Feeling The Pressure To Reduce Leakage?

By Brad Clarke, VP of Marketing & Sales, Singer Valve

Water is a resource that is often taken for granted. As we see the effects of climate change and population growth, the challenges we will face regarding water supply and availability will only increase. Examples of this are beginning to surface extensively in many areas of the world. In Adelaide, Australia, the Murray River has long supplied Adelaide with its source of water however the Murray River has seen extensive overuse for potable, agricultural and industrial use and now combined with changing weather patterns, Adelaide is in trouble. In North America you need look no further than Lake Lanier in Georgia which is essentially the sole source for Atlanta's water supply and is once again approaching a critically low period where Atlanta's water supply could be threatened. In Las Vegas and the US Southwest, the Colorado River which supplies Lake Mead and the Hoover dam is in a critical low period and this supply is seriously threatened. Unless weather patterns change water supply in these regions will continue to have increased challenges with population growth and dwindling resources.

So what does pressure management have to do with scarcity of water? Every water utility has some degree of leakage or water loss within their systems which can be greatly reduced by pressure management.

Antiquated leaking valve on Catalina Island, California

In North America between 10% and 30% of the water we pump or feed into our distribution systems simply leaks out of the system and into the ground. Internationally leakage can be as high as 70%. So what is the cause of these leaks? Aging infrastructure (old pipe and valves), cracked pipes, poorly maintained valves, leaking gaskets and leaking threaded connections at curb or corporation stops, are only a few examples of where these leaks or water loss occurs.

The costs are far greater than the actual cost of the water being lost as we are also wasting the energy required to pump this water, and losing the chemicals we use to treat this water and we are building

additional reservoirs to store more water to provide reasonable storage of this precious resource. IWA (International Water Association) and the AWWA (American Water Works Association) have many water audit tools that can easily determine the levels of water loss that a water utility might be encountering.

So what can we do about this lost water? In an ideal world we would replace our entire infrastructure; old pipe, valves, poorly threaded connections and make sure our systems don't leak! While this would be a very effective way to solve this problem it is impossible due to the incredible replacement costs. Pro-active water utilities, replace a small percentage of challenged systems every year to eliminate or greatly reduce leakage within that particular pipe section. This approach is sound and is practiced in many utilities around the world and helps mitigate the problem but does not eliminate it.

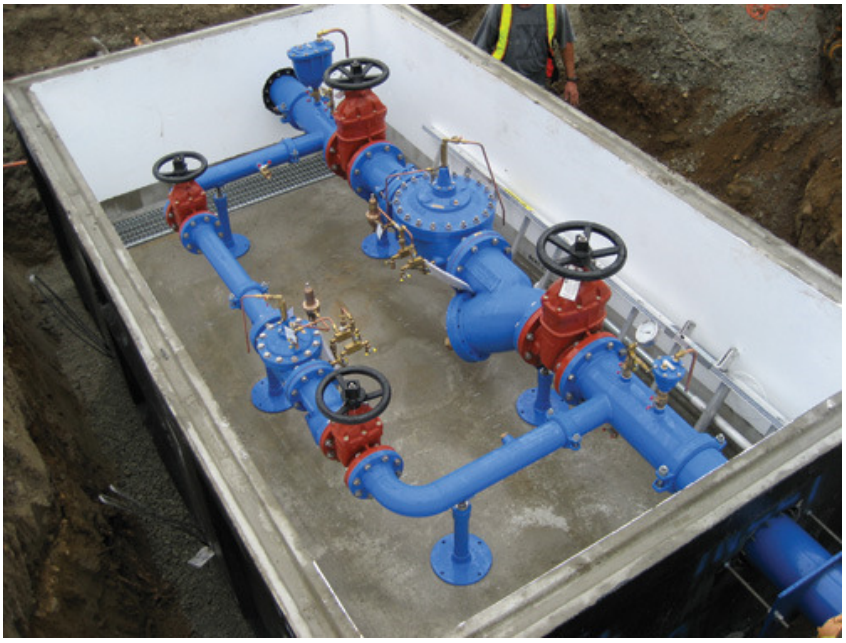
Pressure management is recognized as the most immediate, cost effective approach to reduce water loss and leakage.

So what is the big deal about pressure in a system? If you can decrease the pressure in your system by 1% you will decrease your leakage rate by 1.15% (average and subject to variation). In daytime, consumers use a lot of water to shower, wash, cook etc. and so demand of flow increases, when this happens, pressure is almost always lower. At night time as demand is reduced, the pressure increases in the system. It is not uncommon to see pressure change by 15 – 30 psi (1 – 2 bar) from day time to night time.

