

Cut Your Losses with Relief Valve Monitoring

Jonas Berge explains how smart plants are cutting their product losses by dropping in wireless acoustic transmitters in relief valves.

Relief valves are important safety devices protecting the plant and personnel by relieving over-pressure events to the atmosphere or a flare. After a release, it is not uncommon for the relief valve to not seat back properly. This causes the valve to pass internally, allowing valuable product, feedstock, or other material to escape unnecessarily during normal operation. Although each leak in many cases may be small, with hundreds of relief valves across the plant, over time this translates into significant material losses. Plants literally can witness their profits going up in smoke or disappear into thin air. Because hundreds of relief valves may share a common flare, it is not easy to pinpoint which relief valves are leaking and which ones are not. In this article, Jonas Berge explains how smart plants are cutting their product losses by dropping in wireless acoustic transmitters and often see immediate results.

Relief valve leaks

Out of the relief valves that fail to reseat properly, many leak small amounts, but a few may leak profusely. Plants can measure an increase in flared amount over time, and mass balance calculations also reveal losses. Plant management keeps track of losses, and plant personnel are on the spot to minimize these losses.

Reducing losses, minimizing flaring, and reducing the carbon footprint are industry-wide trends.

Past perfect

Best practice in the past was to routinely pull relief valves into the workshop for inspection and overhaul, without much information about the expected condition of the relief valve. However, dismantling and overhauling

relief valves this way is very labor intensive and can consume considerable time if parts are hard to obtain. Relief valves are often in difficult to access locations such as on top of vessels or pipe-racks that require scaffolding and a crane for inspections and removal.

Conducting manual leak testing with a portable acoustic tester to survey the relief valves in-situ is a somewhat better approach. However, periodically checking hundreds of relief valves is still very labor intensive and therefore does not get done frequently enough. Each condition check is a snapshot in time and a lot can happen until the next survey. The process includes establishing a test route, scraping loose paint and brushing off rust for each valve, checking that the line is pressurized, applying contact compound on the probe and holding it in place, taking a reading and recording it on a check sheet. Inspection rounds must be frequent to be effective.

Continuous relief valve condition monitoring

Continuous monitoring of relief valve condition is more effective for identifying leaking valves than periodic testing. An acoustic transmitter is easily installed on each relief valve to be monitored. The acoustic transmitter can detect and report both relieving events and leaking relief valves typically every minute or as quickly as once per second if needed. There is no need to send personnel into the field to perform these diagnostics and there is no need to remove the relief valve or take it out of service. The relief valve remains in-situ, no shutdown or bypass is required, and it has no impact on the process. The acoustic transmitter with digital communications turns an ordinary relief valve into a smart relief valve by providing diagnostics.

Drop-in

Because acoustic transmitters are non-intrusive, they are very easy to install and a low risk to deploy. The sensors clamp on to the outside of the valve using metal clamping bands or a bracket. There is no cutting, drilling, or welding required. No process penetrations are created.

Principle of Operation

A relief valve is normally closed. As fluid internally leaks through a damaged relief valve, noise in the ultrasound range is emitted. Acoustic leak detection works by detecting the noise in the ultrasound range.



Figure 1: An acoustic transmitter turns an ordinary relief valve into a smart relief valve.

Furthermore, a wireless transmitter requires no power cables and no signal wires so there is no risk to the existing installation associated with opening cable trays or junction boxes. The wireless transmitter is powered by a battery that lasts up to 10 years with a half minute update period.

Immediate results

Continuous relief valve monitoring gives plants the ability to detect leaking relief valves immediately and service them early to stop losses much sooner than was possible in the past. Indeed, at most plants where acoustic relief valve condition monitoring has been deployed, one or more relief valves that may have been leaking for a long time were detected; instant gratification.

With automatic monitoring, maintenance personnel spend less time pulling relief valves or manually testing for leaks, and can instead focus on repairs of those relief valves that are found passing. This makes maintenance more productive. A majority of relief valves can remain in service for much longer without bringing them back to the workshop. Immediate leak detection allows maintenance personnel to schedule overhaul of relief valves when they need it, no sooner, no later. Moreover, personnel spend less time working next to hot process lines.

Identifying leaking valves prior to turnaround enables better turnaround planning, including parts, and makes for a shorter turnaround where no time is wasted on relief valves that don't need service, and relief valves which need service are not left out. That is, leak detection diagnostics become a driver for repair; data-driven condition-based maintenance that also reduces scheduled downtime.

Reduced leaks also mean fewer emissions in the form of venting or flaring, for a lower carbon footprint which is good for the environment. Automatic relief valve monitoring also time-stamps discharges with the start and duration, making emissions reporting easier and also enabling release amounts to be computed. Compliance with ever more stringent environmental standards can be achieved without additional burden on plant personnel.

Time-stamped relief valve release information assists in process troubleshooting by giving the plant the ability to correlate relief valve lifting against other process events to identify the root cause of the over-pressure. Such root cause analysis can be used to make control or procedural changes to reduce venting and flaring in the future, thus further improving efficiency.

System integration

The acoustic transmitters and WirelessHART gateway used for relief valve monitoring can integrate with any control system using Modbus and directly to the plant historian or other software using OPC. There is no need to upgrade the systems to take advantage of this solution. No special software is required. Operators at the control system consoles are interested in overpressure release events which are indicative of process problems. Maintenance engineers are interested in leaking relief valves because they are responsible for repairing them. They typically get their data from the historian. The energy efficiency manager is interested in both overpressure releases and leaks because both cause losses, and get all this information from the historian. The acoustic transmitters can be installed on existing relief valves; there is no need to upgrade the relief valves. Because all data integrates using digital communication, expensive system I/O cards associated with 4-20 mA and on-off signals are not required.



Figure 2: Device dashboard based on human centered design makes the acoustic transmitters easy to manage.

An acoustic transmitter is an intelligent device which digitally integrates with Intelligent Device Management (IDM) software to manage configuration and device diagnostics. Thanks to the interoperability of the HART-IP protocol used between the WirelessHART gateway and the IDM software, all configuration and diagnostics data in the acoustics transmitter can be integrated in third-party IDM software. A device dashboard is created by the device manufacturer using Electronic Device Description Language (EDDL) based on human centered design principles (www.eddl.org) to make the device configuration and diagnostics user friendly.

Shared infrastructure

Relief valves are sometimes used in combination with a rupture disk. An on-off contact I/O transmitter can be used in the same infrastructure to monitor the rupture disk as well. Acoustic transmitters are primarily used on relief valves but can also be used to diagnose the integrity of other valves which normally are in a closed position such as isolation, bypass valves, and emergency depressuring valves.

Plants are now modernizing by deploying a plant-wide wireless instrument network, not just for relief valve monitoring, but as a multi-purpose instrument network for other WirelessHART sensors for pressure, DP flow, DP level, valve position, pH, conductivity, guided wave radar level, vibration, temperature, and corrosion etc. in applications for energy metering, and condition monitoring of steam traps, pumps, blowers, air cooled heat exchangers, compressors, and cooling towers as well as to reduce operator rounds.

Caveat emptor

There are several wireless solutions available that use proprietary wireless technologies. Proprietary technologies may create a lock-in with a single vendor, which could become costly to support in the long run. The IEC 62591 (WirelessHART) infrastructure is supported by multiple manufacturers.

Modernize the plant

By adding intelligence to the relief valves for diagnostics, plants are able to reduce losses, maintenance costs, and emissions while gaining a tool to troubleshoot the processes for greater efficiency.

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