Overcoming Sodium Hypochlorite Offgassing & Other Challenges

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TACOMA PUBLIC UTILITIES

The Task:

- Replace a 1970s era gas chlorination system to provide disinfection for existing 72 MGD unfiltered Green River Surface Water treatment train.
- Provide disinfection for a new 95 MGD treatment train.
- Provide corrosion control and Fluoridation for both treatment trains.

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The Challenges

- Source Water blending of Green River and GWUDI is used for turbidity reduction.
- Surface Water and Ground Water have different chlorine demands.
- Surface Water and Ground Water have significantly different pH.

The Challenges

- Source water blending is performed in 12 MGD increments.
- Chemical injection takes place in “Reactors” – the upper legs of the transmission lines.

The Challenges

- Pipeline flow is very nearly laminar.
- Required 3 log inactivation for Giardia is provided solely through disinfection.
- Contact time is provided in transmission pipelines.

The Challenges

NO CLEARWELL!

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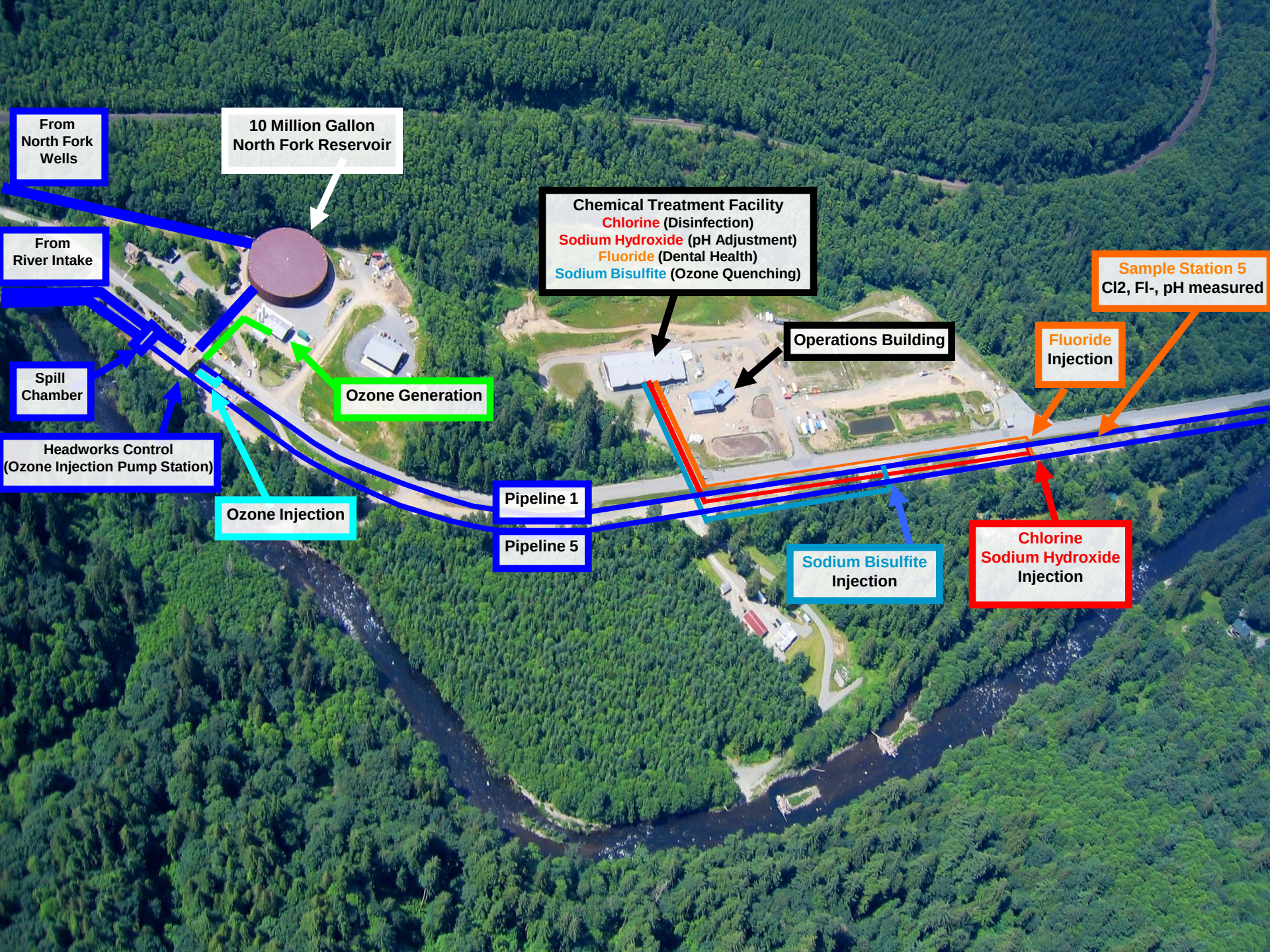
The (first) Solution

- Construct a new facility downstream of existing treatment systems to feed sodium hypochlorite, caustic soda and hydrofluosilisic acid to both treatment trains.
- The new facility will allow the existing chlorine building to be converted for use as part of a future ozonation system.

