Asel-Tech
Leak Detection Solutions

ILBDS – INTELLIGENT LINE BREAK DETECTION SYSTEM

INTRODUCTION

Based on its large experience on pipeline leak detection and the same solid and reliable platform of the SLDS technology, Asel-tech now offers the ILBDS – Intelligent Line Break Detection System for natural gas pipelines. The ILBDS continuously monitors the pipeline behavior allowing instant identification of any problem or failure providing correct line shutdown to avoid disasters. New features based on modern algorithms as artificial intelligence are included to prevent false shutdowns and operational problems as well.

This **Asel-Tech** solution takes line break detection to the next level offering features not available in any other equipment on the market.

THEORY OF OPERATION

The ILBDS allows fast and accurate identification of sudden pressure changes in the pipeline that can be used to identify events such as leaks, changes in consume, etc.

The ILBDS is based on the detection of the pressure transient created when a sudden change in pressure takes place. The pressure transients propagate as subsonic waves throughout the pipeline, in both ways. The pipeline walls work as a guide for the pressure waves allowing them to travel very long distances until reach the sonic sensors installed in the line.

The ILBDS analyses frequencies components in the very low part of the spectrum. Such low frequencies can propagate over long distances due to their lower attenuation. The subsonic waves can propagate several kilometers in the fluid, at sound speed, before losing its energy.

The propagation speed depends on fluid characteristics, such as density, viscosity and other factors.

When the sound wave reaches the sonic sensors, the information is transmitted to the ILBDS electronics, which is responsible for processing and identifying in real time the incoming events. The SRU employs several techniques for signal processing and recognition, including Artificial Neural Network.

If a line break condition is identified the close valve command is sent through a dedicated digital output. The system has digital inputs used for valve operation feedback and correspondent logging.

DISTRIBUTED ARCHITECTURE

In the distributed architecture, all the standalone features are maintained adding resources for real-time data communication to the Central Monitoring Station through network. Data from all monitored points are then available in the control room making possible to identify the event origin and the option of blocking additional points.

Provided the ILBDS is in communication with the Control room, it is also possible to perform remote command to the SDVs.

In the Figure 1 it is shown the typical ILBDS arrangement with an example for monitoring important consume lines.

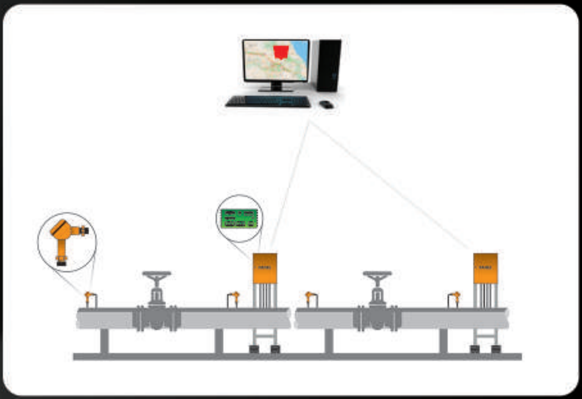

***Figure 1** - ILBDS distribution architecture*

BRIEF DESCRIPTION

The ILBDS can detect and identify events in seconds avoiding erroneous actions and mistakes that can reate unexpected situations such as pipeline shutdown based on partial or poor information.

The technology from Asel-Tech combines Artificial Intelligence and Neural Networks, in addition to acoustic system, offering a unique system for pipelines break detection and protection. The spurious noise filtering techniques gathered along years yields to the ILBDS an incomparable performance and operational reliability.

ILBDS MAIN COMPONENTS

In the Figure 2 is an illustrative view o of the ILBDS assembling along the Shut Down Valve.

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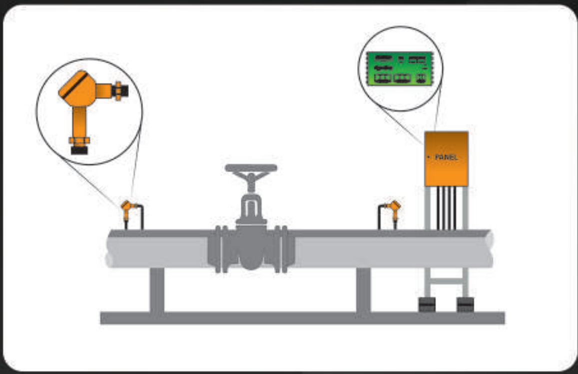

Figure 2 - ILBDS main components

SONIC SENSORS

The sonic sensors are responsible for the acquisition of the signals that propagate through the fluid inside the pipeline. The output signal is a 4 to 20 mA current loop, connected to an analog input of the SRU. The power of this analog loop is supplied by the SRU circuit itself.

