From Pollution to Profits:

Using Continuous PRV Monitoring to Limit Emissions, Cut Costs, Improve Efficiencies, and Short-Circuit Product Loss

An Adaptive Wireless Solutions, LLC White Paper
September 2010

Property of AWS LLC
UNAUTHORIZED USE OF THIS DOCUMENT OR ITS CONTENTS WITHOUT PERMISSION IS STRICTLY PROHIBITED.

For plant managers and staff in today's refineries and petrochemical facilities, efficiency is the name of the game. Operational success hinges on maximizing production and profits by streamlining plant processes to minimize emissions, waste, and unnecessary capital expenditures.

A significant source of controllable inefficiency within plants is undetected VOC loss from pressure relief valves (PRVs). Designed to protect individuals, equipment, and the environment from dangerous pressure build-up in process piping and vessels, these critical safety devices often number in the thousands within a single plant.

Pressure relief valves leak for a variety of reasons, from technical malfunction and simple wear and tear to the operation of system pressures nearer to design pressure in order to achieve maximum productivity. Often processing hundreds of thousands of barrels of valuable product each day within a typical refinery, leakage in these industrial workhorses represents costly operational inefficiencies.

The price of PRV leaks

- Compromised compliance with emissions regulations
- Reduced productivity and profitability
- Leak detection limitations
- Need for flare stack recovery system expansion
- Costly and time-consuming manual valve testing and replacement procedures

Today's strict environmental regulations mean refinery operators have a vested interest in detecting PRV leaks as soon as possible. Catastrophic failures can lead to combustion of highly flammable gas or knock facilities offline, forcing an emergency burn-off from their flares and turning those small pilots into fireballs of pollution.

According to a U.S. Environmental Protection Agency (EPA) Office of Regulatory Enforcement alert, the actual number of leaking valves has been up to 10 times greater than reported by certain refineries.[1] The EPA estimated that leaks not found and repaired could result in additional VOC emissions of 80 million tons annually. These types of statistics are motivating refineries to monitor these controllable disruptions or face steep penalties and the release of hazardous emissions.

Accounting for a significant proportion of all refinery discharge, PRV leaks can be reduced up to 90 percent if detected and repaired in a timely manner.[2] However, the costs and time associated with manually monitoring these valves can be substantial. Finding ways to ease these burdens and stay ahead of the EPA mandate curve can significantly improve the profitability, safety, and environmental standing of a refinery.

Property of AWS LLC
UNAUTHORIZED USE OF THIS DOCUMENT OR ITS CONTENTS WITHOUT PERMISSION IS STRICTLY PROHIBITED.

Fortunately, new wireless PRV monitors are returning power back to the plant, providing almost total control over leaking valves through continuous monitoring. By identifying leaks as they happen, eliminating unnecessary manual testing of healthy valves, saving millions of pounds of process material each year, and often avoiding costly expansion of flare stack recovery systems, continuous monitoring is poised to become the PRV observation method of choice.

This white paper further examines the available methods for detecting PRV leaks. Special focus is given to the advantages of continuous valve monitoring through wireless technology to achieve significant financial gains in reduced emissions, process efficiency, rescued product, and increased recovery system capacity.

Periodic Shop Testing

Until recently, plants had few options when it came to maintaining the thousands of pressure relief valves within their facilities. There simply were no practical alternatives outside a schedule-based system of valve removal and shop testing.

This time-based, labor-intensive approach does not address the other key challenges associated with manual PRV monitoring: costly maintenance, poor leak control, recovery systems reaching capacity, and the resulting need for capital expansions.

Costly maintenance and poor leak control

While it sounds logical that valves and valve locations with a history of poor performance would mark the basis for PRV inspections, it only partly determines most maintenance schedules. Extending the cycle as long as possible means that most schedule-based relief valves are removed for inspection, repair, or replacement just once every 3-5 years.Other profound limitations exist with this point-in-time method:

- Significant leaks could begin well before scheduled removal, going unchecked for months or years.
- Newly replaced valves may begin leaking below design pressure years ahead of their first maintenance check.

Operators performing manual maintenance are unable to identify a problem until each valve – leaking or not – is removed and tested. This time consuming, costly, and often ineffective process does little to stem the flow of valuable product from leaking valves – whether as fuel, flare waste, or emissions. The result? Costly reactive maintenance and less feedstock converted to saleable product at a time when every penny counts.

