PRV Stations Provide Fire Protection, Lower Insurance Rates

by Aaron Eder, P.E., Project Manager/Civil Engineer, Kennedy/Jenks Consultants

The city of Hillsboro, home to businesses such as Intel, Planar Systems and TriQuint, is one of several high technology centers in Oregon. Most of Hillsboro's commercial industry is located in park-like, industrial campuses built to blend in with the surrounding countryside. The water distribution system in the northeast section of the city, where the high-tech firms are located, was experiencing a gradual reduction in service pressure over time. As a result, the water pressures provided to a major customer in this section of the city was lower than the original pressure used in the design of the facility. In late 2004, the facility owners were informed that they could face substantial increases in their fire insurance rates if water pressure was not increased by Jan.1, 2006.

Water supply for this section of the city is pumped from a reservoir by four booster pumps. Because Hillsboro's water system was previously operating within a single pressure zone, they could not simply increase the system pressure. Increased water pressure in one part of the system would have caused excessive pressures elsewhere in the system, such as in the lower residential sections south of the industrial area. Yet, without additional system pressure in the industrial zone, future growth would be problematic.

Searching for a solution

After analyzing the issue, the city concluded that the ideal long-term solution was to create a higher-pressure zone in this area, which they called the "Northeast High Pressure Zone." To create the high-pressure zone, the city identified six locations where pressure-reducing valve (PRV) stations should be installed. PRVs are valves that automatically reduce a higher inlet pressure to a steady, lower downstream pressure, regardless of changing flow rates and/or varying inlet pressure. The city hired Kennedy/Jenks Consultants to provide preliminary design and design services for the PRV stations.

During the preliminary design stage, the consultant determined that the need for two of the PRV stations could be eliminated by simply closing and locking existing valves. The resulting design created a high-pressure loop that surrounds the customers in the Northeast High Pressure Zone. Furthermore, it was not critical for the city to know pressure and flow at another location in the system, but the pressure drop was still necessary to create the two pressure zones. As a result, the city eliminated another PRV station and replaced it with a bypass. The bypass consisted of an orifice plate that restricted flow to the level that was required for water quality purposes and minimized the potential for stagnant water. *(See Figure 1– PRV Bypass)*

The existing system pressure in the area measured about 70 pounds per square inch (psi). For fire protection purposes, however, a pressure of 80 psi is preferable when measured at individual water meters. Oregon Administrative Rule (OAR) 333-061-0050 requires that a distribution system pressure of 20 psi be maintained at all times. Pressures measuring between 45 and 80 psi are appropriate for most uses, while pressures that register higher than 90 psi may cause damage to plumbing systems. For this reason, the Uniform Building Code requires installation of PRVs for all service areas where pressures exceed 90 psi. A desirable pressure range for the high pressure zone, then, would measure between 80 and 90 psi.

PRV package systems

To keep project costs low and ensure that the project was completed before the deadline, Kennedy/Jenks recommended that the city use PRV package systems that could be delivered to the site as intact units. In

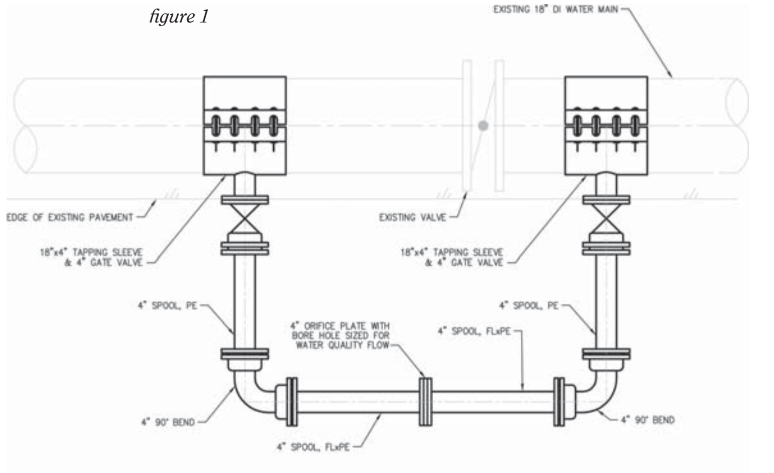


figure 1

selecting the package systems, the consultant reinforced the city's increased emphasis on worker safety by placing greater weight on safe working conditions for city crews. To avoid subjecting work crews to long periods of work in confined spaces, the consultant selected package systems that were designed to be hard-wired to an above-ground electrical cabinet. This allows workers to take readings from the meter, PRVs, and pressure gauges without having to enter the vault. For the few times that confined space entry is required, interior lights were provided for better visibility, and additional clear space was available where the ladder meets the bottom of the vault for greater worker comfort and safer footing.

