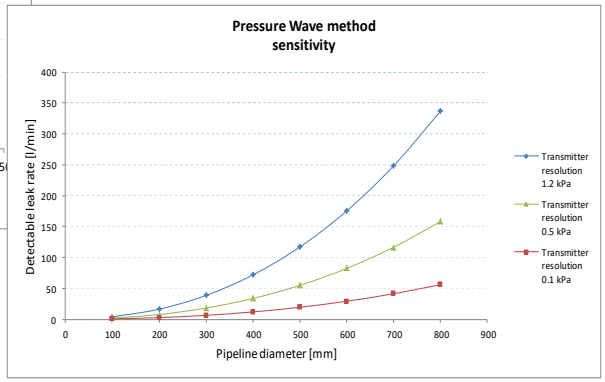


The method uses the principle of pressure wave propagation for leak detection. Rapid pressure changes are monitored on line pressure meters. Time differences in these pressure changes are evaluated and based on this information eventually an alarm is generated.

An alarm is generated in case, when the first pressure meter detects the rapid pressure change and this is confirmed by other pressure meters in the time interval that is specific for pressure wave propagation. Pressure meters to a predefined distance, typically 100 km from the pressure meter which initiated the algorithm, are taken into account for calculation.

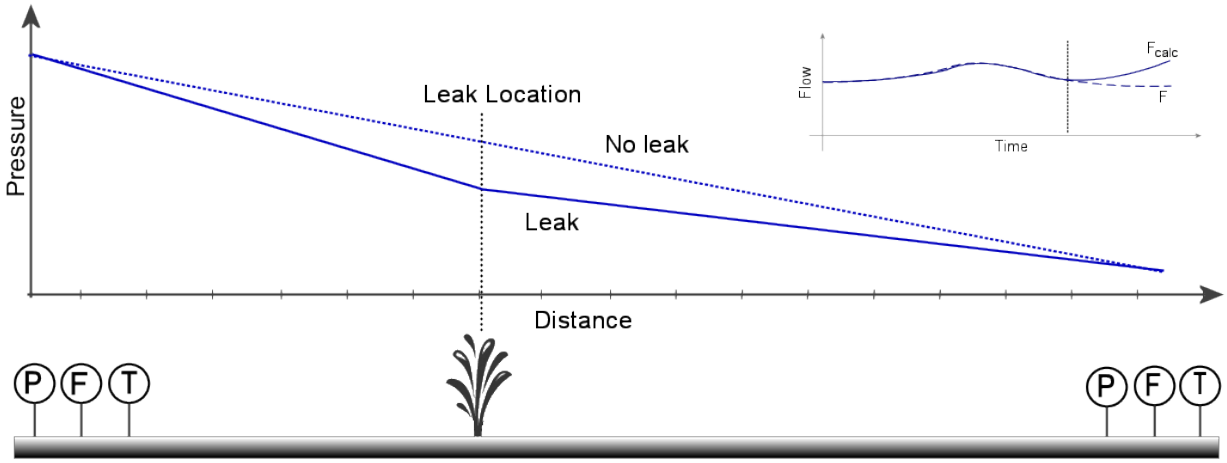
The evaluation of pressure trends on multiple transmitters allows distinguishing of the normal transients on pipeline from leaks. The time sequence of sudden pressure drops on multiple transmitters is evaluated, so that to unmask the pressure variations caused by changes in line valves position, or originated outside of supervised section (inside of the terminal or pump station).





Dynamic simulation of pipeline hydraulics (DSM)

This method is based on real-time model. The primary point of this model is to continuously produce a transient hydraulic estimate of the pipeline, including accurate roughness and thermal characteristics based on real time process data.



The module simulates the hydraulic system based on all known pipeline and liquid data, with boundary conditions supplied for real time. The mathematical model of a pipeline uses the numerical solution of differential equations, describing the liquid pipeline behaviour.

Information about the operation on the pipeline is essential to establish the correct design and functioning of the application software in both steady state and transient conditions.

Real-time model is used as the basis for this leak detection method. Comparison is made between modelled flow and pressure and real-time data. Discrepancies between calculated and measured values result in unexpected variations, which are then used for leak detection.

After longer research concentrated on data series analysis from the real leaks, PipeMan version 5.0 brought a new leak location algorithm which makes the method more accurate than ever.

Model-compensated volume balance

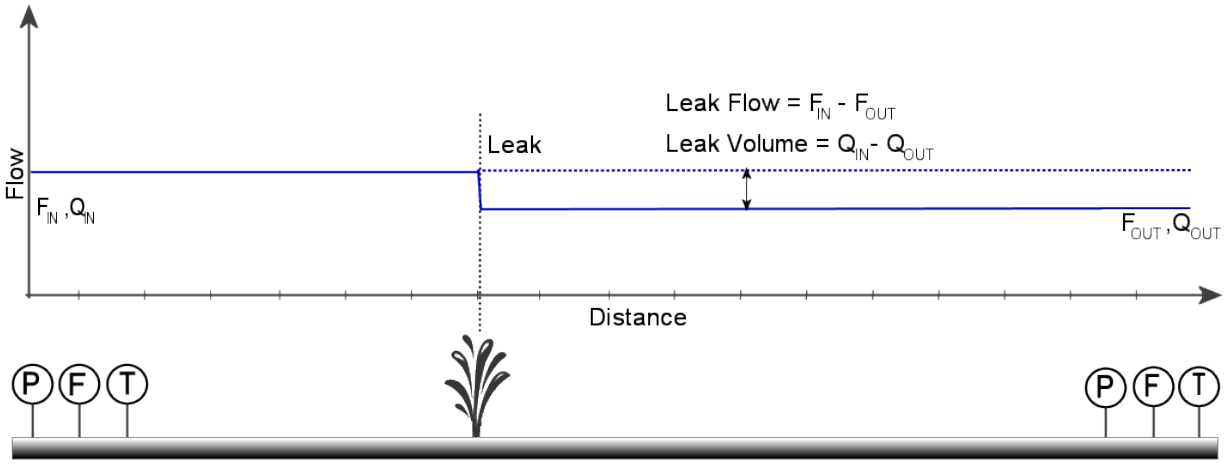
The model-compensated volume balance method calculates an inventory of volume in the pipeline through the accumulation of all inflows and outflows.

The method accounts for the inventory fluctuations with changing pressure and temperature. It is assumed that the temperature gradient between two measurement points will be linear.

The volume balance calculations run in three intervals

- Short term
- Medium term
- Long term

The evaluation logic is arranged in accordance with the user's needs, either to issue the alarms as soon as possible after exceeding the first limit, or waiting until confirmation of the leak, when the limit is exceeded on more intervals



Limits for each of the three intervals and each pipeline route are defined during the tuning period and may be changed by the end user's personnel. Those limits depend primarily on the accuracy of the measurement at inlets and outlets.

