Pressure Regulating Valves

Pressure regulating valves can serve many functions within a pump station. Most common usage is the pressure reducing valve from the pressure vessel to the system. Another common use is for reduction of pressure from the pressure vessel to a self-cleaning intake screen. Less often used, but sometimes necessary are pressure relief valves and surge anticipator valves. Pressure relief valves would be used if any pump's shutoff head (maximum pressure potential) is higher than the rating of the pressure vessel. A pressure relief valve could be used to reduce overpressure within the system.

Surge anticipator valves would be used on very large systems where frequent power failures are possible. They function to open under a substantial reduction in pressure, and close slowly as pressure rises again. This can help reduce effects of pressure surges in pipes caused by the unplanned stopping of pumps under flow. If pumps are stopped under flow, the momentum of water already pumped will cause a low pressure to exist at the pump station discharge. This low pressure is the tail end of an initial pressure surge. If a surge anticipator valve were not installed, once the surge (momentum of the water) had passed, it would return to fill the low pressure area and hit the pump station like a truck hitting a wall. With a surge anticipator valve opened, the returning pressure would be diverted from the system through the surge anticipator valve. From here it is directed back to the water source or to atmosphere, preventing damage to the pump station and piping.

A pressure reducing valve at the pump station discharge into the system will cause a fairly constant pressure to be delivered into the system from the pump station.

Many manufacturers of pressure regulating valves exist. Most of those that produce pilot operated pressure regulating valves, manufacture valves that are adequate for pump station needs. They will normally operate properly if velocities across the valves are kept to twelve feet per second or less (maximum pressure drop of S PSI or less). Motor operated butterfly valves can be used as pressure regulating valves. The motor operator must be rated for modulating duty, and the valve must be sized for pressure drop characteristics instead of line size. Normally butterfly type valves are smaller than pilot operated globe pattern valves for comparable flows. As with other products, there are degrees of quality in both industries, and some manufacturers produce better quality valves, pilots, and motor operators than others.

The best pilot operated valves are of globe pattern design using flexible diaphragms to open and close the discs. Their discs are manufactured from Buna-N or EPDM elastomer, are rectangular in cross section, and are field replaceable. Valve seats are field replaceable, made from brass or bronze, and the seating area is raised and tapered for maximum sealing potential.

Pilots normally provided on a pump station hydraulically operated control valve are pressure reducing pilot, backpressure pilot, opening speed control, and overpressure (surge) prevention pilot. Where cost is of extreme concern and the adverse effects to pumps' operation are not severe, the back pressure pilot can be eliminated. However, with this elimination, the air charge of the pressure vessel can be introduced to the system if the pump station shuts down from power failure or under the actuation of a safety. Occasionally these valves require a check feature which prevents water flowing through the

In most pump station applications, the pressure regulating valve is located at the discharge of the pressure vessel and includes pressure reducing and backpressure pilots. If the valve is 3" size or smaller, an opening speed control is recommended. If the valve is 6" or larger in size an overpressure (surge) prevention pilot is recommended. Sometimes an overpressure (surge) prevention pilot is required on 4" valves.

The best motor operated butterfly valves have single piece Buna-N seats, single piece brass, phosphor bronze, or stainless steel discs, single piece stainless steel stems, and plate mounted motor operators with quick opening and closing times, and an analog position feedback signal. These valves are controlled by a separate programmable controller, specifically designed for pressure regulating valve use, fed with an analog pressure signal. The key to proper pressure control for motor operated butterfly valve lies in the programmable controller for the valve. Improper logic of operation can cause significant large scale pressure swings in the system, resulting in damage to piping and fittings.

Pilot operated pressure regulating valves 8" and larger, or motor operated butterfly valves over *5",* usually require an auxiliary low flow control valve in parallel. These low flow valves are installed to handle all flows from zero to at least the minimum rated flow rate through the main valve, or full jockey pump capacity, whichever is greater. As an example, most 8" hydraulic pressure regulating valves have a minimum flow rate of 200 GPM. Sustained use of the valve below this flow rate will cause cavitations to the disc and seat of the valve. This will eventually necessitate early repair of the valve. A two and one half or three inch control valve, however, has a minimum sustained flow rate of 15 GPM, well below the capacity of the 8" valve. By using the smaller valve for low flows, undue low flow stress on the 8" valve may be avoided, assuring the owner of long valve life.

Butterfly valves, on the other hand, will not sustain cavitations at low flow rates, but on larger sized valves, a small opening of the valve will allow a significant amount of water to pass, possibly more than required. As a result, pressure will rise in the discharge line and the valve will close. This begins a cycle of slightly opening and then closing the valve, which will make the valve continually "hunt" for the proper position, which it cannot achieve. This "hunting" will eventually cause premature wear on the drive train components of the valve and in turn cause early valve operator failure. The auxiliary low flow valve treats the low flow as a normal demand, and will not suffer early failure due to "hunting" of the valve. Such a low flow valve is normally supplied on valves *5"* and larger.

Where two valves are operated in parallel, as in the low flow condition described above, it is best to operate the valves with one controller (either programmable or pilot operated), shuttling the controller between valves as necessary. Use of one controller allows only one set of adjustments to be made for proper operation of either valve.
A programmable valve controller can take over the functions of backpressure, pressure reducing, opening speed and overpressure (surge) prevention pilots, opening and closing a hydraulic valve to provide constant pressure to the system. A control valve, either pilot operated or motor operated, can also be configured to close completely in the event of power failure from the programmable controller.