



# Problems with Hypo: Best Design Practices for Smooth and Efficient Sodium Hypochlorite Feed Systems

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# Outline

- Common Options Available for Chlorine Disinfection
  - Bremerton Water System and New Advanced Disinfection Facility (ADF)
  - Overview of Hypochlorite Feed System
  - Initial Design Layout and Problems Encountered
  - Troubleshooting
  - Final Solution
  - Best Management Practices for System Operation and Design
- 

# Typical Chlorine Alternatives

Disinfection Alternative	Process Overview	Process Pros/Cons
Delivered Chlorine Gas	<ul style="list-style-type: none"> <li>▪ Gas chlorine system previously used by Bremerton.</li> <li>▪ Delivered in 150 lb or ton containers.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Safety risks, emergency planning and regulatory requirements with use of gas.</li> <li>▪ Often the most inexpensive option.</li> <li>▪ Low footprint.</li> </ul>
Delivered (Bulk) Sodium Hypochlorite Liquid  	<ul style="list-style-type: none"> <li>▪ Liquid sodium hypochlorite as a disinfectant is similar to use of chlorine gas and equally as effective.</li> <li>▪ Liquid storage and feed is safer than gas under pressure. Although, NaOCl is a corrosive liquid with unique code and safety considerations.</li> <li>▪ Requires contract with chemical supplier to deliver bulk liquid to storage facilities at the plant site.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Safety risks with liquid systems (corrosive).</li> <li>▪ Requires more pumping/instrumentation control features.</li> <li>▪ Carrier water system/pumps often required.</li> <li>▪ Higher footprint.</li> </ul>
On-Site Generated Sodium Hypochlorite Liquid (0.8%)  Electrolytic Technologies, MiOX, Seimens	<ul style="list-style-type: none"> <li>▪ Hypochlorite generation is based on electrolysis of brine, an electrochemical process that consumes salt, water, and power to produce a liquid hypochlorite solution.</li> <li>▪ Liquid storage and feed system required. However, the storage volume can be reduced as the chemical is continuously generated.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Auxiliary equipment that must be maintained.</li> <li>▪ Higher footprint for storage if lower concentration used.</li> </ul>

# Casad Dam



# Casad Dam



# Casad Dam

- Height: 190 feet
- Length: 416 feet
- Elevation at top: 643.7 feet above sea level
- Thickness at base: 56 feet
- Drainage Area: 3,000 acres
- Surface area at crest: 40 acres
- Water storage at crest: 1.4 billion gallon
- Provides 65% of City water supply