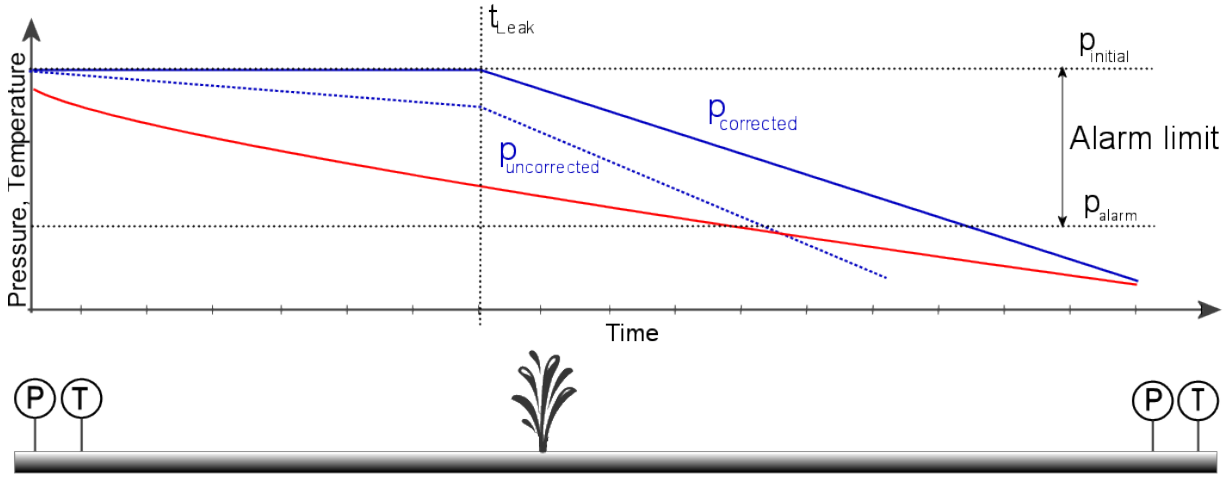
Volume balances are automatically adjusted to the measurement differences from the flow meters and the method handles moderate transients by auto adjusting detection limits to avoid false alarms. However, this behaviour can be changed on customer demand.

On the longer time frames Volume balance detects very small leaks, but it does not provide leak position.

Pressure drop detection

This method monitors all the pressure meters located on a isolated section. When the recalculated pressure values drop under a specified limit alarm is issued.

The alarm limits are configurable in either pressure (kPa) or flow/volume measures (litres, litres/hr, whichever applicable for particular limit. The cross-calculation between pressure change and corresponding flow/volume of leak is provided automatically by applying a particular pipeline and liquid properties.



By examining the pressure drop and gradients, the system evaluates if the changes likely to be caused by a leak or by natural physical processes (e.g. temperature change). The algorithm consists of following calculations:

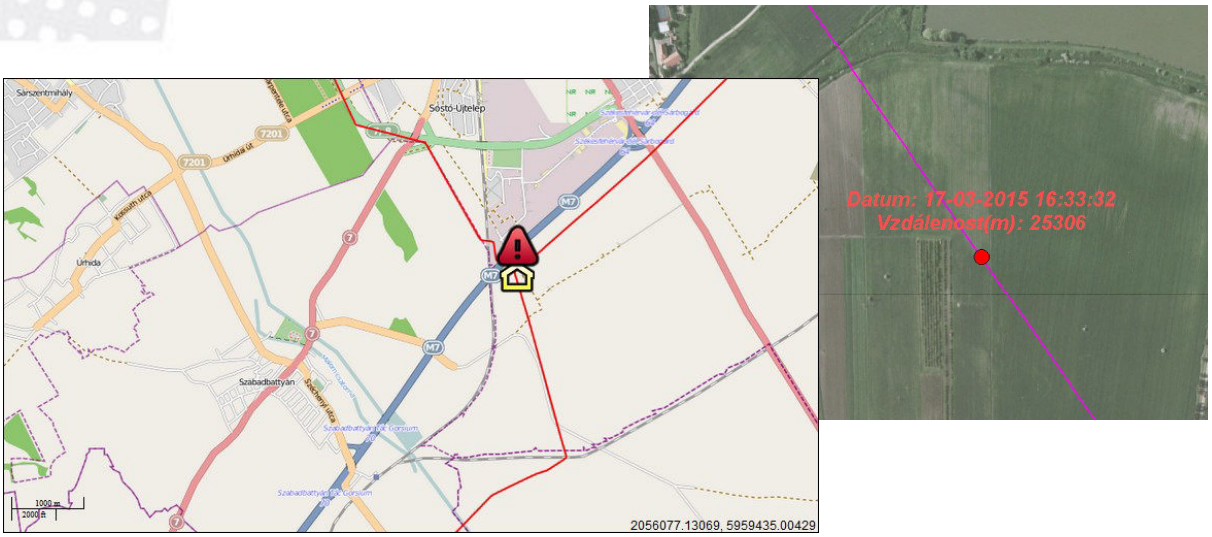
- *Uncorrected absolute differential*: After start-up of the method (expiration of settling period), the uncorrected (natural) pressures on each sensor is stored. Each new pressure value is then compared with the stored one. An alarm is issued if the pressure drops to a lower value than the stored one, minus the threshold.
- *Corrected absolute differential*: The same algorithm is used as above but with corrected pressures. The pressure is corrected to standard temperature in accord with relevant API calculations. The linear temperature fall between both ends of the section is expected.
- *Corrected gradient*: After start-up of the method on a given section and expiration of the settling delay, the method calculates pressure / time gradient and compares this value to a limit value. If the drop is higher, an alarm is issued.
- *Dynamic gradient*: Pressure/time gradient on 2 separate time frames: current and historical is calculated. The gradients of these 2 intervals are compared to a limit value. If the pressure gradient difference exceeds the limit, an alarm is issued.

Comparison of LDS methods

Method	Advantages	Limitations
Pressure wave detection method The calculation of the leak position is based on the time of detection the pressure wave generated by the leak.	Very accurate leak location Very high sensitivity Very fast response	Requires accurate time stamped pressure data scanned with higher frequency Preferable spacing of pressure points is 20 km. Recommend longest section without an intermediate pressure point 100 km
Dynamic simulation of hydraulic system Numerical method for simulation of the hydraulic behaviour of pipeline in real time.	Sensitivity is not compromised under transient conditions	Demanding on the amount of information needed for the method configuration
Volume balance method Volume balance is processed for separate sections of pipeline. Balance is calculated from the total of all inlets and outlets and it can be compensated for pressure and temperature.	Provides high reliability and reasonable sensitivity in spite of its simplicity.	Does not provide the leak location
Pressure drop leak detection Used for shut-in leak detection. The method detects pressure drops in any isolated section or the whole pipeline system when pumping has stopped. System evaluates if the pressure changes were likely to be caused by a leak or by natural physical processes (e.g. temperature change).	Several evaluation algorithms ensure high sensitivity for continuous leaks in static conditions.	Does not provide the leak location