The (first) Solution

- 12 ½% sodium hypochlorite is fed from storage tanks to carrying water lines for injection into reactors.
- Peristaltic metering pumps are selected.
- A pumped carrying water supply is provided.
- A single injection point is provided for Sodium Hypochlorite.


From North Fork Wells
10 Million Gallon North Fork Reservoir
From River Intake
Chemical Treatment Facility
Chlorine (Disinfection)
Sodium Hydroxide (pH Adjustment)
Fluoride (Dental Health)
Sodium Bisulfite (Ozone Quenching)
Sample Station 5
Cl2, Fl-, pH measured
Operations Building
Fluoride Injection
Spill Chamber
Ozone Generation
Headworks Control (Ozone Injection Pump Station)
Ozone Injection
Pipeline 1
Pipeline 5
Sodium Bisulfite Injection
Chlorine Sodium Hydroxide Injection

The (first) Problems

- Because of the distance from the Chemical Feed Building to injection points and the use of carrying water there is a significant lag time between a feed rate change and an actual dosage change reaching the reactors.

The (first) Problems

- Speeding up carrying water requires more power.
- More power requires a very large UPS.
- A Very large UPS is very expensive.

Compromise

- Carrying water pumps are sized to provide a flow rate resulting in approximately 12 minutes of travel time from metering pump to injection point.
- UPS system is sized to supply approximately 20 minutes of power to metering and carrying water pumps in case of utility power and generator failure.

Start up: More Problems

GAS!

Start up: More Problems

- Gas accumulates in elaborate and unvented 2” piping and diaphragm valves between hypochlorite storage tanks and metering pumps.
- Gas accumulates in flex hoses on suction side of metering pumps.
- Offgassing results in air binding of peristaltic metering pumps.

The (first) Solutions

- Frequent Operator Intervention!!!
- “Burp” tank to metering pump supply lines.
- Manipulate flex hoses to move gas through metering pump suction.
- Limited by staffing at start up – Two to three operators working 8 hour days.

The (first) Modifications

- Add vent to atmosphere at start of metering pump suction header.
- Add purge valve to individual pump suctions.
- Add vent to atmosphere on each individual 2” line from tank to suction header.
- Rotate diaphragm valves on their side to prevent gas pocket building up on top.

More Limitations Become Evident

- Peristaltic metering pumps prove to be less accurate than desired.
- Affected by changes in suction head.
- Affected by changes in backpressure.
- Affected by tube and roller wear.
- Require metering pump effluent flow meter feed back loop for accurate dosing.

More Limitations Become Evident

- Metering pumps are configured in two pairs.
- Each pair can only feed to a single reactor.
- A single effluent flow meter controls each pair of metering pumps.
- The effluent flow meters can not be bypassed for maintenance.

R1

Further Problems

- Neoprene seismic isolation fittings failing.
- Isolation fittings are located between tank flange and tank isolation valve.
- Paint on SCH 80 must be removed to make repairs or modifications.
- Calibration columns are graduated in 10th of a gallon – too course to be useful.

Further Problems

- SCH 80 begins cracking at pump influent/ effluent cam-loc fittings – male cam-loc threaded into female PVC.
- SCH 80 PVC breaks when operator flexes hose – damages clothing and shoes.

STOP: Visit Everett WFP

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Everett Hypochlorite System

- 1 ½ inch diameter supply lines limit detention time vs. 2 inch pipe.
- ½ inch lines are placed frequently to vent gas back to tanks. Tanks vent to outside.
- Supply and vent lines are clear PVC.
- Liquid Feeders and Injectors with a gravity water supply are accurate and reliable.

TIME TO REBUILD!

- The new piping system was designed and built by Water Treatment Plant Supervisor Jeff Bolam and Mechanics Brett Cook and Wade Green with input from the treatment plant operators.

TIME TO REBUILD!

- Replaced all piping between storage tanks and carrying water lines.
- Used SCH 80 clear PVC so that gas bubbles can be seen.
- Downsized tank to pump piping to 1 ½”.
- Added flow meter bypass.
- Used ball valves–vented for hypo service.

TIME TO REBUILD!