In addition pressure in a distribution system is almost always higher at the source (pump station or reservoir) and drops due to pressure loss as you get further away from that source and even more so if there is a topographic increase. If you have distribution lines feeding customers in areas close to the source, you are likely supplying too much pressure for what is required in order to serve the most distant or highest elevation customers. To reduce leakage, it is best to give your customers just enough pressure to get the job done, never more as you are simply adding to leakage or wasted water.

A sound approach in reviewing water loss reduction would include a pipe/system annual replacement program (focused on the most challenging areas) and a leakage location plan where teams locate leaks and then expedite the repair of those leaks. If the system is not gravity fed and pumps are involved, Variable Frequency Drives (VFD's) can be one of many tools that can help mitigate this problem. It should be noted that while VFD's can be used as an effective tool, they should always be used in conjunction with a pressure management approach.

When considering a comprehensive water loss and leakage program it is common practice for water utilities to hire a consulting firm that specializes in this discipline. After completing a water audit, a consultant will usually analyze the system and begin to establish DMA's (District Metered Areas) which typically consists of a meter and pressure reducing valve. These DMA's are often designed to be a dedicated pressure zone for between 2000 and 3000 service connections (but this number can vary subject to population and utilities desire to find the smallest leak). The meter then measures the overall flow into that specific pressure zone while the consumer, industrial and commercial meters used for billing, measures flows out of the zone and assuming you have calibrated meters, this will give you leakage rates in that zone. With this information you can now direct your leakage location teams into the most challenged zones and identify areas with the greatest need. DMA's are always most effective if you can provide one source into a DMA zone and avoid multiple meters and PRVs feeding off a looped system. With this approach you can now adjust the pressure reducing valve specifically to each zone and set the pressure in that zone to supply exactly what your customers require, never more. In a small town or city of 10,000 people or less you may end up with 4 or 5 DMA's or pressure zones. In a large city with many millions of residents you may have 100 – 200 pressure zones. Each DMA will often give a payback of six months to a year when evaluating the cost of the water that would otherwise be lost.

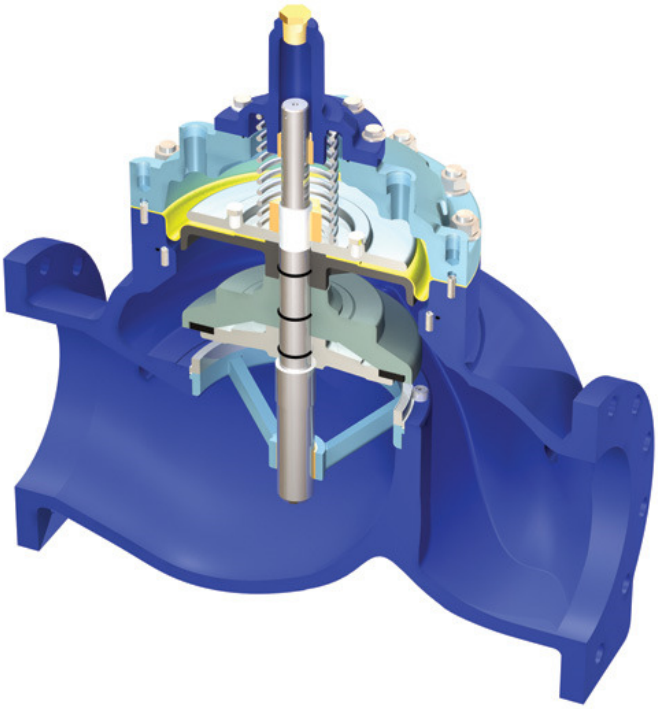


Typical DMA Zone with Meter and Pressure Reducing Valve

Another interesting characteristic of pressure management is the reduction of pipe bursts that coincides with a sound pressure management program. It is a well know fact that pipe bursts are usually a fairly significant portion of annual maintenance budgets. Pipe bursts often happen in off peak periods or night time. The reason why these burst occur is the same as previously discussed due to demand being lower and pressure being higher. By managing your pressures better with DMA's or pressure zones you can decrease your annual maintenance budget and reduce water loss associated with these pipe bursts plus consequential damages.