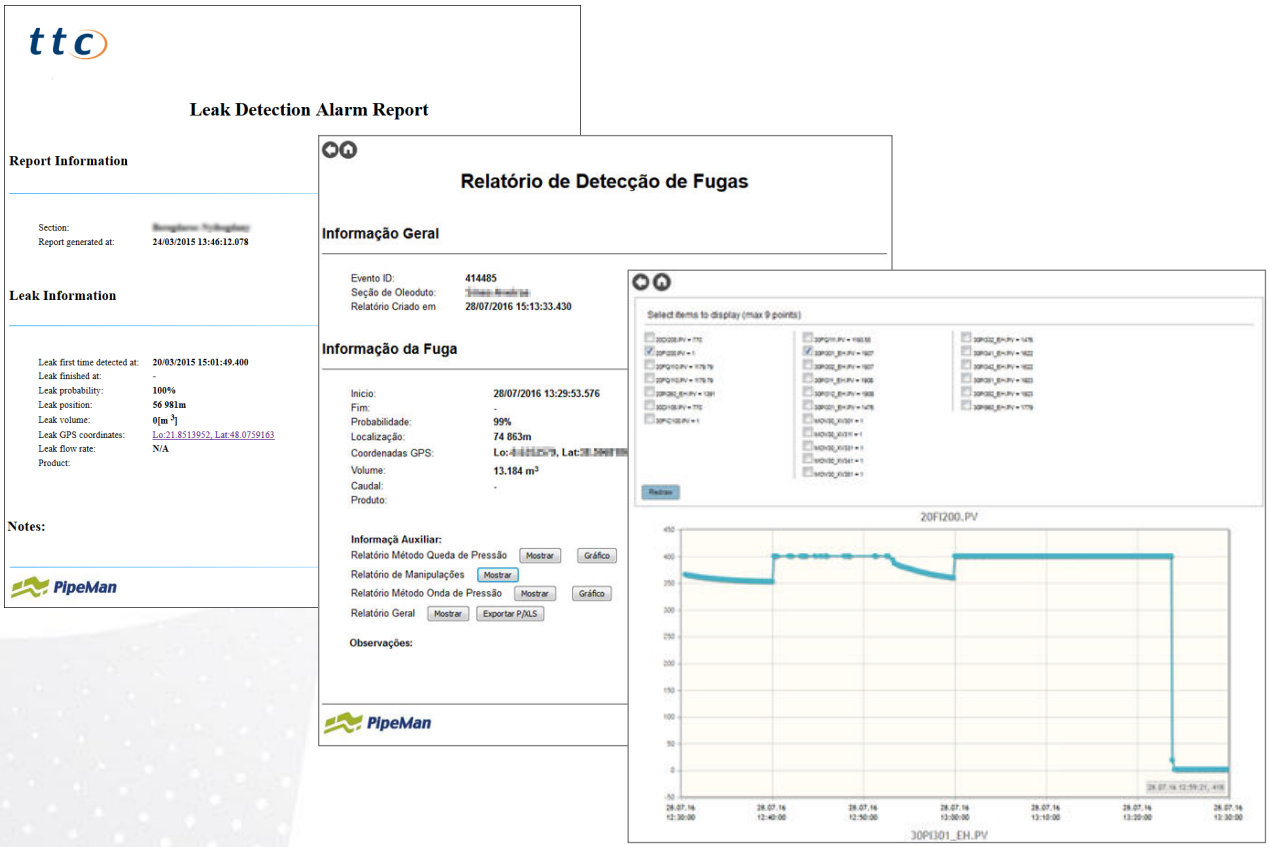
PipeMan LDS method arbiter

Method arbiter collects information from all running LDS methods and evaluates their results. By comparing the results from various methods it calculates the probability of the leak and its location. Arbiter also provides geographical information necessary for coupling with maps system (e.g. google maps) or GIS.



Example of LDS integration with various maps

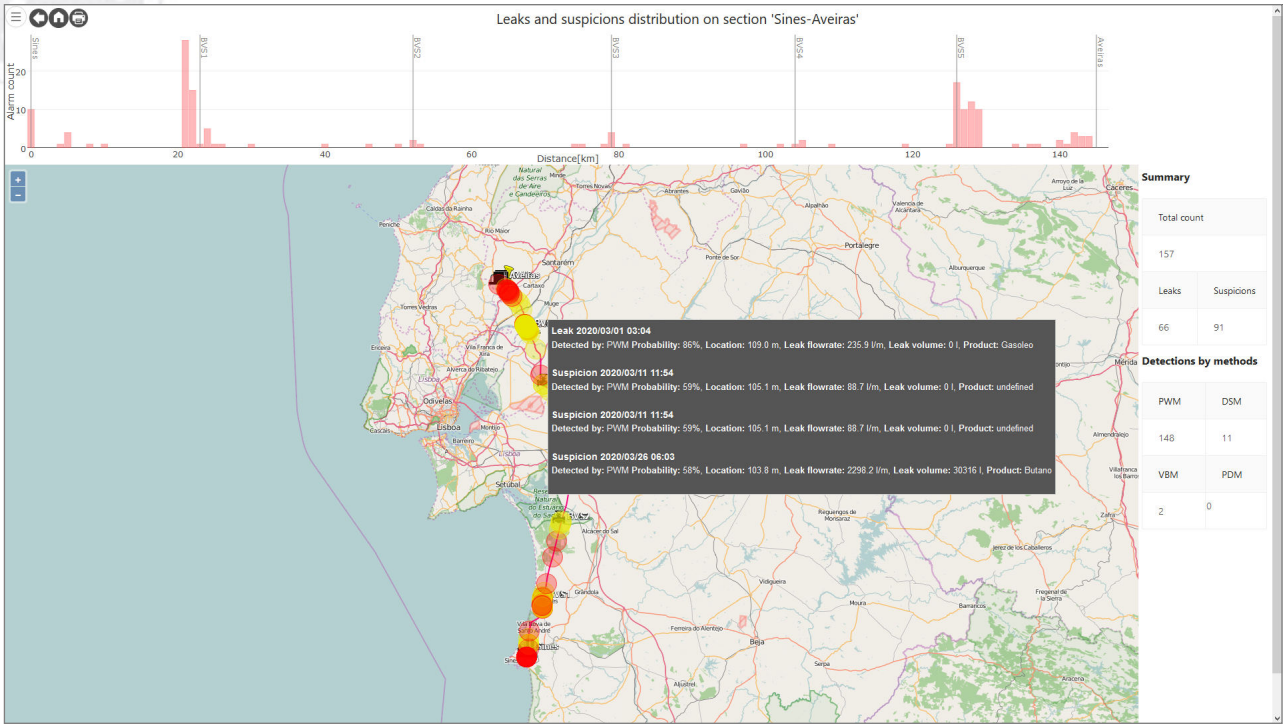
The summary report produced by the arbiter contains all available information related to the leak: leak probability, location (including GPS coordinates), flow rate, volume and product. Additionally it provides data snapshot and technology manipulation report from the time of the leak which simplifies the evaluation of the LDS event.