# New Advanced Disinfection Facility (2.9 – 23 MGD)



# Medium Pressure UV System



# Control Valves (Cla-Val)



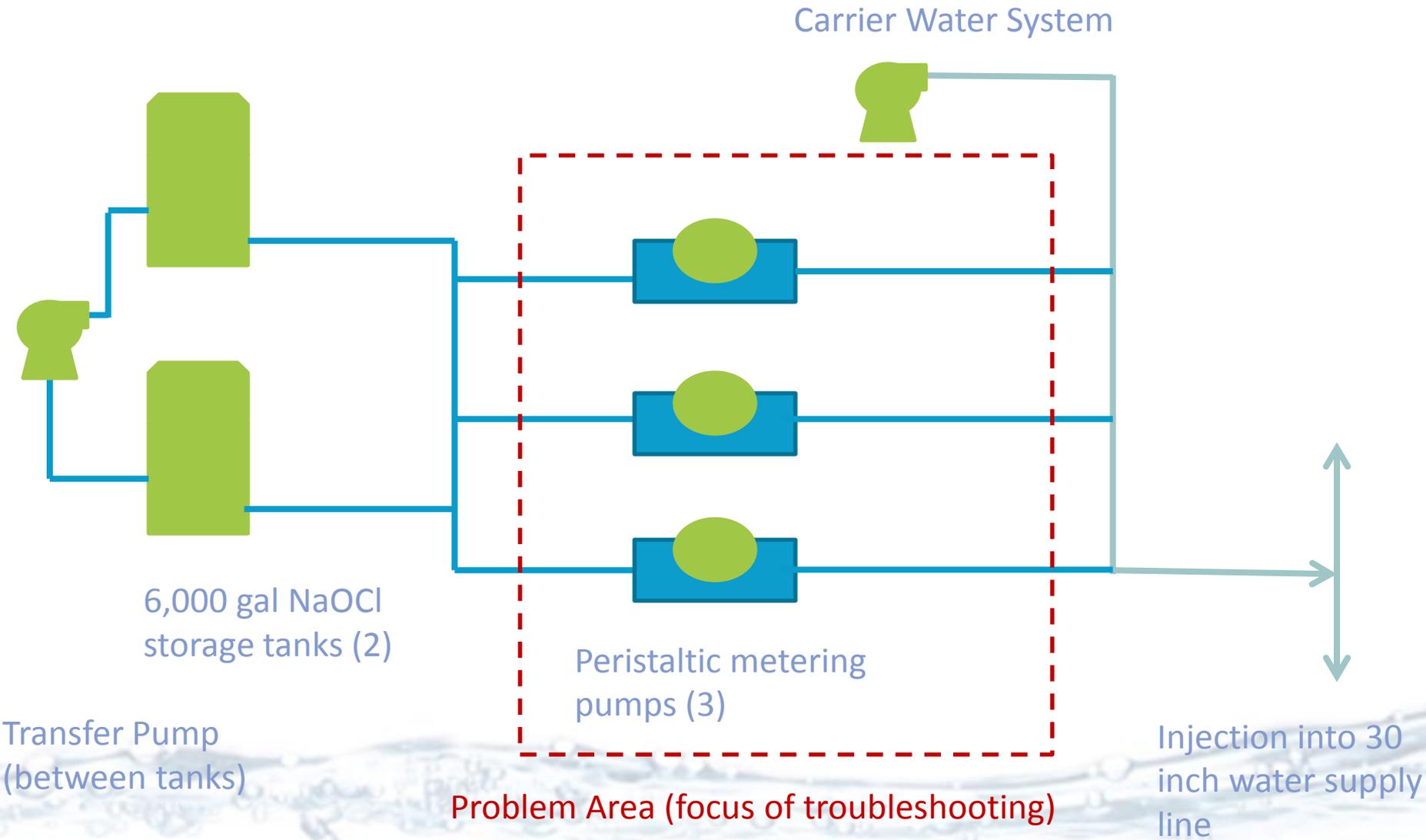
# UV Reactor Control Screen



# ADF Grand Opening



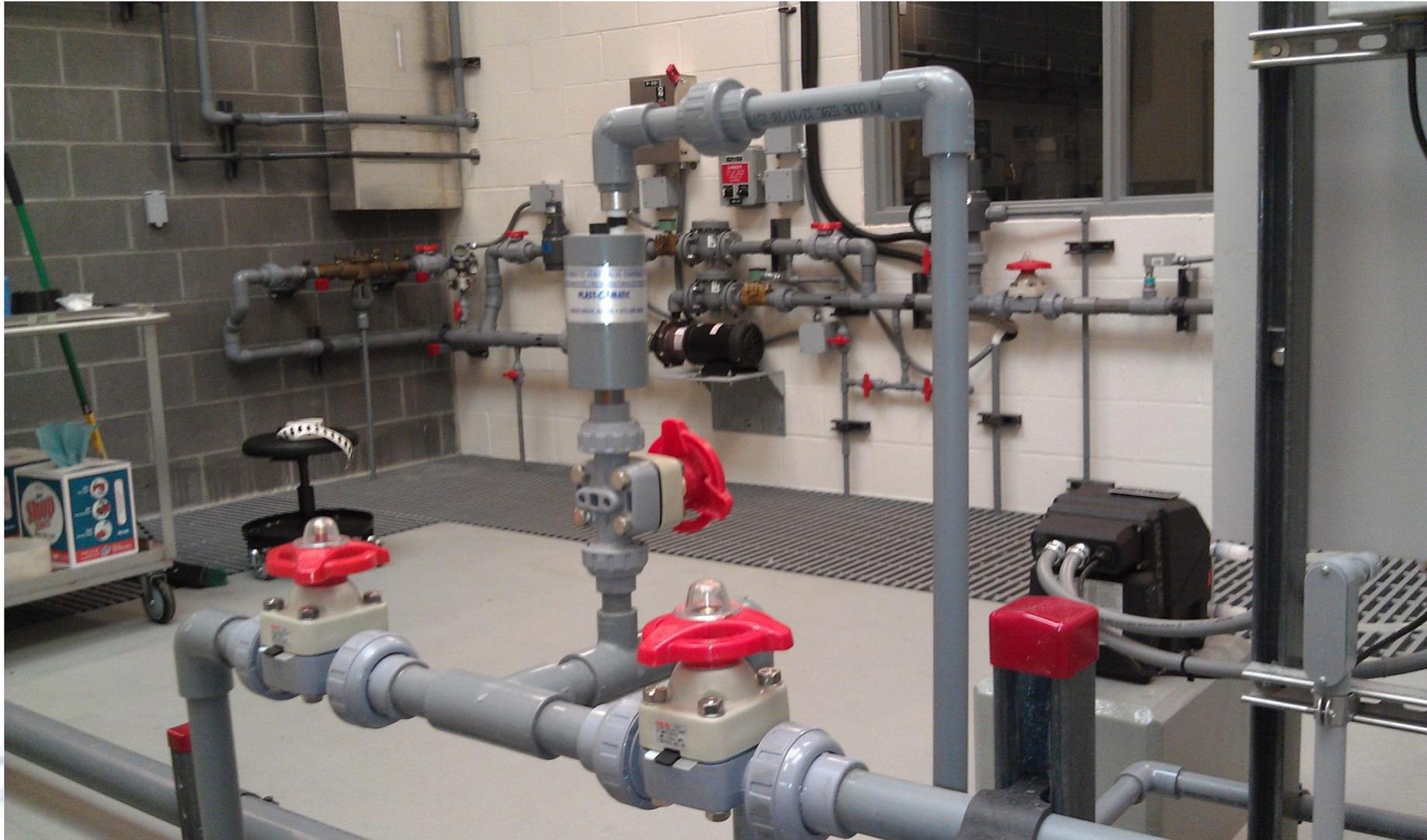
# New ADF Chlorine System



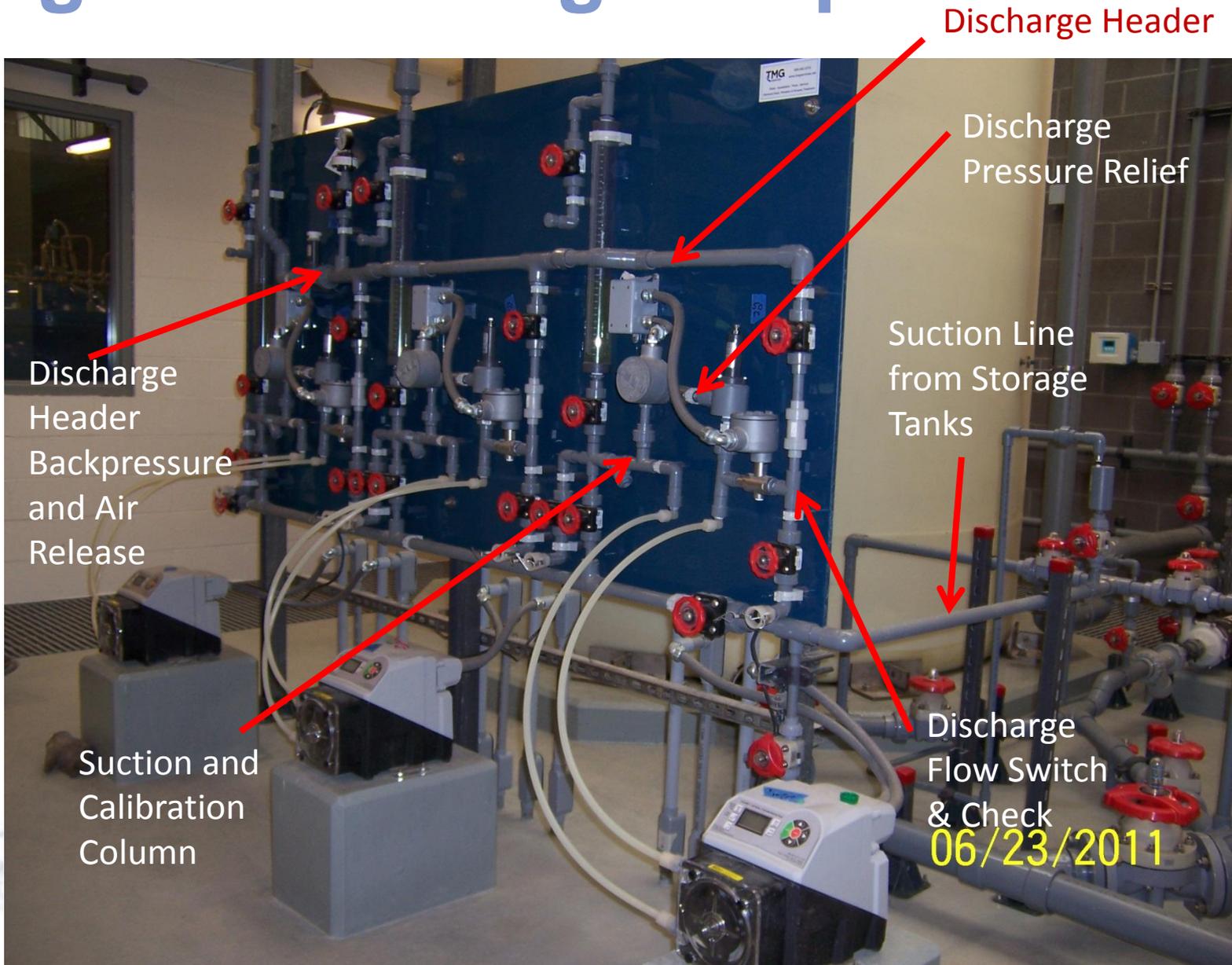
# Carrier Water System



# Gas Relief Valves



# Original