By Jon Steele, Technical Assistant

Options for Taking Water Storage Tanks Out of Service

KRWA staff are frequently approached by operators and managers of water systems with this question: "We need to have work done on the inside of our storage tank; how can we do that and keep water to our customers?" And my and others' response is, "Okay, we can assist you with that however first we need to visit the system to review the system and ask questions."

In past decades, perhaps until about 30 years ago, we would simply install pressure relief valves on fire hydrants and turn on a well or a high-service pump and let it run until the work was completed. However many things have changed since then. Some systems still use the fire hydrant relief valve option. This works but does have inherent problems. For instance, how long will the tank be out of service? How much water will need to be wasted? How will it affect the city or RWD's water rights? Will one pump be adequate to keep up with the demand during peak usage times? Is the system purchasing water from another supplier and if so, what is the cost of that water? These are all questions that need to be answered before taking a tank out of service.

A pressure relief valve should be installed on a distribution system even if other control options are being used. It's a safety valve in case of some other failure.

Today, there are various options for controlling pressure in a distribution system while the storage tank is being serviced. Some options help conserve water – and obviously, save money. Let's review the options in some detail although the specifics of water systems will vary.

Portable pressure tanks

Using a portable pressure tank is popular and works very well with smaller public water supply systems however is not satisfactory for larger systems unless multiple tanks are used. This is due to the high-volume demand during peak usage times and short cycling of well pumps or high service pumps if there is some type of clearwell in the system. If enough pressure tanks are available for use, then this system would be satisfactory even for larger systems although practicality issues with enough tanks begin to factor in. KRWA has two such tanks available for systems to use. The tanks can be plumbed into a distribution system by utilizing a fire hydrant or some other two-inch connection to the system. The tanks are generally used with a pressure relief valve. Sometimes a system's pump control settings need to be modified to allow for acceptable pumping cycles and to prevent pump short-cycling issues.

The portable tank takes the place of the storage tank. It uses a bladder-tank principle similar to what would be found on a rural resident with a private well. However, the portable tanks hold 3,000 gallons and do not have a charged pressure bladder. The portable tanks simply use the air space in the tank which is pressurized by the water from the pumping system. When the system's pumps are operating and the pressure of the city or RWD's system is reached, the pumps are set to stop. The pressurized the tank then delivers helps maintain the water supply to customers. When the pressure drops to the low-pressure set point, the system's wells or high-service pumps are activated to replenish water to the portable tank and pressure to the water system. The primary difference between these portable tanks and the system's storage tank is that there is much less tank volume. Sometimes the water system's pump settings will have to be modified to accommodate better pressure for the water system.

Variable frequency drives

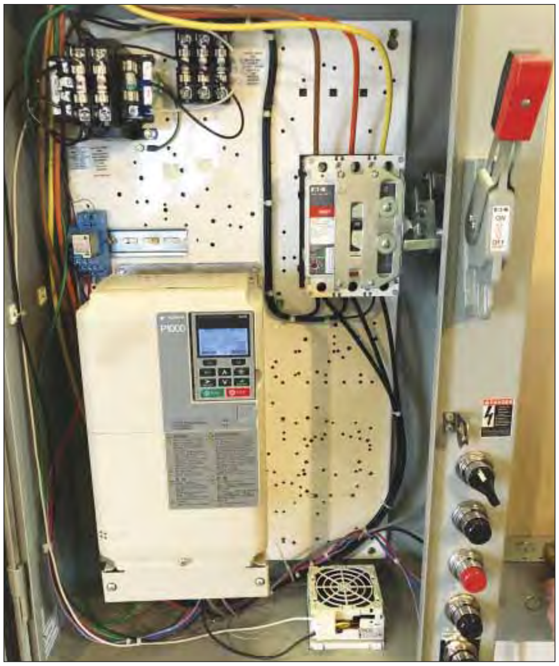
Another widely used method is discussed and KRWA provides training