LDS Report examples

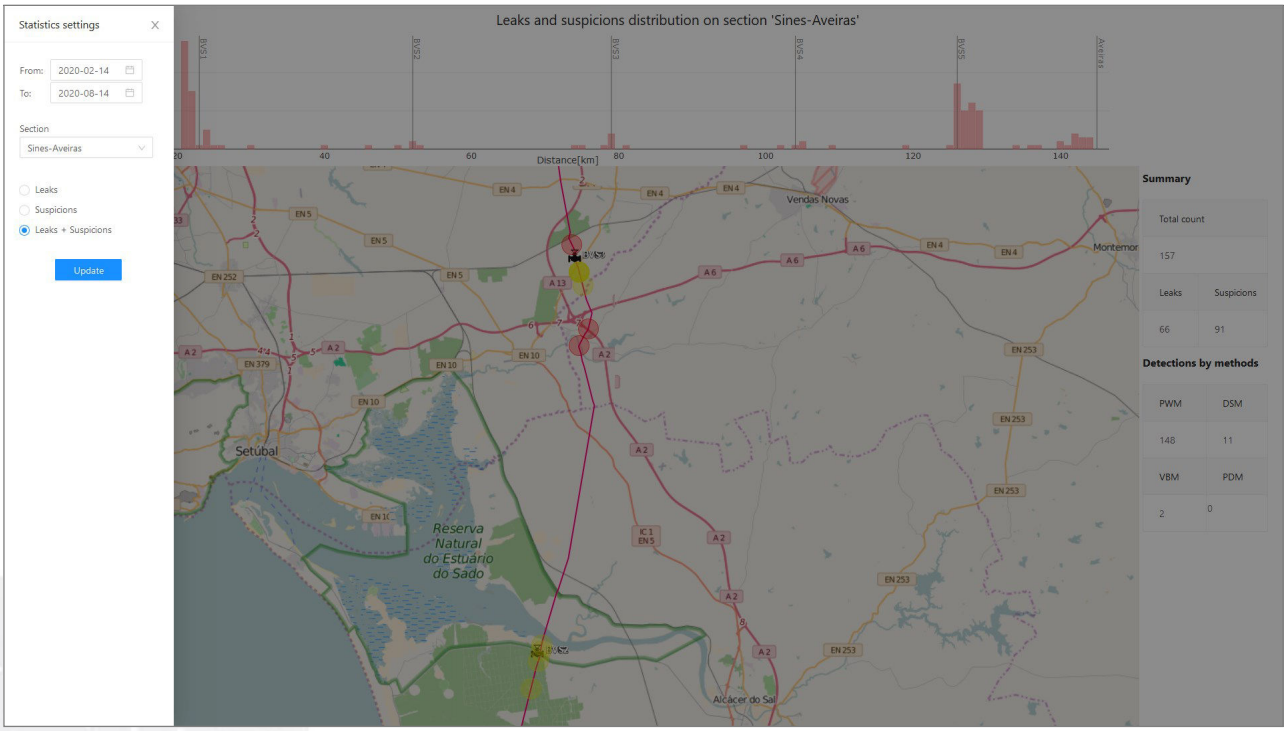
PipeMan Leak statistics module

PipeMan collects leak related data, including detected leaks and leak suspicions in its database. Leak statistics module allows analysis of leak distribution and its visualization on the map.



Example of PipeMan leak statistics module

The settings of the leak statistics can be adjusted including an interval of analysis, pipeline section and type of the leak.



Settings of PipeMan leak statistics module

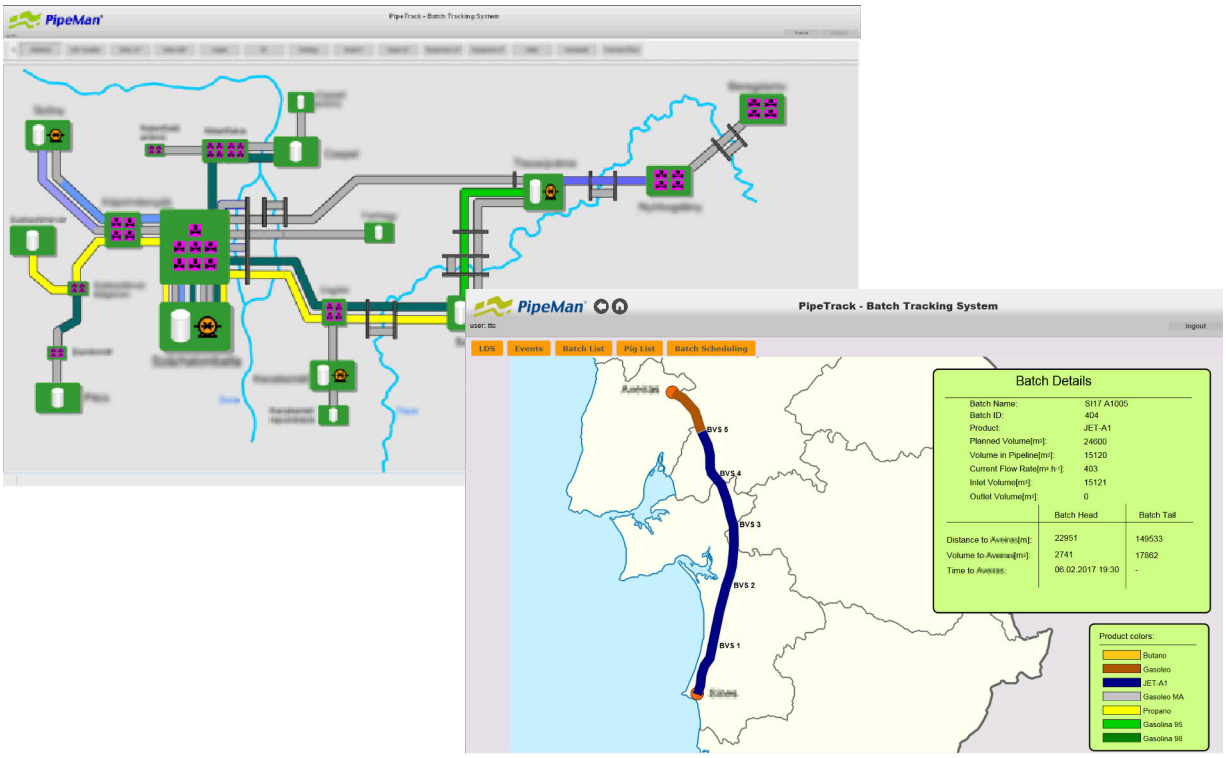
Batch tracking module – PipeTrack

The PipeTrack module is part of the PipeMan package. It calculates the movement and position of individual batches based on monitored technological data from the pipeline network (flow rates, opening/closing of valves) and on data from a transaction table.

The transaction table contains scheduled quantities of pipeline products required for transportation by the multi-product pipeline over a certain period. After completion of the transaction, the actual quantity supplied and actual time of completion is recorded.

PipeTrack module provides the operator with estimated time of arrival (ETA) of the head of the batch/parcel to a pump station/terminal. This information is displayed on the user interface and the related events and alarms are transferred to SCADA.

The PipeTrack can track multiple batches in multiple pipeline sections simultaneously. The batch movement is calculated automatically according to actual pumping routes .



The system can be configured to launch the parcel/batch:

- *Automatically* on any digital or analogue signal (or its combination)
- *Manually* by an operator/supervisor from the user interface

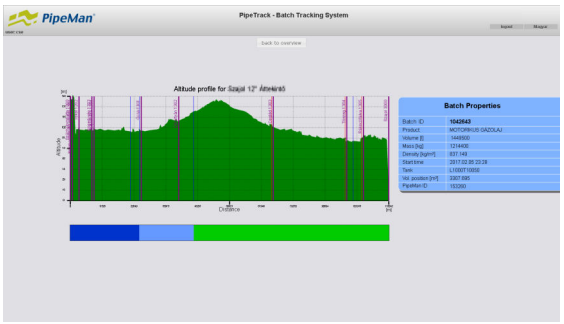
The position of running parcel/batch is then recalculated using actual flow rates (measured by flow-meters along the pumping route).

When a batch arrives to an outlet station, the meter ticket report is generated automatically, listing the batch name, product, start time and actual time of arrival and other information.

Position, motion and volume of batches will be corrected with regard to correction factor for each flow meter.

The PipeTrack module includes also interface detection. This module tracks the interface between different types of products of different density and calculates the volume of the interface. Different mechanisms of interface handling can be configured in the system.

The PipeTrack graphical output displays position of batch interfaces, pigs (scrapers) and batch data on the operator screen. Estimated arrival time to the egress points (terminals) determined in advance, is indicated for each batch.



