



# API RP 1175 Pipeline Leak Detection Performance Metrics, KPIs, and Targets

# Performance Metrics, Key Performance Indicators (KPI's), and Targets

These guide the evolution of a Leak Detection Program

- *"You get what you measure"* - John H. Lingle
- *"Perhaps what you measure is what you get. More likely, what you measure is all you'll get"* – H. Thomas Johnson
- *"Measurement is the first step that leads to control and eventually to improvement. If you can't measure something, you can't understand it. If you can't understand it, you can't control it. If you can't control it, you can't improve it."* – H. James Harrington

# Relationship between Metrics, KPIs, and Targets

In 1175 metrics are the big-picture performance of the LDS, they define the overarching qualities desired from the Leak Detection Program

The metrics inspire the Key Performance Indicators (KPIs). The KPIs are specific and measurable items that quantify the metrics

Performance targets establish the goals for the KPI's. The targets provide the means to track performance and achieve continual improvement

# Metrics in API RP 1175

- In 1175 metrics are the big-picture performance of the Leak Detection System (LDS)
- 1175 uses the four leak detection metrics defined in API RP 1130 for all types of LDS
  - Reliability – can you depend on the alarms?
  - Sensitivity – how small a leak can you detect?
  - Accuracy – how good are the size/location estimates?
  - Robustness – will it work in a less than perfect environment?
- In 1175 the metrics are broadly defined and not necessarily subject to direct measurement, that's where KPIs come in

## Key Performance Indicators (KPI's)

- KPIs support the metrics, each metric may have multiple KPIs
- KPIs, when properly chosen, should facilitate the attainment of the Leak Detection Program goals
- KPI's should directly measure items related to the metric, i.e. the number of false alarms measures reliability
- KPIs may provide diagnostic information for the metric, i.e. the occurrence of slack line explains why excessive alarms are occurring
- KPIs should be specific to and tracked only for particular pipelines, operations, and LDS's

Metric	Example KPI
Reliability	Number of false positive indications per unit time (alarms/month), this can usually be tracked from observed data in normal operations.
Sensitivity	Average leak threshold. This can be a useful proxy for sensitivity, but it should be remembered that due to the probabilistic nature of many LDSs, leaks greater than the threshold may not be detected, and leaks less than the threshold may be. This can usually be tracked from observed data in normal operations.
Accuracy	For both Computational Pipeline Monitoring (CPM) and non-CPM systems leak flow rate accuracy can be observed during leak testing. For CPM systems this metric can be expected to vary substantially with pipeline operation and somewhat with the location of the leak on the pipeline. To completely characterize the performance of a CPM LDS will require observing (or estimating) leak size accuracy at multiple operational conditions.
Robustness	Leak detection robustness is concerned with how an LDS performs when some of the requirements of the LDS, such as measurements, are not available. The metrics, therefore, are the same as those listed above but taken during a time when a specific deficiency exists in the LDS environment.

## Performance Targets

- Each KPI should have a performance target. This allows an operator to measure whether the LDP goals are being achieved.
- Performance targets should not be set arbitrarily, they should be set with cognizance of what is being achieved and what can be achieved.
- Performance targets should be determined by analysis using sound engineering expertise and judgment. Performance targets can be determined by estimation or observation of the LDS performance.

# Establishing Performance Targets by Estimation

Performance estimation uses detailed knowledge of the LDS and considers how the inputs affect the performance. (API 1149 is an example of this approach for CPM)

The advantages of estimation are:

- May be done before an LDS is implemented
- Allows some comparison of different LDSs for an asset
- Provides prediction of the effects of changes to the asset on the LDS

The disadvantages of estimation are:

- It is a theoretical exercise that is not perfectly accurate
- Inaccuracies in the estimating process make comparing different LDS difficult
- The configuration of the asset should be known in detail, including items such as accuracy and precision of inputs that are difficult to obtain
- The physical principle of the technique used for the LDS should be known in detail. This may not be available for proprietary technologies.
- Implementation of an estimator may be difficult



# Establishing Performance Targets by Observation

Performance observation uses analysis of historic performance of the LDS and/or testing designed to establish the performance of the LDS

The advantages of observation are:

- It provides a definitive result for the performance
- It accounts for as-built, real-world conditions
- It does not require detailed knowledge of the asset or the LDS technology

The disadvantages of observation are:

- It does not identify factors limiting the performance
- It does not provide predictive information on how changing the configuration or operation of the pipeline system may affect performance

Metric	KPI	Operation			Notes
		Shut-in	Steady	Transient	
Reliability	False Alarms	< 1 per month for all operations			Obs./His
Sensitivity	Average Alarm Threshold	10 bbl/30 min	100 bbl/30 min	500 bbl/30 min	Obs./Hist
		20 bbl/1 hr	200 bbl/1 hr	1000 bbl/1 hr	Obs./Hist
		40 bbl/2 hrs	400 bbl/2 hrs	4000 bbl/2 hrs	Obs./Hist
Accuracy	Leak Flow Rate	No target	+/- 20 bph	Not Determined	Obs/Testing
	Leak Location	No target	+/- 5 miles	Not Determined	Obs/Testing
Robustness (Reliability)	False Alarms during comm fail	No increase			Obs./Hist
Robustness (sensitivity)	Degradation in Average Alarm Threshold due to Missing Pressure Measurement	100%	0%	25%	Est/API 1149
	Degradation in Average Alarm Threshold due to Missing Flow Measurement	0%	100%	100%	Est/API 1149
Robustness (accuracy)	Degradation in Leak Flow Rate accuracy due to Missing Flow Measurement	No target	No target	No target	
	Degradation in Leak Flow Rate accuracy due to Missing Pressure Measurement	No target	No target	No target	