When selecting a pressure reducing valve, it's important to have the highest quality product available and minimum maintenance. Not all manufacturers build these valves the same way so it is important to specify things like 316 stainless steel seats (no bronze/brass as this soft yellow metal will wear), stainless steel fasteners on the external portion of the valve (no plated or galvanized – prone to rust) and always insist on heat fusion epoxy coatings on both the external portion of the valve as well as internally on all wetted surfaces (avoids rusting bare ductile iron on the inside of the valve).

There are emerging technologies that can assist you in ensuring your pressure reducing control valves are stable throughout their entire stroke. Traditionally flat diaphragms have been used in most diaphragm operated pressure reducing valves. These valves can operate very effectively when operating mid stroke but can be challenged at very low flows to be stable. There is a technology available called "Single Rolling Diaphragm" which can supply very consistent pressure throughout the entire stroke of the valve virtually from shutoff to the highest flow required. This is best for pressure management systems during low flow periods.



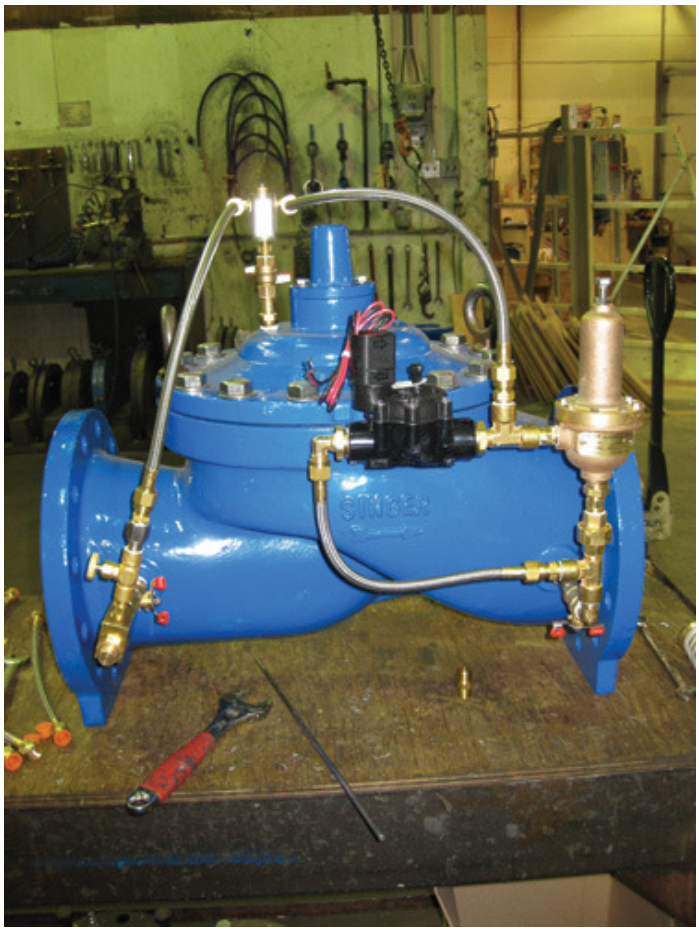
Single Rolling Diaphragm Technology

A standard Pressure Reducing Valve (PRV) can be a very effective tool to control pressure. Once installed there are many options that can be incorporated in the initial PRV's to make this valve have different functions. With a standard PRV, your only limit is you have one pressure setting downstream and can not change this without staff manually adjusting the pressure. You must also have some pressure at the inlet to the valve (minimum of 10 psi or .6 bar) for the valve to function.

Standard Pressure Reducing Valve

Another approach that can assist a pressure management scheme is to use a standard PRV and use two mechanical pilots (two pilots specific to night time pressure and day time pressure) and use a simple inexpensive battery operated timer (IP -68) & solenoid to change pressures based on time. This

approach can supply higher pressures in the daytime but cut pressures back at night time or off peak periods.