Metering Pump Board 1



# Original Metering Pump Board 2

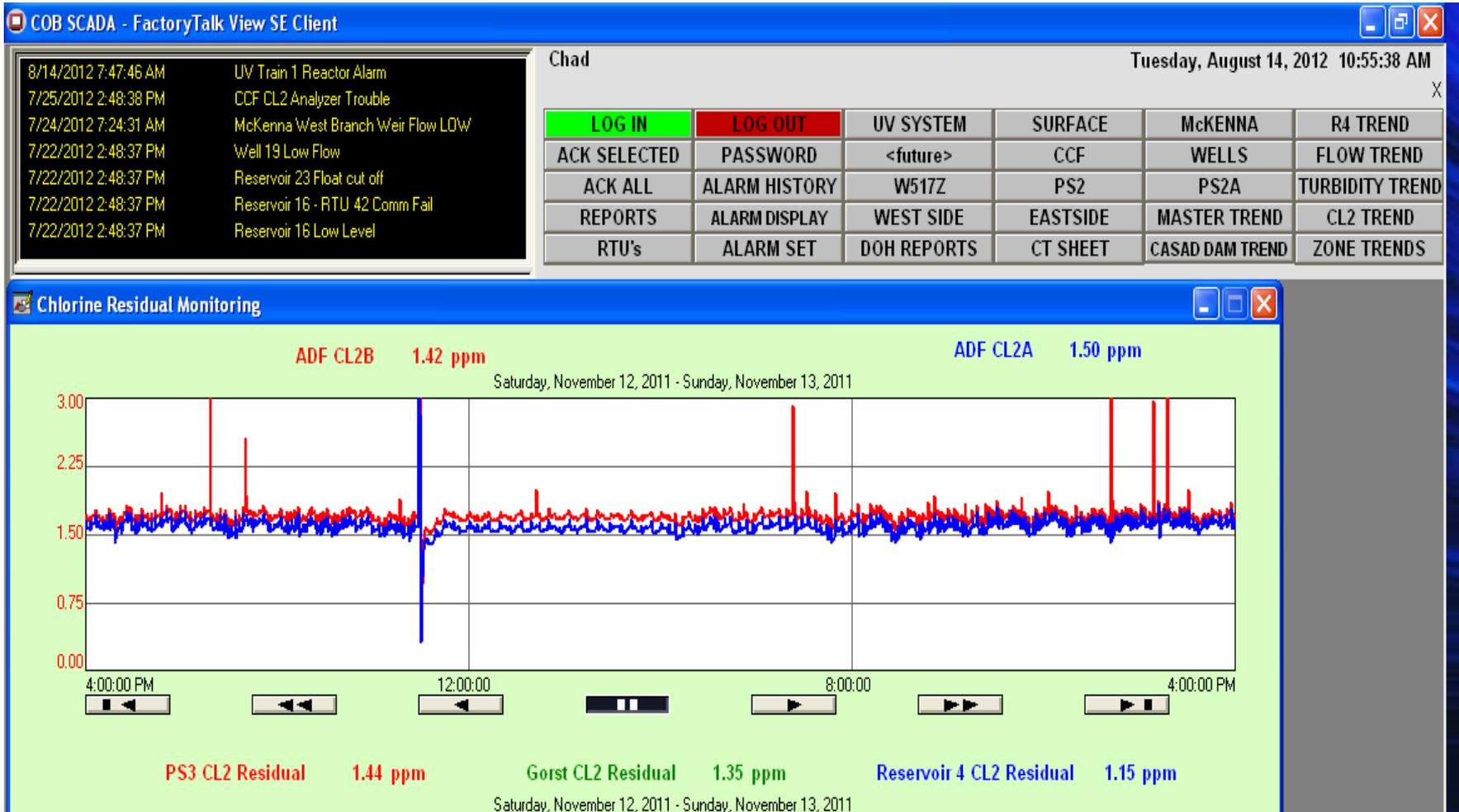


# Problems with Initial System

- Air binding on suction side of pumps
  - Air traps, 90 deg bends, flat piping
- Inability to maintain a smooth (flat line) chlorine residual
- Tubing failures within 24-100 hours of operation
- No flow and pressure relief alarms
