Mass balance leak detect, can it work for you?

By
Richard D. Newell, Auspex, Incorporated
Bill Greenwood, Enviropipe Applications, Incorporated

Introduction

Covered in this discussion are reasons for having a leak detection system and what one might expect from operating one. The information was compiled from several operating pipeline leak detection systems, from various publications and past experience working with software vendors and being a software vendor. Items addressed are the why, what and how of a typical leak detection system. The discussion wraps up with protection of investment and purchasing a system including a few general questions to consider.

Why a Leak Detection System

There are several reasons why a leak detection system is needed as a critical feature for pipeline operation. From 1989 to 2002 there was an average of 400+ incidents per year involving injuries, fatalities and all together almost a billion dollars in environmental damage[1]. Having a reliable leak detection system can reduce the impact caused by a leak. Other reasons may include:

- Better public image
- Legal requirements and minimize litigation
- Reduced financial and environmental impact
- Improved operation and performance

Basics

Historically the transient model was the only available type of software based leak detection systems. The problem is they were susceptible to the butterfly effect, small physical changes in the pipe or environment that threw off the transient model calculations. Modern mass balance systems determine pipeline status in a completely different way using changes in operating data rather than attempting to calculate absolutes. Systems incorporate various forms of additional analysis to improve leak detection performance and minimize false alarms. These systems continuously analyzed pipeline data for events that can be perceived as possible leaks such as a sudden change in linepack, an unexpected flow increase or pressure drop.

The frequency of data and data skew can dramatically impact the quality of the leak detection. Scans every 2 minutes may do fine for block valves but leak detection works better with faster rates. For optimum performance consider the following, faster scan rates, synchronized scans of key points (meters in particular), scans by exception or time tagged sequence of events. Flow meters scanned at different times will tend to keep a pipeline constantly near a state of alarm since the mass in/out is always changing.

[1] Jonathan Theakson and Gregers Larnes, Selecting and Installing a Software Based Leak Detection System, Pipeline & Gas Journal, Oct 2002.

©2006 Auspex, Incorporated - Houston, TX
www.auspex-inc.com

Mass balance works best if mass entering and exiting a pipeline can be accurately measured. Additional pipeline measuring equipment may be required for optimal operation. Orifice meters typically offer only 2-4% accuracy verses .25% with a turbine meter. Dr. J. Zhang[2] talks about meter accuracy and detecting leaks and states the size of a detectable leak is limited by the accuracy of the instrumentation.

Enviropipe Application's Approach

Two different pipeline operators were used for operational background, a Texas company with about 19 crude and product lines and a Montana company with a crude line crossing the Rocky Mountains. In both cases they were using the Enviropipe Applications Leak Track 2000 system. Key features that made the product so successful for the users are:

- Highly accurate volume correction and batch tracking
- Leak analyzer that accurately determined the probability of a leak
- Leak location display
- Easily handled events without generating false alarms
- Automatically adjusted limits during transient conditions
- Rapid return to normal after an event using a predictive step down algorithm
- Many advantages of a model system without the complexity
- Configuration tools to simplify initial installation and setup
- Automatic creation of all displays
- Training simulator

The system proved to offer a very high level of protection without major investments in money, time, extensive analysis or special equipment. The operators were very quick to adopt the system because the reliable batch tracking made their job easier.

[2] Dr. J. Zhang, Designing a cost effective and reliable pipeline leak-detection system, The Pipeline Reliability Conference, November 1996, organized by Pipes & Pipelines International.

©2006 Auspex, Incorporated - Houston, TX
www.auspex-inc.com

Configuration

Compared to older traditional leak detection software, mass balance systems are easy to configure. The configuration of LT2000 is very simple. Entering basic pipeline and station data is all that is required (Fig. 1) and the displays are automatically created. Several spreadsheet templates help organize needed information thus making the configuration process very simple and easy to understand.