Whenever possible, pairs of sensors are used, observing adequate distance from each other. The installation of redundant sensors eases the identification and filter out interferences. Operating in pairs, even in the instances of failure of one of the sensors, the system continues to work with the remaining sensor.

The installation in the line can be made using “Hot Tapping Machines,” without needing to stop pipeline operation. Therefore, there is a reduction in the system installation cost, as there are no production losses during installation.

Besides working as a redundancy, the installation of a pair of sensors allows them to be used as a phase detection filter, providing the origin of events identification. It is important to observe the distance between these two sensors as they operate complementarily.

SONIC REMOTE UNIT – SRU

The SRU-504 remote units are installed in the field and in close proximity to the sensors. They are normally placed in a standard rack mount cabinet located in the equipment shelter. Each unit supports two pairs of sensors (FSS). Its function is to conduct a pre-processing of the data acquired by the sensors and send them over digital communication to the central monitoring station.

The SRUs can be connected to the Central Monitoring Station via a single or a combination of media, such as optical fiber, GPRS, radio, satellite, etc.

CENTRAL MONITORING STATION - CMS

System configuration and operation are performed on a dedicated computer running non-proprietary supervisory software. It acts as a Human-Machine Interface (HMI) and features customized pictographic screens illustrating pipeline aerial views and highlighting the monitored points and many other vital system details.

Configuration parameters and operating conditions are inputted into the supervisory software through user friendly engineering screens. The above screen capture demonstrates the layout of a pipeline segment and the monitoring stations where normal operational conditions are represented in green whereas alarm conditions are displayed in red. When a line break is detected and confirmed, an alarm will sound off and the screen will change to show the line break with date and time. The HMI screen can be customized in many ways to client requirement.

The supervisory computer system is responsible for various informational, communication, security and diagnostic functions. In addition, it manages and maintains an intricate database and reports as well as historical event logs.

DETECTION TIME

The time needed to detect and confirm a line break event by the ILBDS is dependent on a few factors and conditions, mainly the sound propagation velocity in the gas and the distance from the break point to the sensors.

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FEATURES COMPARISON

The table below shows the main features comparison between conventional system and the new Asel-Tech ILBDS.

Features	Conventional Systems	Asel-Tech ILBDS
Decision Algorithms	Based on pressure drop rate and thresholds	Standard evaluations + complete signal analysis & recognition based on artificial intelligence models with learning capabilities for inhibiting false shutdowns
Parameters Configuration	Local	Local/Remote(*)
Rate of pressure drop evaluation	Standard ROD	Standard ROD + Capability to distinguishsudden increase in demand from real failures neural network)
Data Loggin	Event Only	Embedded event and signal recording in high resolution
Learning Capability	No	Yes
Use of data from flow computers and auxiliary instrumatation	Not Possible	Optional integration to enhance decision tools and reliability
Sampling Rate	1Hz (max)	100Hz (max)
Operational Perfomance	High susceptibility to false shutdowns due to irts limited processinf algorithms	High reliability with very low false shutdown granted by sophisticated and powerful signal processing techniques
Pipeline Section Monitoring	Single Point Monitoring	Double sensing allows keeping track of both sections (downstram and upstream) even when SDV is blocked
Redundancy Sensor	No	Yes
Individual Shutdown Disabling	Yes	Yes
Scada Integration	Yes(*)	Yes(*)
Local/Remote Valve Operation	Yes(*)	Yes(*)
Distributed Sensing Capability	No	Yes
Event Origin Identification/ Localization	No	Possible feature to be added depending on system configuration (*)
Remote Configuration	No	Yes(*)
Trend Plots	No	Yes(*)
Power Consumption	Low	Low (suitable for solar power installations)

(*) Depending on communication availabilty