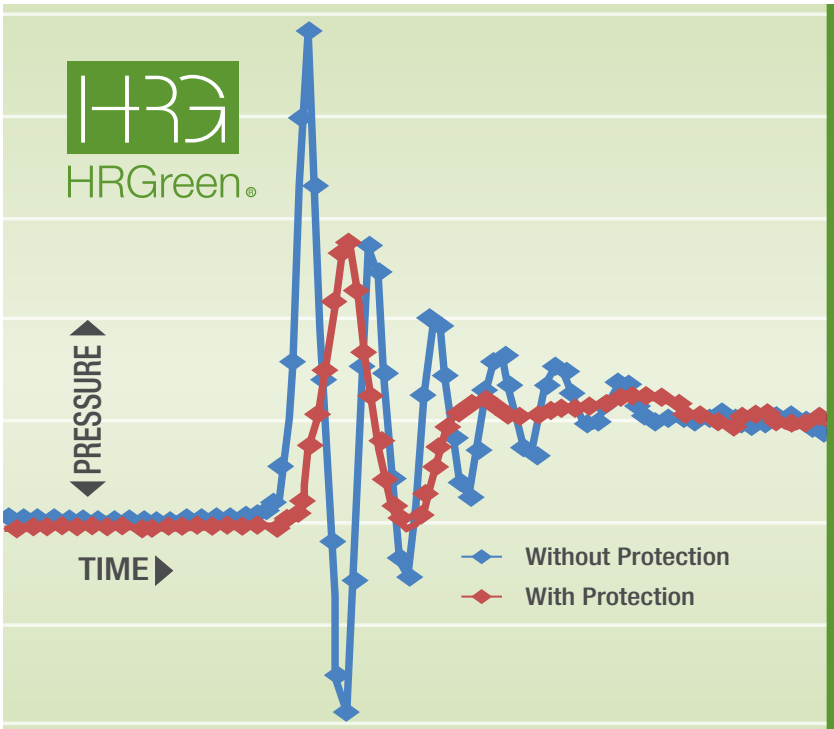


WATER

WATER HAMMER (TRANSIENT ANALYSIS) PROJECT APPROACH

Water Hammer Prevention

Critical to large piping and pumping system design and operation is an understanding of water hammer (i.e., hydraulic transients or high and low pressure surges) and how they may be induced in your system. These pressure surges occur in potable water, waste water, storm water, and other fluid transport systems.

The surges are caused by changes in the velocity of the fluid being conveyed through the system. Causes of velocity changes include but are not limited to pump start up and shut down, valve opening and closure, check valve slam, surge relief valve opening and closure, combination air/vacuum and air release valve closure, surge tank flow release, etc. They can be a serious problem because they can create pressures that exceed the pressure ratings of your system.