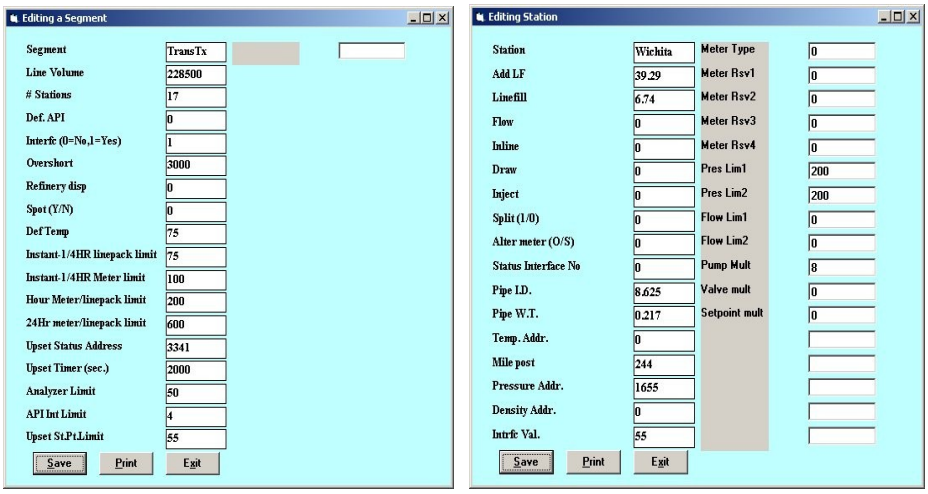

Fig. 1. Editing a pipeline and station data

Maintenance

Older systems typically needed constant tuning or their performance would rapidly degrade. The earlier transient model systems did require constant adjustments because physical parameters are constantly changing[3]. Enviropipe's product is particularly reliable by automatically adjusting key data for robust performance. It has proven to be reliable, operating for months or in an extreme case over a year without any maintenance.

Periodic maintenance is recommended on leak detection systems just like vacuuming the dust off your computers. Occasional maintenance is advised to adjust for optimum performance and to verify all systems are working properly. It is rare for pipelines or SCADA systems to not change with time. Verification that the correct data is being processed, operational parameters are valid and the system is working should be considered part of normal maintenance. If you can simulate a leak by opening a metered outlet it is even better, giving the operators a test.

Another aspect of maintenance is operator training. Every operator should have a periodic leak refresher course. There is a disturbing history of pipelines being restarted after major leaks because the operator did not realize or did not believe the leak they were seeing was real. A leak simulator should be required for any system and is necessary for training to allow operators to experience leak events.

---

3 Crane Engineering Department, 1988. Flow of Fluids through Valves, Fittings and Pipe.

©2006 Auspex, Incorporated - Houston, TX
www.auspex-inc.com

Adding a new pipeline is something most will likely be faced with in this world of mergers and acquisitions. Assuming no licensing restrictions, adding a new pipeline should be an easy exercise. Adding a new pipeline with multiple stations using LT2000 is easy. Update a few tables, supply the new SCADA data and everything is up and running, including all displays (Fig. 2).

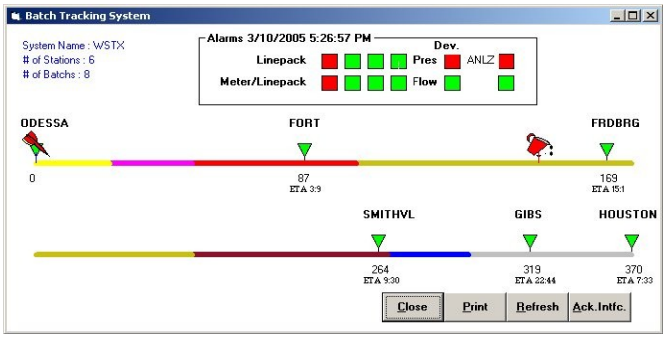

Fig. 2. Batch tracking display indicating a leak and tracking a pig location

Operation

Operators using the leak detection system need to have easy access to it. This needs to be done in such a way that it becomes a part of the operator's life[4]. Once in place and verified the operators will wonder how they ever ran the pipeline without it. Using information such as a linepack (Fig. 3) or a hydraulic gradient trend allows pipelines to be operated more economically and safely.

