THE UNHEALTHY RELATIONSHIP BETWEEN PRIVATE FIRE SYSTEMS, MUNICIPAL WATER SYSTEMS, AND PRESSURE SURGES

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1. Understand what causes pressure surges and their potential for failure.
2. Evaluate the potential for pressure surge and identify surge control strategy.
3. Require necessary surge control equipment.
Defining a Pressure Surge (transient or waterhammer)

A temporary increase or decrease in system pressure caused by a rapid change in flow rate.
Pressure Surges Can be Caused by Numerous Routine System Operations
Hydraulic Transient Event

Initial flow and pressure condition

Rapid change in flow rate/velocity

Change in water column momentum

Final flow and pressure condition

Dampening of pressure wave

Propagation of pressure wave

Change in pressure

Hydraulic Transient Event

Excellence Delivered As Promised
Pressure Surge Can Result in System Failures

- Main Breaks
- Joint Separation
- Pipe and Joint Fatigue
- Intrusion/Backflow
- Pipe Collapse

Pressure (psi) vs. Simulation Time (seconds)
Case Study Background

- 725' OF
- Approx. 1 mile of 16-inch main
- Approx. 1 mile of 12-inch main
- Approx. 1.5 miles of 16-inch main

Private Fire P.S.

Retail Customer #1
- Surge Relief Valve

Retail Customer #2
- Private Fire P.S. (elev. 591')
Main Break During Testing Of Fire Pump

Approx. 1 mile of 12-inch main

Start-up Testing of Fire Pump and Relief Valve

Retail Customer #2

Private Fire P.S. (elev. 591')
Fire Pump Operation Can Produce Surge in Municipal System and Result in System Failure

- Fire Pump Start-up, Shut-down or Valve Operation
- Rapid Change in Flow in Municipal System
- Pressure Surge in Municipal System
- Main Break in Municipal System
Proper Evaluation Can Identify the Need for Surge Control

Step 1: Develop Transient Computer Model

Step 2: Identify & Evaluate Transient-Resulting Operations

Step 3: Identify & Evaluate Transient Control Alternatives

Step 4: Recommend/Design/Construct Appropriate Transient Control Strategy
Modeling Evaluation to Assess Surge During Pump Test

Pump Shutdown: 1,500 gpm to 0 gpm in 2 sec.
Identify and Evaluate Other Surge-Causing Operations

Pump Startup: 0 gpm to 1,200 gpm in 2 sec.
Proper Surge Control Equipment Can Control Pressure Surge

For “normal” system operations:
- Variable-Speed Drive Pumps
- Pump Control Valves
- Slow Operating of Valves and Hydrants

For “emergency” system operations:
- Surge Relief Valves
- Surge Anticipator Valves
- Surge Tanks
- Air Valves
Surge Relief Valve Minimizes Surge During Shutdown

Shutdown – No Surge Control

Shutdown With 6” Surge Relief Valve
Surge Relief Valve Dampens Surge but Does Not Control Low Pressure Surge On Startup

Startup – No Surge Control

Startup With 6” Surge Relief Valve
Surge Tank
Can Control Surge On Shutdown

Shutdown – No Surge Control

Pressure (psi)
Time (sec.)

Shutdown With 6” Surge Relief Valve

Shutdown with 1,500 Gal Surge Tank

Pressure (psi)
Time (sec.)
Surge Tank
Can Control Surge On Startup

Startup – no surge control

Pump Startup with Surge Tank

Startup with 6” Surge Relief Valve
Recommend 1,500 Gal Surge Tank to Control Surge and Minimize System Failure

Private Fire P.S.

Retail Customer #1
Surge Relief Valve

Retail Customer #2
Private Fire P.S. (elev. 591')

Young Engineering Manufacturing, Inc.
Proper Consideration of Private Fire Pump Surge Can Protect Mun System Against Failure

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2. Evaluate the potential for pressure surge and identify surge control strategy.
3. Require necessary surge control equipment.
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