  - Air trapping in thermal flow switches



# Erratic Chlorine Residual

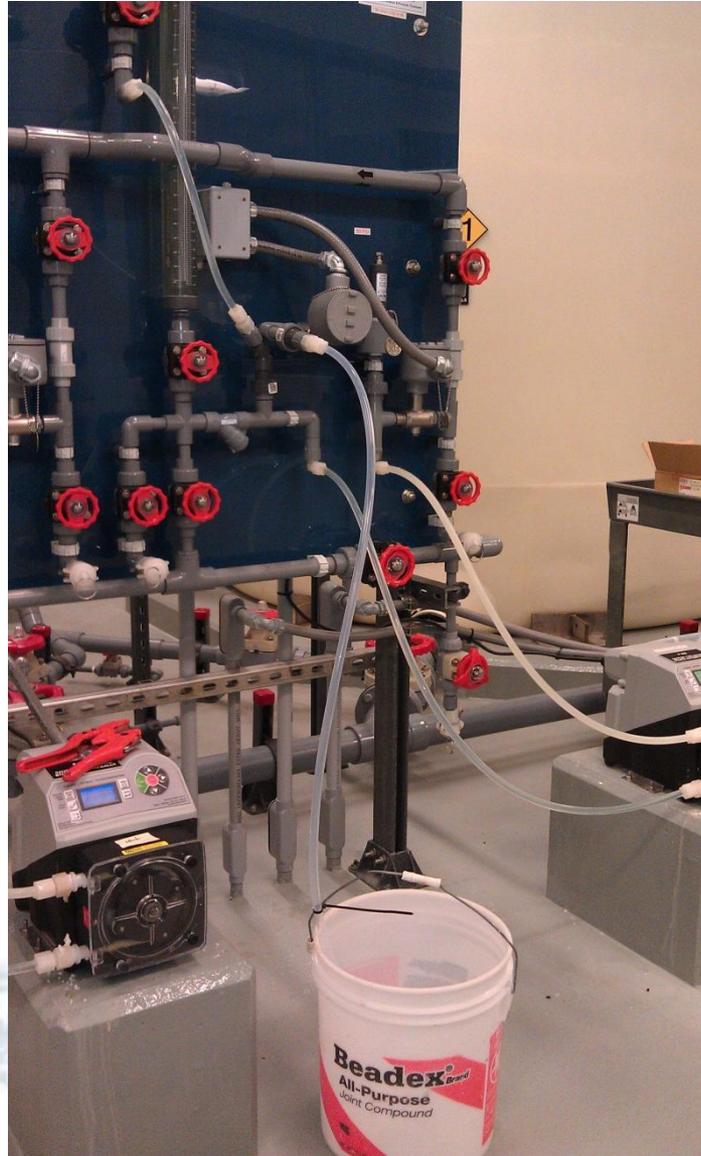


# Troubleshooting (First Round)

- Disconnected pressure relief line and ran tubing to an open bucket
- Plumbed the suction side connection to the vent line
- Helped to smooth chlorine residual, but still problems with air on suction piping, poor degassing on discharge side