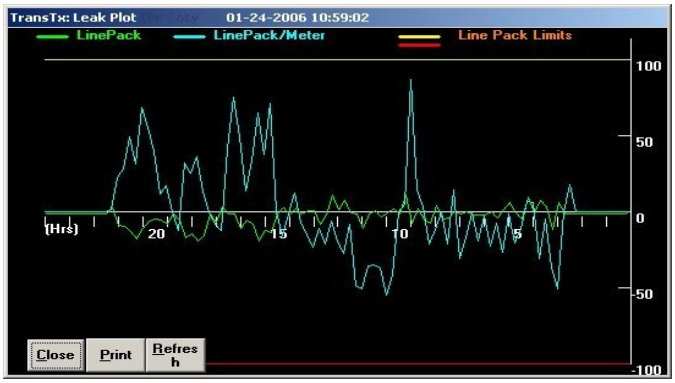

Fig. 3. Example 24 hr linepack graph

Intelligent determination of a leak is very important to minimize false alarms. Leak detection systems with daily false alarms will very soon become ineffective as the operators begin to ignore the annoyance alarms. LT2000 has a very direct method for analyzing events with its "leak analyzer". The analyzer is very effective at rapidly detecting real leaks and dismissing the non-leak events. Utilizing available data, the analyzer is rapidly able to detect a leak, alarm the operator and minimize the spill.

---

4 Craig S. Alexander, Successful Leak Detection Systems: Taking Ownership, Entelec April 2003.

©2006 Auspex, Incorporated - Houston, TX
www.auspex-inc.com

Once a leak is determined, the location becomes important for repairs. Having the software estimate a milepost can save time and money in finding the physical leak. LT2000 supports multiple methods to localize a leak area. The milepost estimator graphically displays the calculated leak location. Two additional methods, the leak locator and the leak plot can then be used to validate and cross check the calculated milepost. Using all three methods gives a good estimation of the leak location. Figure 2 shows an example of the leak analyzer alarm indicator and estimated leak location with the oilcan icon.

Accurate batch tracking is important for several reasons. Operators need to know where the batches are within the line and when the batches will arrive at the delivery points. The distribution of each batch within the pipeline is also required for accurate data processing. LT2000 uses a proprietary method to automatically adjust pipeline volumes resulting in a very accurate tracking of batches.

Management and sales might need access to operational data. LT2000 can provide password protected web-based read-only access to the pipeline data for management or sales (Fig. 4). The data is available in an XML format allowing for easy integration into the corporate data systems.

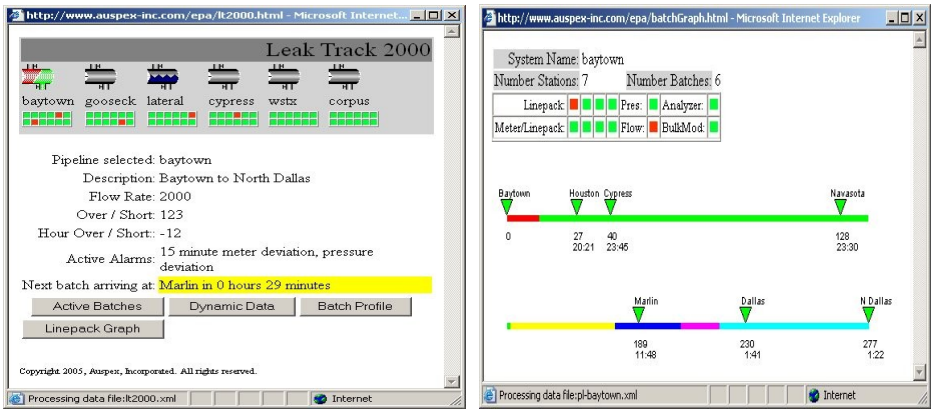

Fig. 4. HTML access

Insurance policies

Once a leak detection system is acquired it is good to know your software investment is protected. Two ways of doing this is to have the real source code[5] and a service contract. You may never need the source but it protects you from the unforeseen events such as mergers and discontinuation of products or vendor. Many providers from just 10 years ago no longer exist. Having the source code gives you the option of self-maintenance (if ever required) or replacement.