PipeTrack allows batch/parcel manipulation:

- position movement (of interface or whole batch)
- split
- merge
- remove

Automatic position adjustment is by default included in the module. Position can be adjusted by density-meter or colorimeter.

Batch tracking module provides following main outputs:

Reports

- Meter tickets
- Batch tracking report

Alarms:

- Preliminary alarm (batch about arrive)
- Batch launched alarm, along with product id code
- Batch received alarm, along with product id code

Summary reports:

- Weekly / monthly pumping summary

Scraper/pig tracking module

The scraper/pig tracking is a part of PipeTrack and it can be used also separately. This module monitors the position of the pigs (scrapers) in the pipeline and computes estimated arrival time (ETA) of each pig to the pig chamber.

Scraper position can be adjusted automatically by scraper signallers along the pumping route. Additionally individual slide factor for each scraper type can be set.

Scraper/pig tracking module provides following outputs:

Alarms

- Preliminary alarm (scraper reaching end of route)
- Scraper launched alarm, along with pig id code
- Scraper received alarm, along with pig id code

Reports:

- Scraper arrival report

Custody Transfer Module

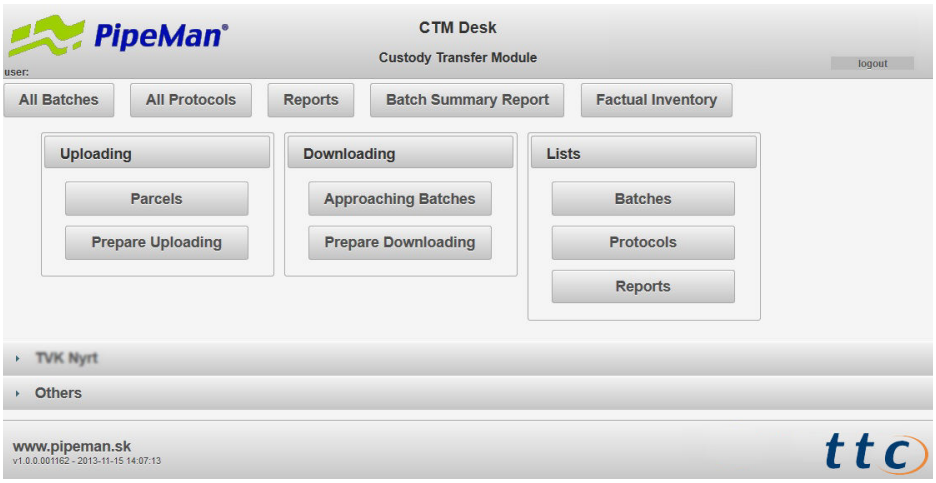
Custody transfer module extends PipeMan package and offers functions to support whole process from scheduling through monitoring of pumping process to an analysis of pumping history:

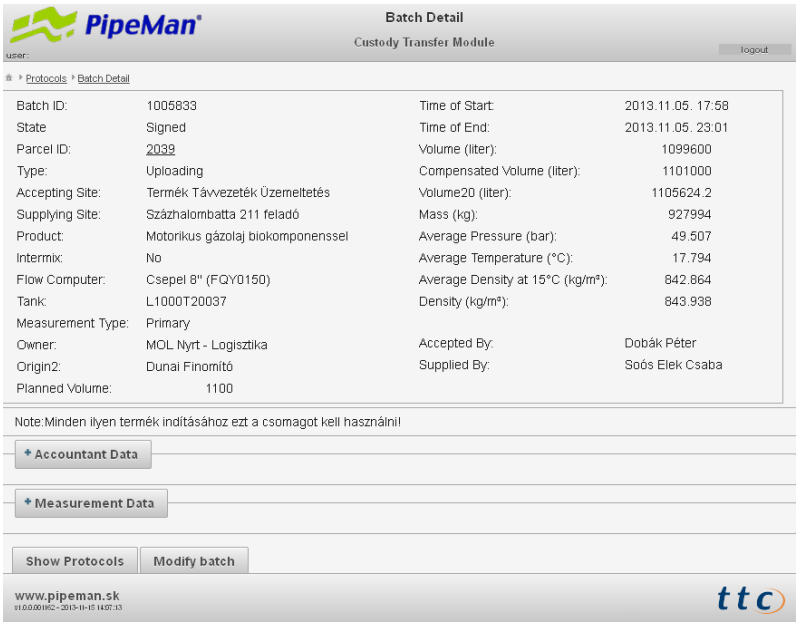
- Advanced batch scheduling
- Batch ticketing
- Pumping history analysis
- Pipeline Inventory
- Flow metering functions
- Reporting

The module provides a wide range of functionality out of the box but it is also expected to be customised to meet the customer's specific needs.

The custody transfer module can cooperate with third party systems the customer currently uses.

The module provides integrated web based user interface for each group of users such as operators, dispatchers, accountants or managers. Each group has its own duties in the pipeline logistics and the module also provides a dedicated user interface to each of them.





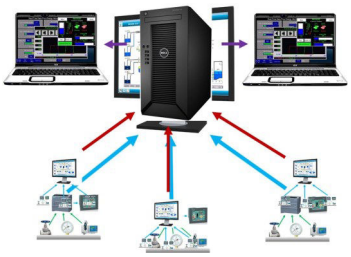
PipeMan Historian

Comprehensive, cost-effective solution for historical data collection, their processing, long term archiving and presentation

PipeMan Historian

PipeMan Historian is a powerful software solution designed for collecting, processing, archiving, and presenting technological process data. It is an integral part of the PipeMan product suite, which provides a comprehensive software solution for the efficient management of pipeline networks.
PipeMan Historian is the ideal solution for businesses seeking a reliable, scalable, and cost-effective way to manage and analyze technological process data. With its robust data collection, intuitive interface, and seamless integration with reporting tools, it provides an indispensable resource for operational efficiency and decision-making.

Comprehensive Data Collection



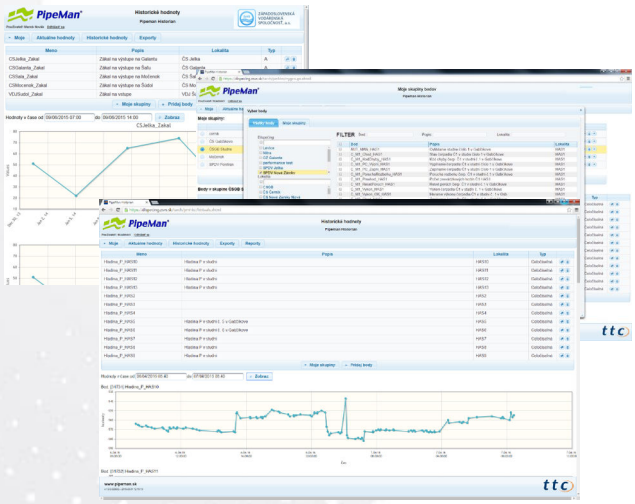
PipeMan Historian features a robust and scalable data collection mechanism, making it suitable for a wide range of applications—from simple local implementations to complex, large-scale systems with distributed data sources and repositories.
Its modular architecture integrates distributed data loggers that support various data sources, including OPC, DDE, and ODBC. These loggers ensure seamless data collection and storage in a unified database.
Even in the event of a network failure, PipeMan Historian prevents data loss. Once the connection is restored, the system automatically synchronizes collected data with the central database. This reliability can be further enhanced by utilizing a distributed database system.