Property of AWS LLC
UNAUTHORIZED USE OF THIS DOCUMENT OR ITS CONTENTS WITHOUT PERMISSION IS STRICTLY PROHIBITED.

Startling Statistics

According to independent studies the realities of these tedious manual assessments are startling:

For every 100 valves removed for routine inspection, about 25 leak below design pressures. That means that a quarter of all PRVs are wasting product or polluting while 75 percent are absorbing high costs of an ineffective process and an inefficient deployment of labor.

Aging recovery systems and capital expansions

Aging recovery systems are driving refinery managers to reexamine their valve monitoring practices as well. According to the National Petrochemicals and Refiners Association, the last new refinery built in the United States was Marathon Ashland's Garyville, La., plant – and it was completed in 1976.

Today's aging petrochemical facilities face multiple stressors – including PRV leaks resulting from the operation of outdated systems at higher levels, and expensive expansion of flare stack recovery systems to handle the burden. With just two options, plants must make an expensive decision: either vent to flare and incur an EPA-sanctioned penalty, or expand the recovery system at a price premium.

What About Other Methods?

Using wired sensors to monitor and optimize PRV performance can help refineries operate at peak efficiency. But, the high cost of wiring the sensors to PRVs in a facility makes the technology impractical. With the average cost of hardwired PRV sensors totaling more than $30,000 *per point*, hardwired pressure sensors have not been widely adopted because of their prohibitive costs.

Similarly, the high personnel expense incurred to use portable sensors makes it impractical for continued operational efficiency gains, and only provides a snapshot of the PRV's performance.

The Solution -– Returning Power to the Plant through Wireless Monitoring

Fortunately, new wireless applications are helping turn the tide toward continuous monitoring methods that allow technicians to focus on *fixing* leaks rather than *finding* them.

Property of AWS LLC
UNAUTHORIZED USE OF THIS DOCUMENT OR ITS CONTENTS WITHOUT PERMISSION IS STRICTLY PROHIBITED.

In fact, the President's advisers on science and technology asserted a decade ago that the development of wireless sensors could improve production efficiency by 10 percent and reduce emissions by more than 25 percent.[3]

Today's new wireless sensors eliminate the cost of the wiring and conduit needed for conventional sensor technologies and allow more flexibility in sensor placement. They also save money by helping refineries use energy more efficiently, reduce production costs, and increase productivity. Finally, when a leak is quickly identified through continuous wireless monitoring, plant personnel can correct it before it becomes a serious problem.

And the best argument for wireless? Research shows the costs associated with installing, maintaining, and upgrading wiring have escalated while costs for installation and maintenance of wireless technology continue to drop.[4]

When continuous monitoring is in place, a number of additional benefits emerge, including:

Emissions reduction:

In some states, EPA regulations now mandate continuous PRV monitoring or closed discharge systems. Wireless monitors allow rapid leak detection so immediate corrections can be made – thereby reducing the opportunity for flare release. By sending less waste into recovery system, refineries process more product, enjoy a reduction in flare events and emissions, and save money on fines and expansions.

Further enhancing process efficiencies, wireless monitoring allows plants to continue operating systems closer to design pressure by pinpointing leaks and preventing burdens on the recovery system. By sending less waste into the system, productivity increases, cash is conserved, and the capital expense of a recovery system expansion is relieved.

Event-based pinpoint leak detection:

Pinpointing the source, onset, volume, and duration of each PRV leak or release event is paramount to avoiding serious consequences such as injury, explosions, and product losses. Wireless methods enable valves to remain in service until a leak is automatically detected by software that continuously gathers and analyzes PRV data. Allowing exceptions to be caught within minutes of onset, wireless monitors minimize leak severity, prevent product loss, and advance productivity – thanks to the power of real-time data sharing.

Property of AWS LLC
UNAUTHORIZED USE OF THIS DOCUMENT OR ITS CONTENTS WITHOUT PERMISSION IS STRICTLY PROHIBITED.

Additionally, because only leaking valves are removed from service, healthy valves can keep doing their job – protecting the people and equipment inside the plant without disrupting operations through manual valve removal and testing.

Ease of use:

Without the need for power or signal wire infrastructures, plants are free to monitor valves in remote corners and obstructed plant areas without worrying about wiring costs or logistics. The need for dedicated maintenance and installation teams is diminished, freeing up labor for other plant needs.

Rapid and reliable return on investment:

A moderate investment in wireless PRV monitoring begins paying plant dividends immediately, with the entire system often paying for itself after a few short weeks or months of product savings and eliminated manual testing.