[5] Donald B. Ashton, How to Avoid Getting Stuck with a Dead-End SCADA or Leak Detection System, Entelect 2004.

©2006 Auspex, Incorporated - Houston, TX
www.auspex-inc.com

Service contracts are insurance policies. A majority of systems installed may never have a problem but having a service contract can be a warm and fuzzy feeling knowing someone is there to help fix any problem. Many times what is broken will have nothing to do with the leak detection system but the additional help might help isolate the real problem. A service contract may also include reduced rates for any special training or development.

Buying integrated or stand-alone

A few pipeline SCADA vendors offer various levels of integrated leak detection systems as a way to help market their SCADA product. The leak detection might not be the easiest to manage and may have poor performance. Sometimes they will offer a better and more expensive leak detection system as an upgrade.

The advantages of a stand-alone system are significant. You get to pick the features you need and want. The stand-alone vendor typically deals only in leak detection and has a better understanding of the problems encountered and how to resolve them. You can standardize across multiple SCADA systems, a common problem in today's merger environment. If you have a separate data feed then the leak detection system can act as a validation of your SCADA system or limited backup if the SCADA should go down. You can upgrade your SCADA and still keep your current leak detection giving you one less item to be concerned about in training.

Primary considerations in buying any leak detection system should include the following basic features:

- User friendly
- Easy to configure and maintain
- Robust performance to rapidly detect leaks
- Minimize false alarms
- Hands-off operation
- Maintainable by the user

Questions to consider

A few general items to consider when selecting a leak detection system.

- Can the vendor offer an easy solution for your specific pipeline configuration?
- Will you need to modify your SCADA data to comply with your leak detection system limitations?
- What is required to add a new instrument, station, pipeline or operator?
- If the vendor goes out of business or is bought; can you continue to support the software yourself?
- If you change your SCADA do you need to buy a new leak detection system or can you integrate it with the new SCADA?
- If your pipeline has some complicated situation that your current leak detection is unable to process will your vendor make changes at a reasonable cost to resolve your problem?

©2006 Auspex, Incorporated - Houston, TX
www.auspex-inc.com

- Does the vendor train you to be independent?

Conclusion

A mass balance leak detection system does not have to be complicated, hard to maintain or use. Having a fully functioning leak detection system can minimize the loss from a leak while at the same time improving pipeline performance and efficiency. The final results can be a beneficial and meaningful system that once in place becomes indispensable to both operators and management.

For more information on Enviropipe's Leak Track 2000 product visit their web site at www.enviropipe.com. All LT2000 information was used with permission.

References

1. Crane Engineering Department, Flow of Fluids through Valves, Fittings and Pipe, 1988.
2. Dr. J. Zhang, Designing a cost effective and reliable pipeline leak-detection system, The Pipeline Reliability Conference organized by Pipes & Pipelines International, November 1996.
3. www.enviropipe.com/dot.htm web site, 2006.
4. Craig S. Alexander, Successful Leak Detection Systems: Taking Ownership, Entelec April 2003.
5. Computational Pipeline Monitoring for Liquid Pipelines, Pipeline Segment, API 1130, Second Edition, November 2002.
6. Jonathan Theakson and Gregers Larnes, Selecting and Installing a Software Based Leak Detection System, Pipeline & Gas Journal, Oct 2002.
7. Donald B. Ashton, How to Avoid Getting Stuck with a Dead-End SCADA or Leak Detection System, Entelect 2004.

©2006 Auspex, Incorporated - Houston, TX
www.auspex-inc.com