Cost-effective and Scalable Solution

Unlike traditional data historians that impose licensing limitations based on data points or sources, PipeMan Historian offers unlimited data collection and user access. Its client-server architecture supports web-based clients, allowing for rapid deployment across the customer's network while maintaining centralized access management.

User-Friendly and Open Interface

The intuitive user interface can be customized to meet specific customer requirements. PipeMan Historian naturally supports data export to commonly used formats, including SQL, CSV, and XLS.

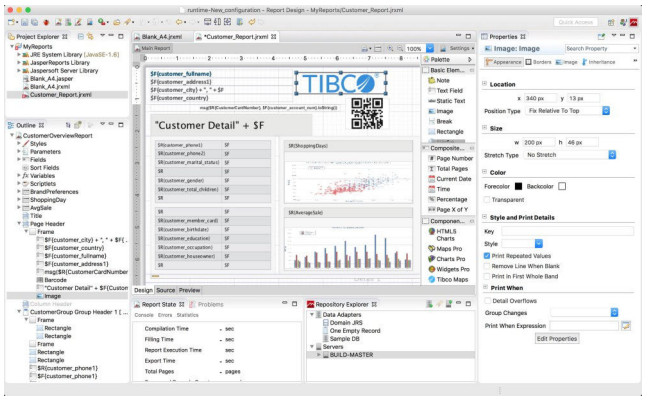


Reliable Data Backup

To ensure business continuity, PipeMan Historian includes an automated backup module that securely stores configuration and historical data on external storage. In case of a software or hardware failure, the system can be fully restored from backup.

Advanced Reporting and Data Export

PipeMan Historian seamlessly integrates with JasperReports, the world's most widely used open-source reporting system. This Java-based tool enables users to generate pixel-perfect reports using



data from any source. Reports can be viewed, printed, or exported in multiple formats, including HTML, PDF, Microsoft Office (Excel, Word), and OpenOffice.
For customized reporting, iReport Designer for Eclipse allows users to develop and modify reports quickly, streamlining the reporting process.

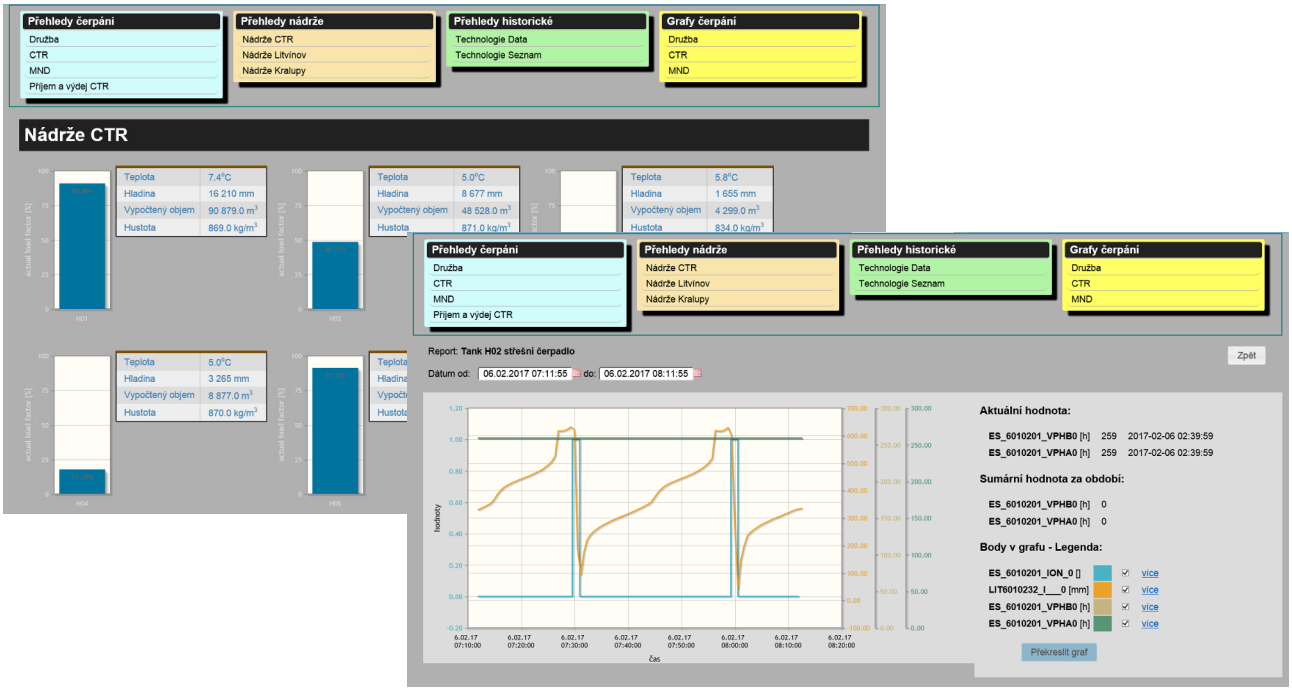
Key Features

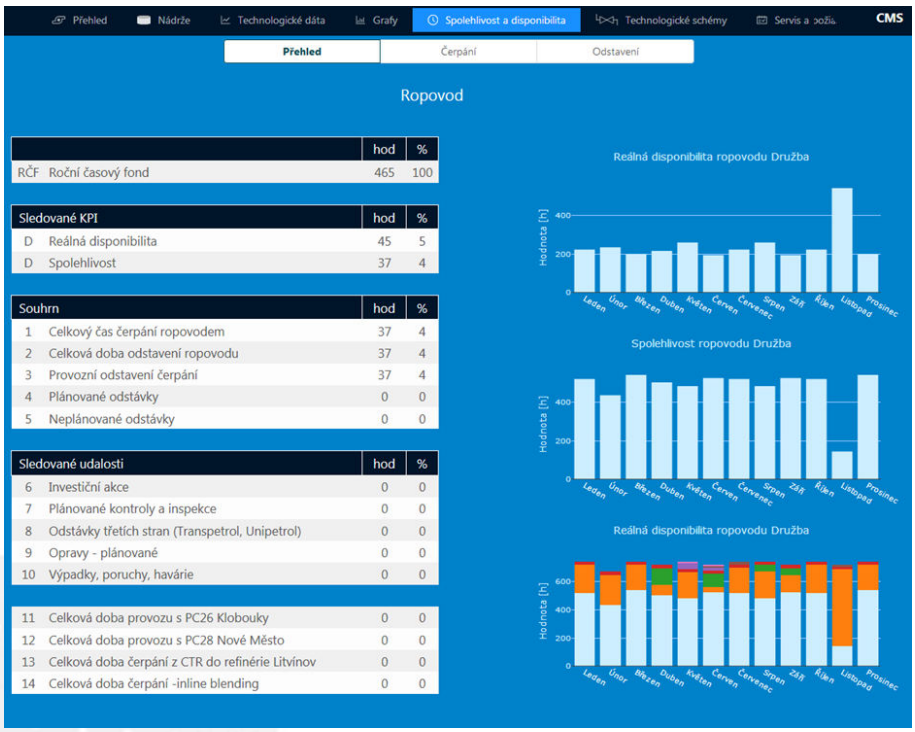
- Long-term storage of operational data in a scalable, distributed NoSQL database (Apache Cassandra) or a traditional SQL database (PostgreSQL, MS SQL, etc.)
- Flexible deployment options, from standalone installations to enterprise-grade solutions with distributed data sources and repositories
- Resilient data collection mechanism (OPC, DDE, ODBC, etc.) ensuring zero data loss during communication failures
- Instant access to critical process data, enabling rapid response to operational issues
- Centralized access management, providing a unified approach to historical data for better technological process analysis
- Customizable dashboards and reports for efficient data visualization and decision-making
- Web-based access for easy data retrieval from any location
- Granular user access control, ensuring secure and compliant data usage
- Advanced search functionality, allowing users to filter data by name, description, type, area, and more
- Customizable point groups, enabling tailored data views
- Live and historical data visualization for real-time monitoring and analysis
- Unlimited licensing, with no restrictions on the number of users or data points
- Scalable functionality, allowing future expansion based on specific customer needs

Content Management System

Content Management System (CMS) is web based application that allows the user to monitor and analyse operating status of the technology without the need of direct usage of SCADA system.