Ensuring uninterrupted flow

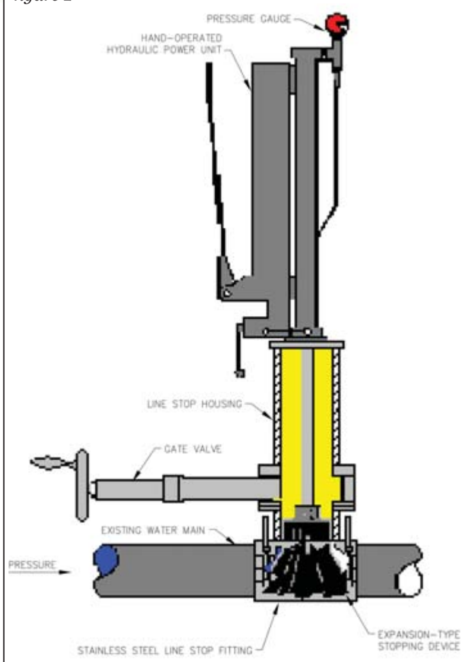
The high-tech firms in Hillsboro run multi-billion-dollar operations in their facilities. Even temporary interruptions in water service would have major repercussions. For this reason, the consultant needed to ensure that the existing water mains would not be shut down for installation of the PRVs. A further concern was that PRV bypass branches are typically constructed on either side of an existing in-line valve, which normally would be closed.

To address these concerns, the consultant recommended "hot tapping," the accepted and proven method of installing bypass branches without loss of pressure or content, allowing the connection to be made without interruption of water service. The hot tap procedure involves attaching a branch connection, such as a stainless steel sleeve, and a valve on the outside of an operating pipeline; cutting out the pipeline wall within the branch; and removing the wall section through the valve. Since one of the Hillsboro PRV stations did not have an existing in-line valve in which to construct bypasses, one had to be installed.

According to current practice in the water industry, installation of valves under flow conditions is limited to pipes that are up to 12 inches in diameter. However, the existing main at this location was 16 inches. To install a valve in the 16-inch line, line stops were installed and a valve was cut in. Line stops are similar to line tapping, with the addition of stopping flow. Once the hole is cut in the line, the cutter is retracted, removed, and replaced with an expansion-type stopping device that uses a valve, fitting, and sealing machine. *(See Figure 2 – Line Stop)*

The stopping device is inserted into the pipe through the same hole and expanded, effectively stopping the flow of contents at that point. When two line stops are done in conjunction, the length of pipe between them is isolated. This allowed the contractor to install an in-line valve on the isolated pipe segment without interrupting water service to the nearby customers.

figure 2



A smooth start-up

The city took care to avoid impacting the surrounding service areas during installation of the high-pressure zone. Kennedy/Jenks and the city prepared special PRV startup procedures to ensure that the residential customers in the area immediately adjacent to the new high pressure zone would not notice the introduction of the new pressure zone. They accomplished this by outlining a detailed sequence of procedures and obtaining input from the city, contractor, subcontractors and PRV manufacturer.

The sequence of procedures included opening the PRV bypasses; hot-tapping main-line valves; closing existing valves at the outskirts of the new high-pressure zone; and gradually increasing the pressure in increments of 5 psi to avoid water hammer. Water hammer occurs when flowing water in a pipe is abruptly cut off due to a valve or hydrant that is closed too quickly. This causes a sudden pressure wave that is transmitted downstream, shocking the pipes. After each procedure, the contractor took pressure measurements and recorded them at several locations within and outside of the new pressure zone, ensuring that the impacts would not be noticed by nearby residents.

Startup procedures began on March 1, and no noticeable impacts were felt by the residential customers close to the new high pressure zone. Insurance rates were not increased, because the insurer was aware of the city's project and had been standing by until the project was completed. The high pressure zone is now active, operating between 80 and 90 psi. Downstream, the pressure is in the mid-60s, matching the pressures that were measured prior to startup of the new high pressure zone.

Summary

This innovative engineering project installed PRV stations to increase water pressure for high-tech firms without impacting either residential or other industrial customers. In doing so, the project not only eliminated the need for half the PRV stations, but also saved the city a substantial amount of money.

About The Author: Aaron Eder, P.E., is a project manager and civil engineer in the Portland, OR, office of Kennedy/Jenks Consultants, one of the West Coast's leading water and wastewater treatment and design firms. He is a licensed professional civil engineer in Oregon and Washington. Eder received a bachelor's degree in civil engineering from the University of Washington in 1995 and his master's degree in civil engineering from Portland State University in 2005. Eder was instrumental in Kennedy/Jenks recently being awarded several high-profile projects with the city of Portland Bureau of Water Works and the city of Hillsboro. He is currently serving as the project manager and project engineer for water main relocations in 5th and 6th Avenues for TriMet's Portland Mall Segment of the South Corridor Project. ■