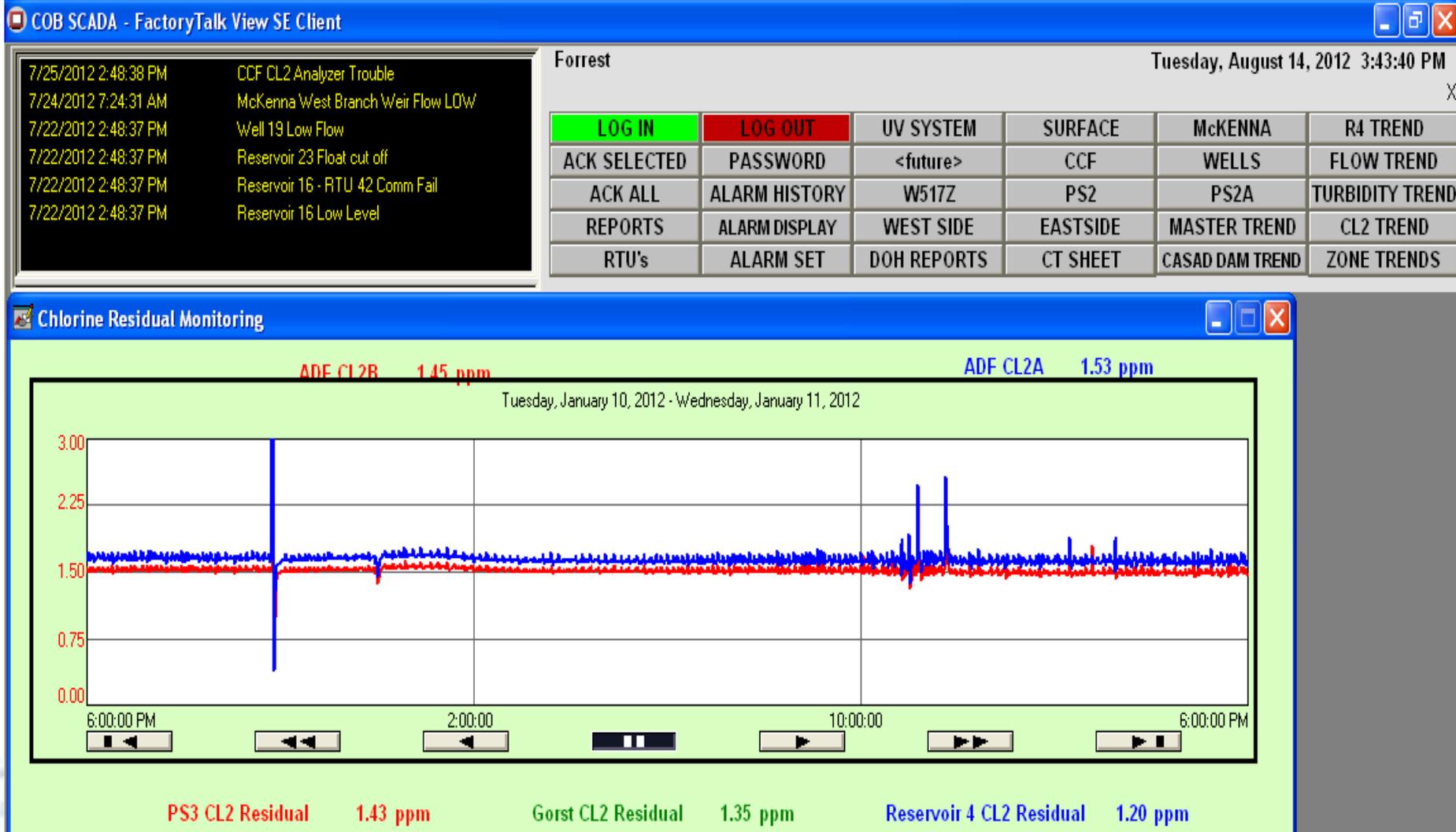
# Pressure Relief Check 1



# Pressure Relief Check 2



# Residual after First Round



# Troubleshooting (Second Round)

- Removed horizontal pipe, strainer, and 90 deg bends on suction side of pump
- Utilized vertical wye fittings
- Bypassed the flow switch on the discharge side of the pump
- This reduced air binding on pump suction and the chlorine residual was much smoother
- Still occasional spikes in residual, followed by drop (1-2 times per day)