Battery Operated Control with two Pressure Settings

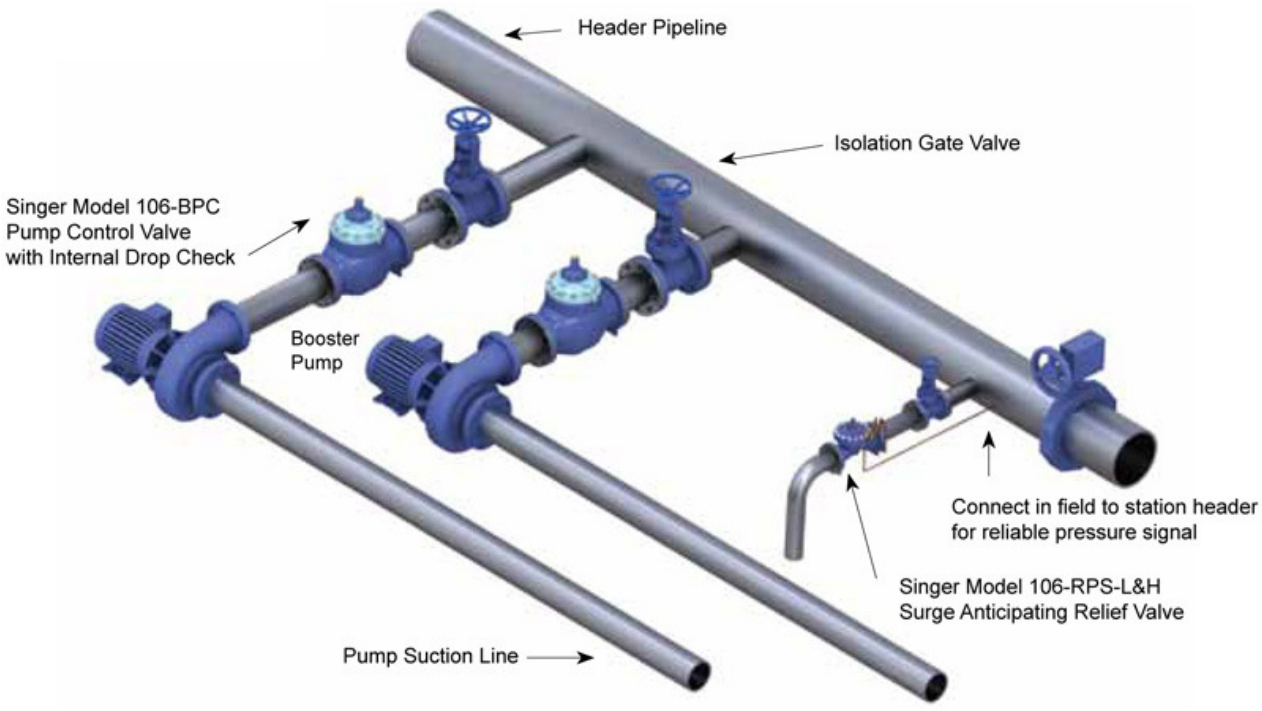
A third approach is to have a special mechanical pilot modulate pressure based on flow. This approach includes the use of a proprietary pilot system and can change pressures based on flow. For this technology to be most effective you must have a minimum of 45 psi (3 bar) at the inlet to the valve and only one supply point into your DMA. This valve can mechanically change (no batteries or power required) pressure based on flow by up to 30 psi (fully adjustable). This means it will lower pressure at nighttime when demand is low and pressure high and will increase pressure in daytime when demand is high and pressure is low.

Pressure and Flow Control Mechanical Solution

A fourth approach can be full SCADA control of PRV's. By adding a 4-20 mA motor and incorporating pressure switches and flow information, a complete system can be operated remotely through SCADA, constantly adjusting pressure based on varying flow demands.

4-20 mA control of standard PRV

In addition to pressure management a well thought out program of pressure relief valves and the associated topic, of transients (surge), is an area that is often overlooked. Any where you have pumps starting and stopping suddenly due to PLC failure or power loss due to lightning storms, you are at risk of surge damage to your pumping and piping system and again water loss and leakage due to pipe bursts or increased stress on the piping system. All pump stations regardless of having single speed motors or VFD motors should have some sort of surge protection. There are numerous models of diaphragm operated control valves that can provide this protection. These models include standard pressure relief, surge anticipating and rate of rise anticipating pressure relief valves.



surge anticipating pressure relief example

In conclusion pressure management is becoming a very popular topic as water utilities are being pressured to maximize the efficiencies of their systems and reduce the water loss and leakage rates we are all dealing with. There are many different solutions available and a well thought out program utilizing various options can often be the best approach. A well thought out pressure management solution can have a very short payback period when reviewing a business plan showing cost of water saved versus capital costs for initial installation. The end result is better use of an ever increasing scarce resource, water. After the air we breathe, water is the most important resource for humanity as without it, we can not survive!

Author Bio

Brad Clarke *is the VP of Sales and Marketing for Singer Valve Inc, a global designer and manufacturer of automatic control valves. He has spent the last 35 years working in the water industry and has written and presented several papers around the world on key issues that improve the operation, conservation and management of water systems.*