Some examples of dramatic Adaptive Wireless Solutions results:

- Refinery, Europe: Nineteen valves targeted for continuous monitoring at an investment of $38,000. A major leak source was detected, resulting in product volume savings of $1.1 million per year.

- Refinery, Washington: Implemented continuous monitoring system for 50 pressure relief valves in 2004. Based on volume of rescued product, the system was scaled up to 100 units between 2006 and 2007.

- Chemical Plant, Louisiana: Plant study shows 6-week ROI on 50 permanent and 100 temporary in-situ monitoring devices.

- Refinery, California: Installed 400 wireless PRV monitors for continuous monitoring of high risk valves at non-attainment facility. Resulted in complete compliance with EPA regulations and continued operation.

- Ethylene terminal and pipeline, Texas: $1 million annual lost product savings for investment of less than $50,000.

The New Word in Wireless – Adaptive Wireless Solutions, LLC

Adaptive Wireless Solutions (AWS) enables clients to reduce unnecessary expenses and increase efficiency, productivity, and environmental compliance through partner-specific, high-value industrial measurement and process solutions.

Property of AWS LLC
UNAUTHORIZED USE OF THIS DOCUMENT OR ITS CONTENTS WITHOUT PERMISSION IS STRICTLY PROHIBITED.

A proven expert in tether-free PRV instrumentation, Adaptive Wireless Solutions brings the following unique advantages to continuous monitoring:

- **True wireless technology:** AWS provides the only true wire-free and ready to use system on the market today. Battery-operated field units are virtually maintenance-free – running five years without a battery change and transmitting signals up to 3,000 feet. With no field wires, no permits, and no licenses, AWS gives you what no one else can: a truly tether-free valve monitoring solution.

- **Liquid and gas leak detection platform:** With the ability to detect both liquid and gas PRV leaks with just one instrument, AWS streamlines the entire leak detection process. The advantages: reduced inventory of replacement monitors, simplified training, and additional leak point measurement.

- **Systems integration**: Highly adaptable to virtually any valve design, AWS monitors are non-invasive, portable, and easy to install. Both integral and remote sensor mounts are available for easier mounting in awkward locations.

- **Sensor design and placement:** Tightly calibrated sensors and sensor boards mean greater accuracy and fewer false alarms.

- **Built for harsh industrial environments:** AWS wireless monitors exceed durability and reliability requirements and have been proven in harsh petrochemical and refinery environments.

- **Service support:** Adaptive Wireless Solutions handles the entire lifecycle of PRV monitoring – from needs analysis, planning, and training to implementation and around-the-clock remote and on-site support.

- **Security:** Protection against interference and data interception is an essential component of Adaptive Wireless Solutions' PRV monitor. New strategies for encrypting wireless data transmissions provides the highest level of security.

- **Industry leader:** AWS is agile enough to meet your custom requirements, yet stable enough to leverage its 24 years of experience in industrial measurement solutions. Our patent-pending PRV sensor technology allows an exceptionally narrow acoustic frequency range for wireless monitoring – a singular claim in the industry.

Property of AWS LLC
UNAUTHORIZED USE OF THIS DOCUMENT OR ITS CONTENTS WITHOUT PERMISSION IS STRICTLY PROHIBITED.

How to Learn More

To take the first step toward regaining control over leaking valves through continuous monitoring, visit the Adaptive Wireless Solutions website at www.adaptivewirelesssolutions.com, call 978-875-6000, or email our sales department at sales@adaptive-wireless.com.

Footnotes:

[1-2] United States Environmental Protection Agency, Office of Regulatory Enforcement, Enforcement Alert (October 1999). *Proper Monitoring Essential to Reducing 'Fugitive Emissions' Under Leak Detection and Repair Programs*, 1-3.

[3] President's Committee of Advisors on Science and Technology, Energy Research and Development Panel (November 1997). Federal energy research and development for the challenges of the 21st century, 3-16.

[4] Manges, W.W., Allgood, G.O., and Smith, S.F. (April 1999). It's time for sensors to go wireless; Part 1: Technological underpinnings, *Sensors: The Journal of Applied Sensing Technology*, 16(4), 10-20.

###

Property of AWS LLC
UNAUTHORIZED USE OF THIS DOCUMENT OR ITS CONTENTS WITHOUT PERMISSION IS STRICTLY PROHIBITED.