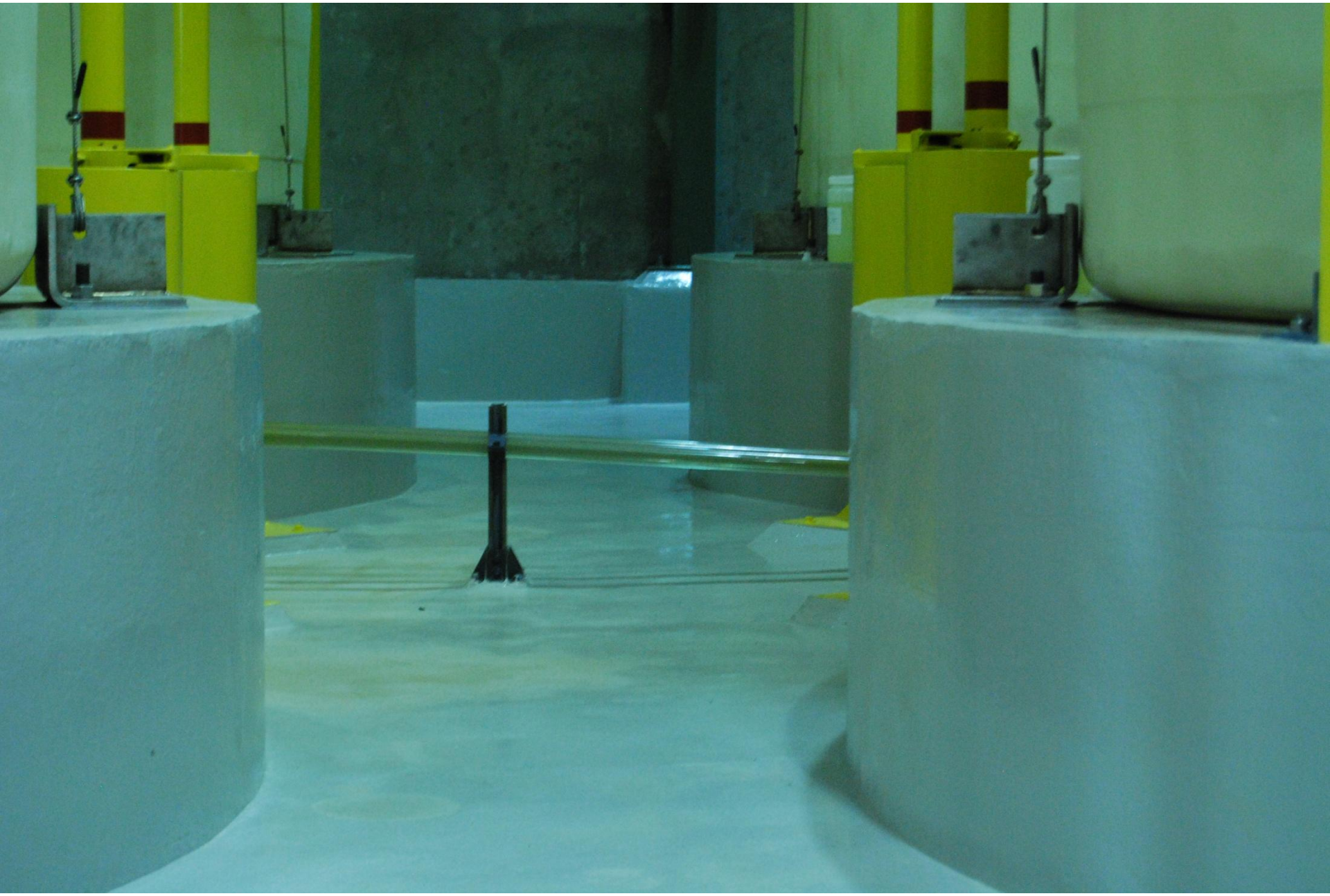
- Sloped Piping from Tanks upward to pump suction header.
- Added vents at high spots to allow escape of gas.
- Routed vent lines back to storage tanks.
- Avoided unnecessary elbows, flat spots and downturns to prevent gas buildup.

TIME TO REBUILD!

- Added ability to route all pumps to either reactor for enhanced redundancy.
- Maintained one reactor in service while making modifications.
- Purchased portable 110 volt diaphragm metering pump and portable generator for additional redundancy.

Sodium Hypochlorite TK 803
TANK 4

Sodium Hypochlorite Tk - 280
TANK 4
4 3 1 2
4 3 1 2
R1



FIRE

R5
R1
CAUTION

Working with Nature: it works!

- Sloped lines and vents at high spots have given gas a place to go.
- Gas bubbles now vent themselves without operator intervention.
- All pumps can now be routed to either reactor.
- Flow meters can now be bypassed.

What is next for Tacoma?

- Filtration.
- Multiple injection points.
- Shorter feed lines.
- Clearwells.
- Control upgrades?
- A gravity water supply?
- Injectors?