CMS can provide various views on the pipeline network operation including pumping status, tank farm status, etc. In connection with the Historian can provide advanced historical data analysis as well as future prognosis.





		hod	%
RČF	Roční časový fond	465	100

Sledované KPI		hod	%
D	Reálná disponibilita	45	5
D	Spolehlivost	37	4

Souhrn		hod	%
1	Celkový čas čerpání ropovodem	37	4
2	Celková doba odstavení ropovodu	37	4
3	Provozní odstavení čerpání	37	4
4	Plánované odstávky	0	0
5	Neplánované odstávky	0	0

Sledované udalosti		hod	%
6	Investiční akce	0	0
7	Plánované kontroly a inspekce	0	0
8	Odstávky třetích stran (Transpetrol, Unipetrol)	0	0
9	Opravy - plánované	0	0
10	Výpadky, poruchy, havárie	0	0
11	Celková doba provozu s PC26 Klobouky	0	0
12	Celková doba provozu s PC28 Nové Město	0	0
13	Celková doba čerpání z CTR do refinérie Litvínov	0	0
14	Celková doba čerpání -inline blending	0	0

Training simulator

The training simulator is the application that facilitates the operator's training of actions in both standard and exceptional situations, like an unexpected pump trip or leak.

Training simulator is used for training of pipeline operators on the system that behaves as real pipeline operation and has the same SCADA user interface as a live system. This is done by using a copy of SCADA system operated by a customer and simulator of technology and pipeline hydraulic behaviour.

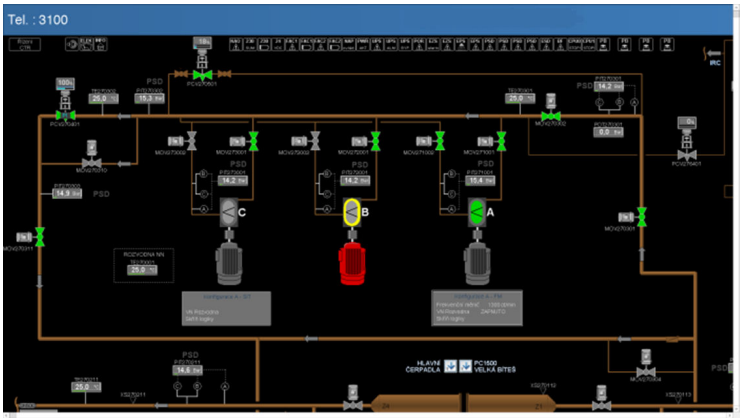
The system has two defined levels – trainer and trainee access. The trainer is able to run scenarios and make changes to examine the behaviour of the trainee.

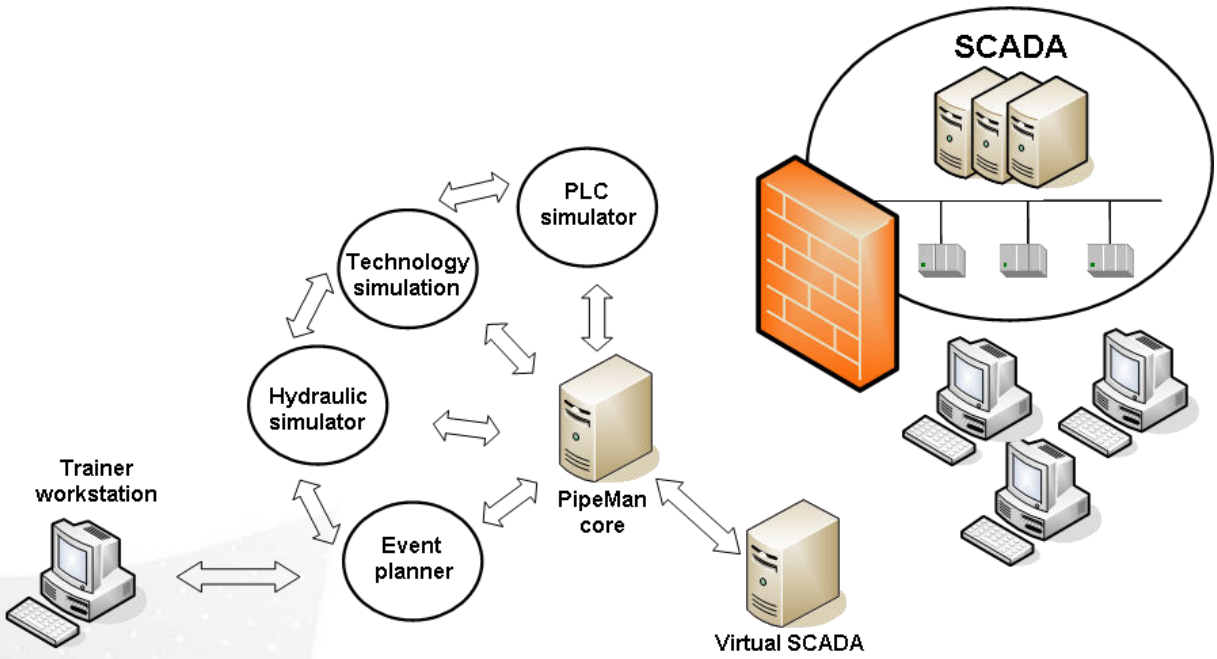
The training simulator consists of three principal components:

- SCADA package with all its features, running offline from the real-time system
- Technology and PLC/RTU logic simulator
- Hydraulic model and simulator – Training Simulator Package, which models the scenario and responds to operator's actions in terms of variations in pressure and flow in the pipeline system

The Pipeline Simulator simulates but is not limited to elements like:

- Single pipeline branch
- Pipeline junction
- Pump (Booster and Main Line Pumps)
- Valve, regulation valve