# Partially Modified Board



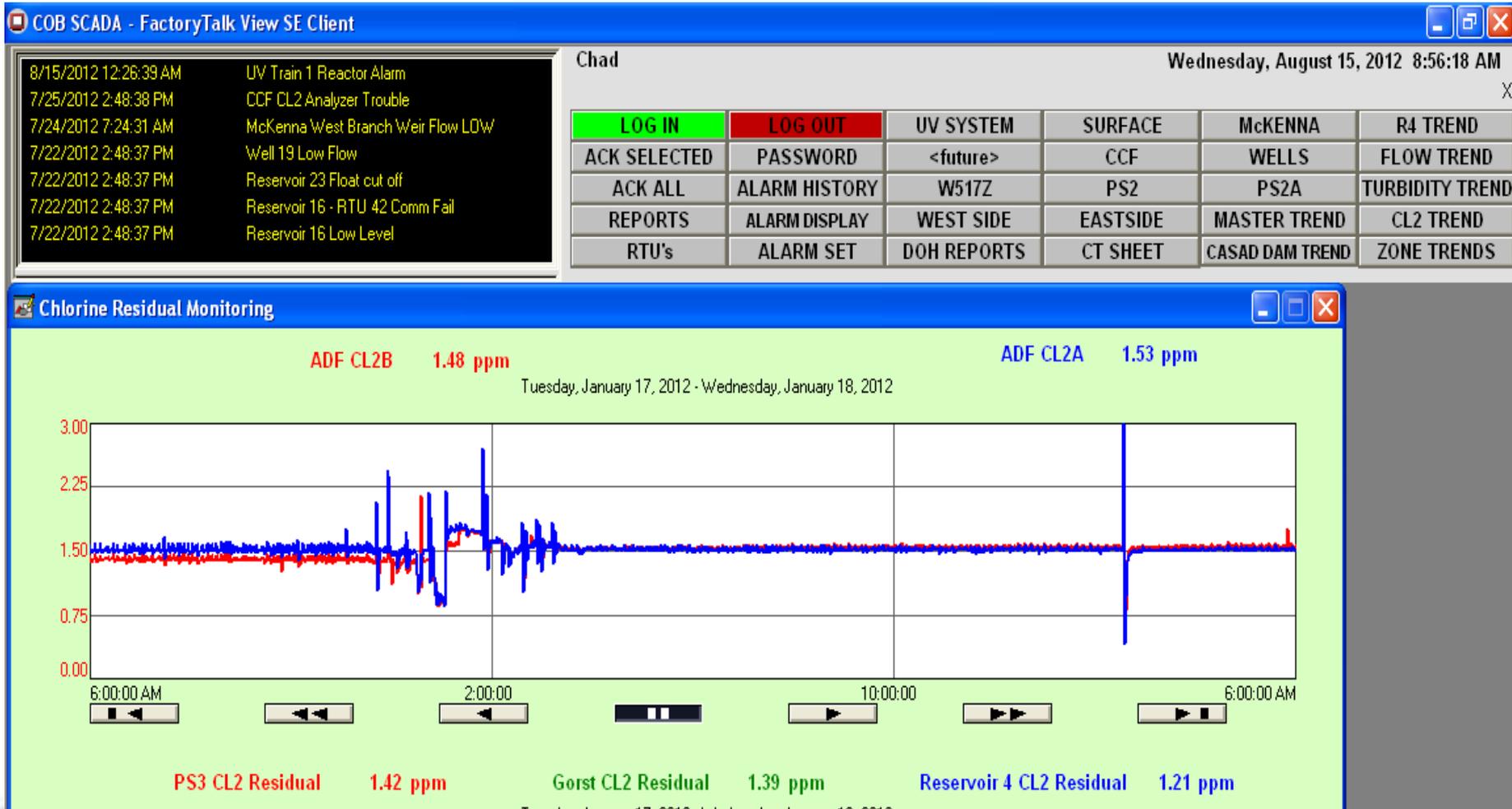
# Flow Switch Inlet



# Flow Switch Outlet



# Residual after Second Round

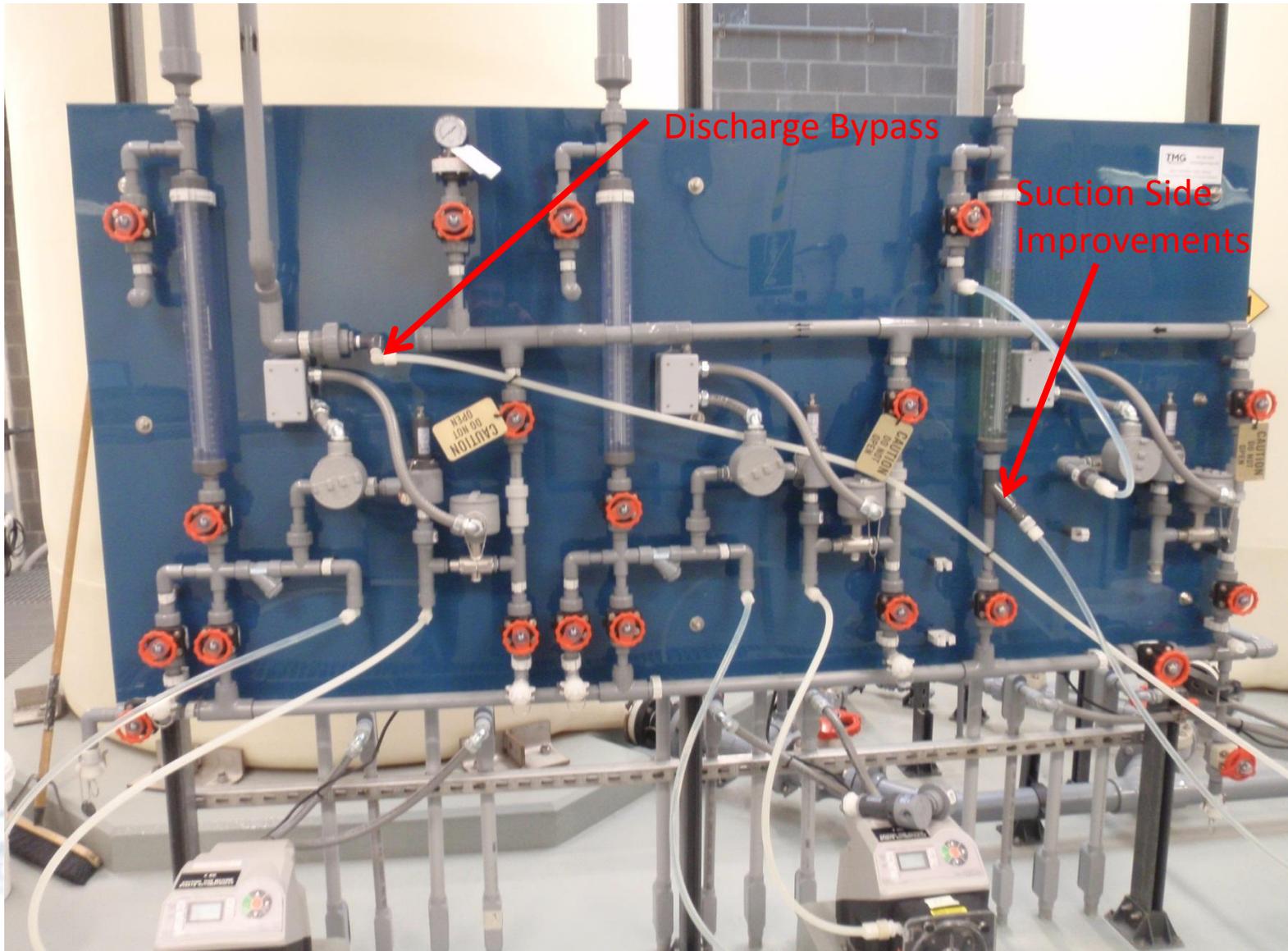


# Troubleshooting (Third Round)

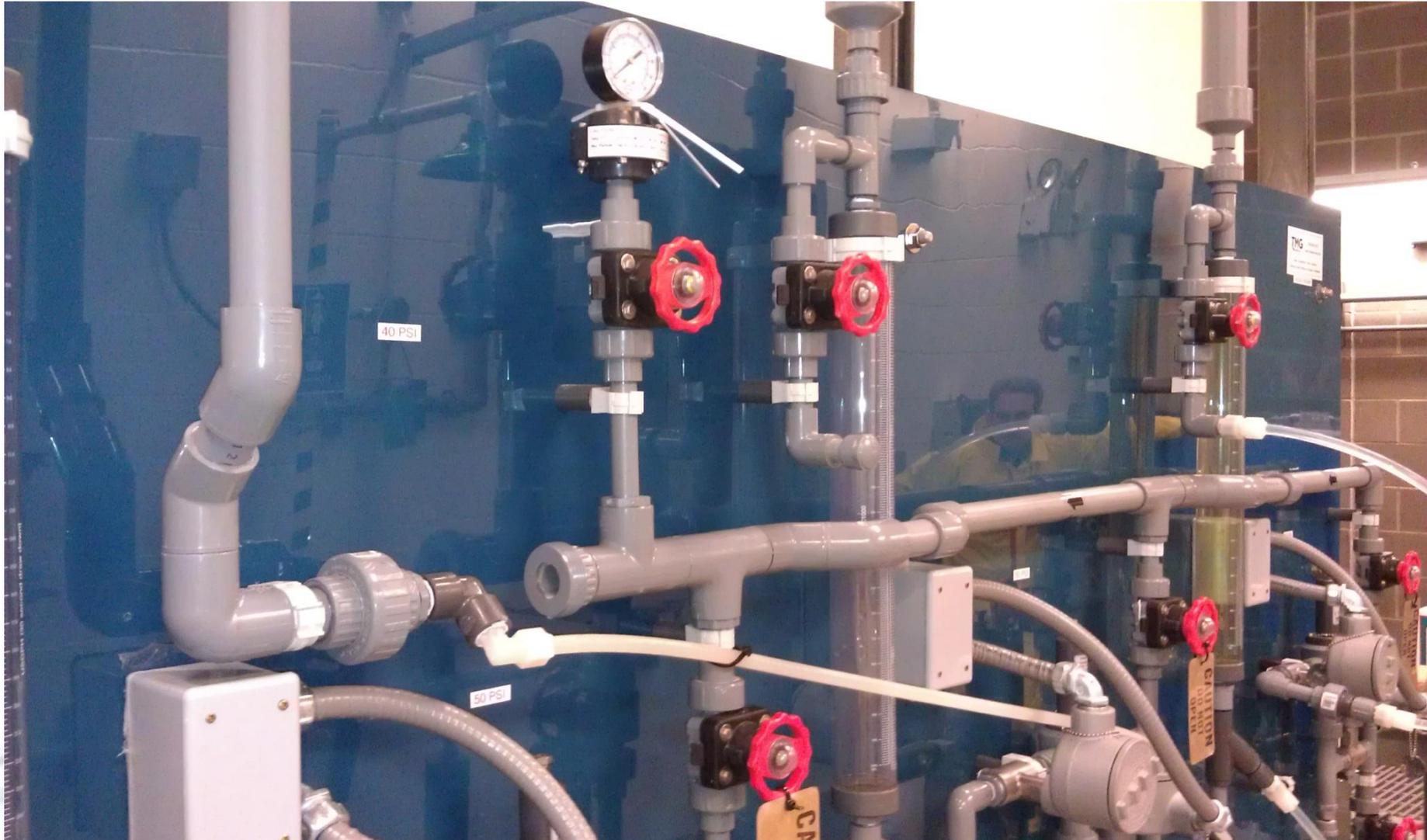
- Bypassed the discharge piping backpressure valve
- The 1 inch to ½ inch connection at the valve may have air pockets developing; building with occasion pulses to release
- This cleared up the remaining residual spikes