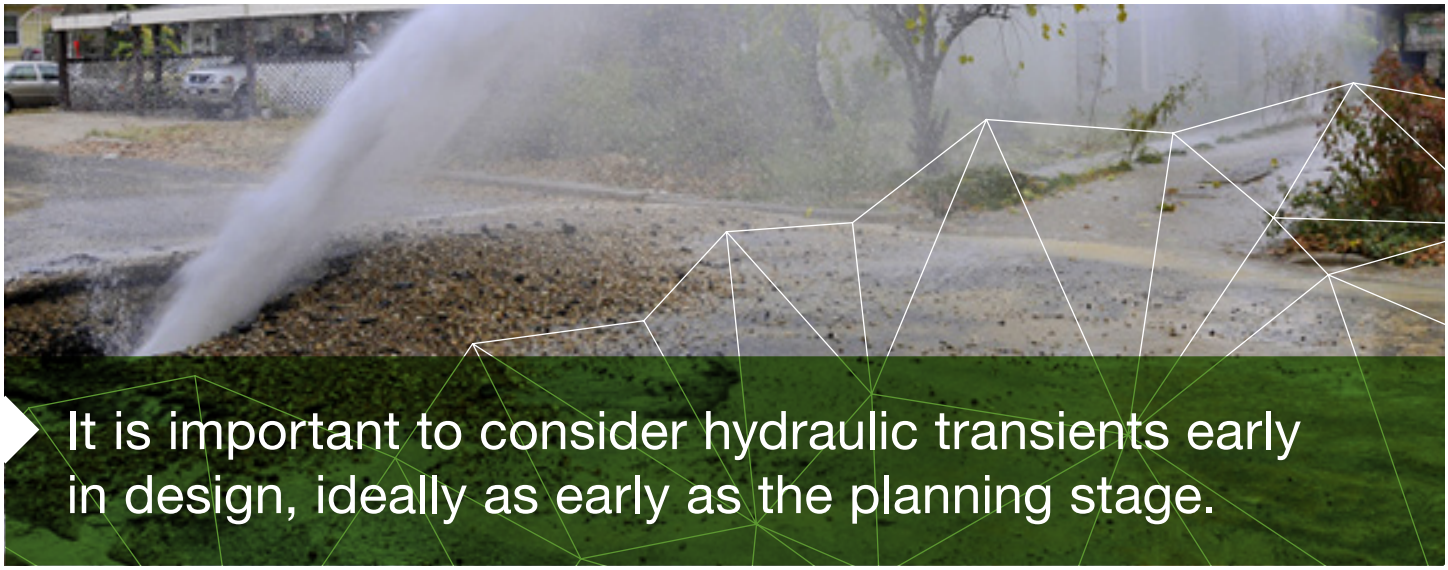
Though sometimes counter intuitive, flow disturbances can also cause low pressure spikes. Low pressures could result in vapor cavity formation, subsequent vapor cavity collapse, and catastrophic high pressures, higher than would otherwise be seen in the pipeline.

HR Green uses specialized software to perform transient analyses in house. The purpose of these analyses is to calculate the potential for hydraulic transients, compare the predicted surge pressures with allowable piping pressure ratings, and recommend surge protection measures to be incorporated into the system. It is important to consider hydraulic transients early in design, ideally as early as the planning stage because the likelihood of a given pipe system experiencing issues with hydraulic transients is dependent on the pipe profile.

▷ Surge protection equipment itself brings with it increased cost, operation and maintenance requirements, equipment layout challenges, and ironically even added risk of hydraulic transients if improperly designed. As a result, the equipment must be an integral part of pump station and piping design.

▷ Combination valve

▷ Surge relief valve



It is important to consider hydraulic transients early in design, ideally as early as the planning stage.

OUR APPROACH ON EXISTING SYSTEMS:

1. Collect field data on existing or newly constructed pump stations and create a calibrated model that behaves in accordance with the way the actual system behaves.
2. Use calibrated models for the purpose of troubleshooting hydraulic transient issues that have taken place. Follow the below steps if design changes are called for.

OUR APPROACH DURING SYSTEM DESIGN:

1. Selecting the piping alignment such that the profile minimizes high points.
2. Selecting piping diameter to balance the decreased risk of solids deposition and air pocket formation at higher velocities with the increased risk of higher magnitude hydraulic transients.
3. Performing transient analysis modeling of the pumping and piping system and use models to recommend surge protection equipment including the following:
   a. Combination air/vacuum and air release valve sizing and location placement
   b. Valve closure time / method
   c. Surge relief valve sizing
   d. VFD acceleration and deceleration time
   e. Flywheels to increase pump inertia
   f. Surge tank sizing and location placement
4. After preliminary equipment selection we meet with clients specifically to discuss the risks, costs, operation and maintenance impacts, and long term infrastructure viability impacts of the various protection options.
5. Selecting pipe materials that are suitable for the range of hydraulic transient pressures that are anticipated given the protection equipment selection.

▷ Surge Tank

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