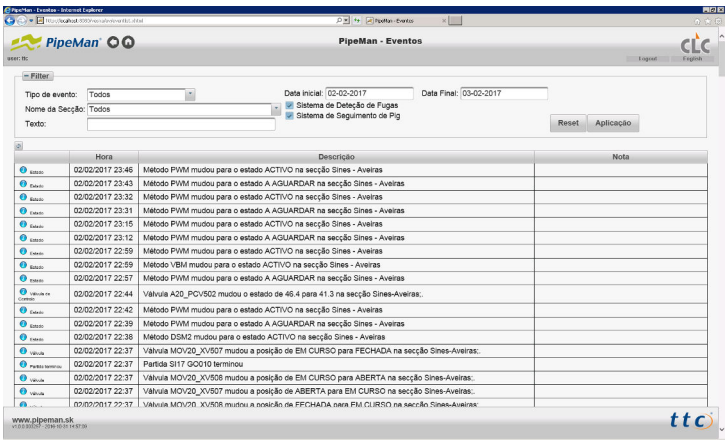


Architecture of Training Simulator

Events and alarms

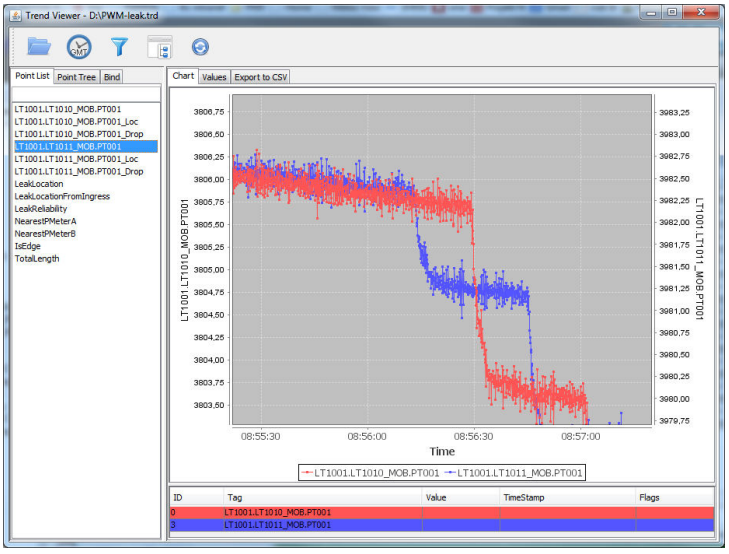
PipeMan package uses alarms and events log similar to SCADA systems. All PipeMan online modules can use it to log important messages for the user. Additionally the report with all related information for selected alarms can be generated and attached to the event.

User interface provides view with wide sorting and filtering functions.



Trend archiving functionality

Beside the Historian, PipeMan package provides out of the box basic historization functionality. Any data point (input or internal) can be stored in trend files on the server. The trend files can be later automatically compressed to reduce the storage requirements.

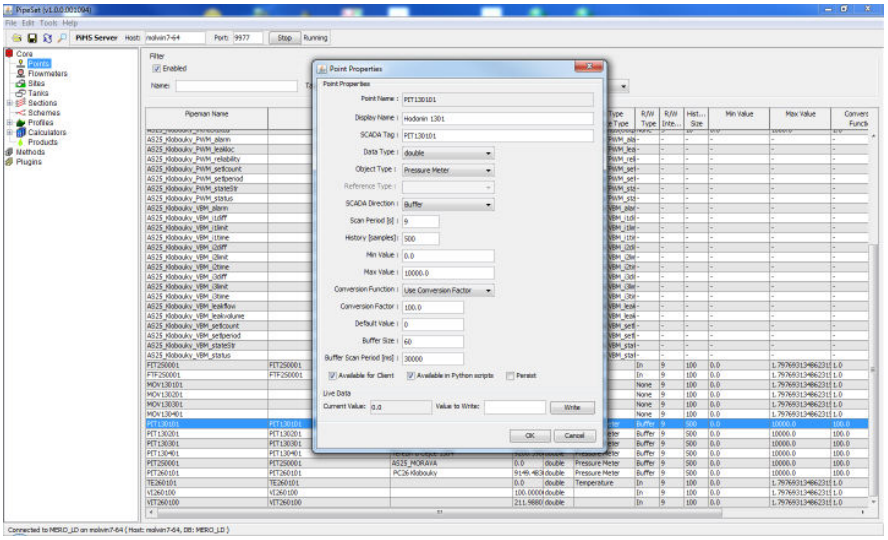


Archived data can be viewed and analysed using trend viewer tool. The export to CSV file format is available as well.

Moreover the trend files can be replayed with offline system to analyse behaviour of the system in various scenarios or can be used to debug eventual issues.

Configuration tool – PipeSet

The PipeSet is the pipeline configuration utility, which allows the configuration of the system including points, sections, methods and calculators as well as custom scripts.



The configuration is fully graphical and the most common options are preset to simplify and speed up configuration process. Its point oriented philosophy provide a good starting point for user skilled in SCADA configuration (SCADA engineers).

The application can be extended with additional plug-ins for new calculators, new methods or other tools. PipeSet allows also to change parameters for the already configured system. The helpful feature is also a facility for monitoring live data values .

Configuration data are stored in the configuration database and it is shared with other PipeMan modules.

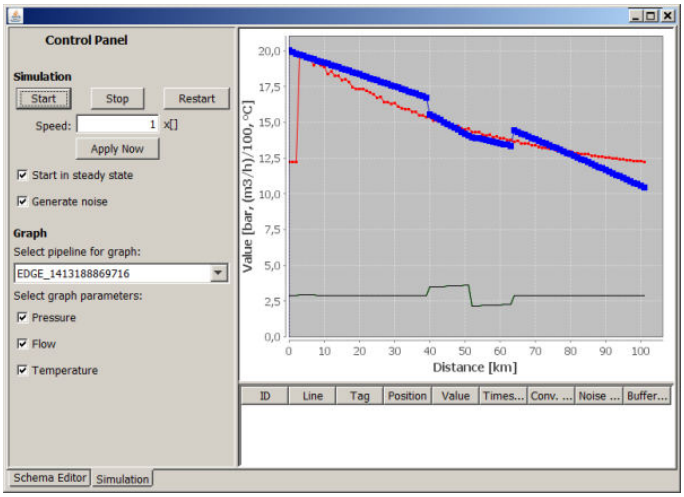
PipeSet includes also diagnostic functions to tune the parameters of methods and calculators, e.g. the point viewer or script tuning functions.

PipeSet can be run as a standalone application or as a web application.

The Python scripting engine is a standard part of PipeMan server. The PipeSet configuration tool comes with editor for creation of python scripts and for their tuning. The editor provides syntax highlighter and syntax checker

Pipeline simulator

Pipeline simulator application allows to configure complete pipeline network with pumps, valves and tanks for hydraulic simulation. It allows to simulate various operational scenarios in real time to observe the transient states in the pipeline or use the accelerated time function to verify the steady state operation.



The simulated data can be observed on line, can be written to OPC server or logged to a trend file for further analysis.

In connection with OPC server the simulator is a powerful testing tool for the PipeMan platform. It can be used to simulate various technology operational states, including product leaks to test the configuration in the early stage of project implementation (FAT) prior the commissioning.

Selected support functions, modules and tools

- *PipeCheck* module checks availability of instrumentation and validates the instrument data used by other PipeMan modules.
- *Over/Under pressure method* monitors the pipeline for pressures outside the allowed operational range taking in account elevation profile and current products contained in the pipeline. It alarms the excess of maximum allowed pressure as well as possibility of "slack line" conditions.
- *Pipeline efficiency* function can provide information about the efficiency of transportation by analysing of pipeline friction losses
- *Pig stuck detection* application works in online or offline mode. It detects stuck pig/scraper and located its position using the data from pressure transmitters
- *Redundancy and data replication* option makes from PipeMan server a robust solution
- *Client server architecture,* web based or stand alone UI and multiple user levels with customizable accesses. Operator and supervisor roles are by default configured in PipeMan
- *Possibility of total integration with SCADA* including the use of SCADA UI
- *Comprehensive, configurable log system* for troubleshooting