This pressure relief valve is on a fire hydrant and is set for 50 psi. KRWA has multiple relief valves for system use. Relief valves provide a safety net to help avoid pipeline breaks when a tank is out of service.

on the use of variable frequency drives (VFDs) to control pumps and supply to the distribution system. This is an excellent method if the well pumps or high-serve pumps are capable of meeting the required demand volume during times of peak demand. If not, then pressure could decrease too low unless a second or even a third pump is brought online in a lead-lag type of system. The other inherent problem is if there is a loss of electrical power to the VFD, the pump motor stops. With the loss of head pressure of water being pumped, the pressure on the downstream side of the pumping unit can result in a reverse flow. Check valves, if present, should close rapidly. This sequence can create serious water hammer with pressure waves exceeding the pipeline specifications. Pipes will generally split longitudinally due to such conditions.

Pump control systems and VFDs have to be set up properly to accomplish the desired results of maintaining distribution system pressure. The system pressure is monitored by a pressure transducer which is a device that changes water pressure to an electrical signal. A VFD cannot understand water pressure in a conventional sense, however, it does respond to the small electrical signal coming from a pressure transducer. The

A pressure transducer, often called a pressure transmitter, is an electromechanical device designed to measure pressure with a high degree of accuracy. Pressure transducers sense applied pressure and output an electrical signal by using a combination of mechanical and electrical components. The most common transducer outputs are voltage and milliamps.



This Yaskawa P1000 VFD is at work in a south-central Kansas water system. This drive can provide control for variable torque loads.

two devices communicate to achieve and maintain the pressure that is programmed into the VFD. The VFD is constantly in a state of correction adjusting the speed of the motor to meet pumping to maintain the desired pressure.

I will attempt to further explain the VFD option. Suppose the VFD has been set to maintain 50 psi and the pump is capable of a maximum yield of 500 gpm at that amount of head pressure. If the demand on the distribution system is 200 gpm the VFD senses that the desired pressure is being met and begins to slow the speed of the motor, reducing the yield volume. The VFD will continue to reduce motor speed as the demand diminishes right on down to zero or a sleep mode on some VFDs. Thirty minutes later, the water system users begin to use the 200 gpm. Again the VFD will increase the motor speed to the previous setting. Ninety minutes later the demand increases to 300 gpm and the pressure drops slightly in the system. The transducer delivers this new information to the VFD that pressure has fallen below the desired set point. The VFD is set to turn speeds up or try to correct the deficiency by increasing the rpm of the motor which provides higher pumping output to meet the newly increased demand. The VFD option works very well unless the pumping system is not capable of keeping up with the required gpm flow during peak demand. For example, if the demand were to increase to 800 gpm, the pressure would drop even though the VFD was operating the motor and pump at full capacity.

Some small public water supply systems are designed to operate primarily with elevated storage tanks or standpipes that are capable of delivering high volumes of water during peak times even though the pumping system may be relatively small. Some small systems may only be capable of delivering 100 gpm from their supply well but are capable of a peak demand flow of 750 gpm once the elevated storage tank is full, assuming the distribution system piping is adequate for that amount of flow.

Think of the elevated storage tank as a storage battery like on a vehicle. When the engine starts, large amounts of electrical current are needed to turn the engine over against compression. But once the engine is running, that demand on the storage battery diminishes and the alternator trickles small amounts of electrical current back to the battery to recharge to the full charge state. This is similar to the principle in a small public water supply system. An exception would be larger water systems with high-rated horsepower pumping systems on large supply wells or ground storage tanks are used. These systems may have enough pumping capacity to meet system demands merely with the pumping system.

So to conclude, it's best to do more than just install a hydrant relief valve to avoid having the system being over-pressurized. Likewise, some systems have experienced significant pipeline breaks because a control mechanism malfunctioned and there was no hydrant relief valve in place. KRWA staff always recommend that no matter the method of control, always have a relief valve somewhere to prevent over-pressurization.

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