# Discharge Piping Bypass



# Discharge Piping Bypass



# Final Update of Piping

- Keep wye fittings
- Eliminate flow switches
- Simplify piping – keep things vertical
- Eliminate backpressure valve
- Route carrier water to hypo panel (not hypo panel to carrier water)
- Results
  - 1,000 plus hours of tube life with 1-1.5 million revolutions
  - No spikes, smooth residual



# New Hypo Panel



# Pump 1 Piping

Pressure Relief  
(no high point)

Vertical Suction  
with Wye Fittings

Vertical  
Discharge with  
Wye Fittings, no  
Flow Switch



# Pump 2 Piping



# Hypo Injection Point



Carrier Water  
Supplied  
Immediately  
Above Discharge

# Final Residual Trend with New Panel

COB SCADA - FactoryTalk View SE Client



8/14/2012 7:47:46 AM UV Train 1 Reactor Alarm  
 7/25/2012 2:48:38 PM CCF CL2 Analyzer Trouble  
 7/24/2012 7:24:31 AM McKenna West Branch Weir Flow LOW  
 7/22/2012 2:48:37 PM Well 19 Low Flow  
 7/22/2012 2:48:37 PM Reservoir 23 Float cut off  
 7/22/2012 2:48:37 PM Reservoir 16 - RTU 42 Comm Fail  
 7/22/2012 2:48:37 PM Reservoir 16 Low Level

Chad

Tuesday, August 14, 2012 10:35:50 AM

LOG IN	LOG OUT	UV SYSTEM	SURFACE	McKENNA	R4 TREND
ACK SELECTED	PASSWORD	<future>	CCF	WELLS	FLOW TREND
ACK ALL	ALARM HISTORY	W517Z	PS2	PS2A	TURBIDITY TREND
REPORTS	ALARM DISPLAY	WEST SIDE	EASTSIDE	MASTER TREND	CL2 TREND
RTU's	ALARM SET	DOH REPORTS	CT SHEET	CASAD DAM TREND	ZONE TRENDS

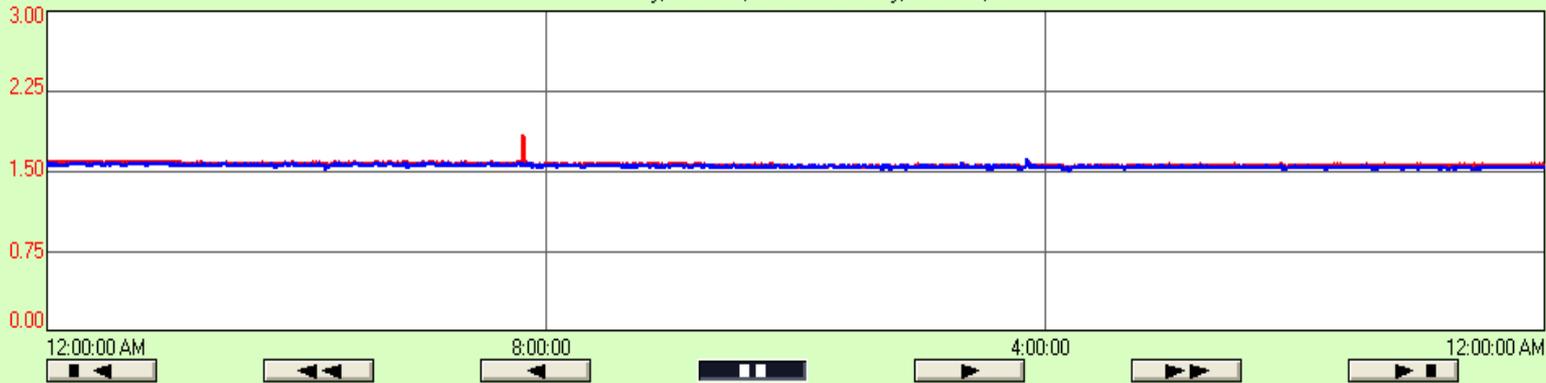
Chlorine Residual Monitoring



ADF CL2B 1.45 ppm

ADF CL2A 1.50 ppm

Tuesday, March 27, 2012 - Wednesday, March 28, 2012



PS3 CL2 Residual 1.43 ppm

Gorst CL2 Residual 1.36 ppm

Reservoir 4 CL2 Residual 1.20 ppm

# Best Management Practices for Hypo System Operation & Design

- Keep system piping “vertical” as much as possible
- Be cautious about flow switches versus flow meters
- Do you really need that valve?
  - Determine whether backpressure valves, check valves, etc., are really needed or if a modification in piping could potentially eliminate them
- Get carrier water to the hypo, not hypo to the carrier water
- Be aware of tubing “extensions” from peristaltic pumps to hard piping
  - Can be twisted, overly long, etc.

# Best Management Practices for Hypo System Operation & Design

- Use a simple approach to pressure relief/protection
  - Avoid high points
- Use gas relief/air relief valves as needed (cheaper than potential problems)
- Avoid hard 90 elbows - smooth out with wye fittings or 45 deg bends
- Avoid long “horizontal runs” of piping
- **Key Point: avoid complexity when precision is demanded. Keep it simple.**



# Questions?

