Membrane Filtration – The Right Choice for Wheeling's WTP Upgrade

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OTCO Water Workshop, March 8, 2017

Brian T. Bisson, P.E.

AGENDA

- Wheeling Water Background
- Timeline
- Drivers for Upgrade
- Gannett Fleming Investigations
- Membrane Procurement and Piloting Process
- Review of Construction
- Finished Water Quality
- Take Aways

Wheeling Water Background

- Utility Formed in 1836
- WTP built in 1920’s
- Upgraded in 60’s, 70’s, & 90’s
- Conventional surface water WTP
- Back-up Wells to Ohio River supply
- Serves Wheeling and 5 Wholesale Customers
- Avg Day/Max Day = 7.2/9.9 MGD
- Plant Capacity = 12 MGD

System Pressures from 30 to > 130 psi

Time Line

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2003

- WTP Condition Assessment Report by Gannett Fleming

2005

- Membrane Evaluation and City Selection for Filter Upgrade

2006

- 2006 Engineer Procurement for WTP Design; CT Selected

Time Line

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2007

- July 2007 CT/City execute engineering agreement; studies and design begin

2008

- April 2008 Membrane Procurement Document
- Sept 2008 – March 2009 Pilot Testing

2010

- Jan 2010 Bench Testing Report Completed

Time Line

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2011

- April 2011 Basis of Design Complete, Design documents submitted for Regulatory Approval
- June 6, 2011 Permit Received from WV Department of Health and Human Resources, Bureau of Public Health

2012

- 2012 Funding: Rate Case filed 1/5/2012; final 8/20/2012; Project financed by 6% interest revenue bonds.
- Sept 2012 – December 2012 Siemens Shop Drawings Reviewed & Approved; Final Design Completed

2013

- January – March 2013 Bidding
- June 12, 2013 Pre-Construction Conference

Time Line

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2015

- July 17, 2015 finished water pumped to system

Drivers for Upgrade

- Water Quality
- Filter Replacement
- HS Pump Replacement
- Repair and Rehab (Basins)
- Site Limitations

GF 2003 Investigation Reports

- 8 Disciplines investigated
  - Structural
  - Architectural
  - Process
  - Mechanical
  - Instrumentation
  - Electrical
  - Process Evaluation
  - Hydraulics

Investigation Report Findings

- Structural
  - Pretreatment – Repair structural
  - Filter Bldg – Extensive masonry repair
  - Finished storage – Structural deficiencies
  - Blower Bldg – Slab settlement & Masonry

  Architectural

  Pump Sta – Elevator; masonry; windows

  Blower Bldg – Replace roof

  Filter Bldg – Roof flashing

  Chemical Bldg – Replace roof

Investigation Report Findings

- Process
  - Consider VFD for HS pumping
  - Consider UV disinfection
  - Filter expansion – only 27% available
  - Filter media – 30” of sand
  - No filter to waste
  - Filter effluents not manifolded
  - Chlorine storage and feed in same room

Investigaton Report Findings

- Mechanical
  - Much of equip beyond useful life (heaters, ventilation, toilets, sprinklers, etc)
  - Instrumentation
    - Components beyond useful life
  - Electrical
    - No backup generator
    - Low voltage panel boards are 1963 vintage
    - Filter Building MCC obsolete

Alternatives Analysis - 2004

	Current	New WTP	UV	Membrane
PW Operations	$19,978,000	$20,988,000	$20,988,000	$18,755,000
Capital	--	$29,375,000	$19,950,000	$21,020,000
Total PW	--	$50,363,000	$40,938,000	$39,775,000

Bench Scale Testing for DBPs - 2008

- 3 Coagulants evaluated (ferric chloride, ferric sulfate, and proprietary ferric blend)
- Recommendations:
  - Continue ferric chloride use.
  - Lower coagulation pH to 6 – 7
  - Distribution system DBPs reduced 20%
  - If chloramines are used, proceed with caution
- Pre-chlorination in the basins was discontinued with start-up of new facilities

Pilot Testing Protocol Objectives

Flux
Recovery
30 days between CIPs
Turbidity < 0.08 NTU 95%; < 0.1 NTU
Pretreatment to min Fe and Mn < 0.1
Reduce TOC to < 0.5
Estimate quantity/quality of residuals
Giardia > 99.99%; Crypto > 99.999%
Training/familiarization of operators

Siemens Pilot Testing Results

Parameter	Run 1	Run 2	Run 3
Dates	11/6 - 12/18/08	12/18 – 1/21/09	1/21 – 3/16/09
Source	Settled River	Settled River/Wells	Settled River
Temp, C	8.4	6.1	2.7
Feed Turbidity	2.0	3.8	2.8
Flux, gfd	38	38	38
Maintenance Washes	Chlorine Daily/Acid Weekly	Chlorine Daily/Acid Weekly	Chlorine Daily/Acid Weekly

Pilot Test Results, cont.

Performance	Siemens	Pall
Ability to achieve water quality requirements	Yes	Yes
Fouling problems	No	Potential
Confirmed B.O.D.	Yes	Raised questions

Pilot Testing, cont.

	Siemens	Siemens	Pall	Pall
	Proposal	Updated	Proposal	Updated
Capital Cost	$6,820,000	$5,199,000	$5,944,000	$5,345,750
O & M	$153,000	$180,000	$190,000	$265,000
Net Present Value *	$8,441,000	$7,100,000	$8,187,000	$8,150,000

* Best value selection procedure as defined in Section 5A-3-10b of the WV Code.

Planned Improvements

- Rehab Pump Bldg & Equipment
- Rehab Pretreatment Basins
- Rehab Chemical Bldg and Systems
- Replace Rapid Sand Filters with Membranes
- Replace HS Pumps
- Replace Chlorine Gas with Sodium Hypochlorite
- New Clearwell
- New Admin Offices and Lab

Bid Opening 3/22/2013

Engineer's estimate = $35.0 million (not published in WV)

6 Bidders: 5 from $30.5 to $33.5 million and 1 bidder at $37.6 million

Low Bidder was Shook by $110,000

Other Bidders: Adam Robinson, Bowen Engineering, Kokosing, Ulliaman Schutte, Walsh, and Wayne Crouse

Schedule of Values

1. General Conditions	$7,458,500
2. Site Work	$2,733,500
3. Membrane Building	$10,646,000
4, Admin Building	$2,220,000
5. Settling Basins	$1,394,000
6. Clearwell	$2,530,000
7. LS Pump Station	$2,445,000
8. Blower Building	$480,000
9. Tunnel Access Shaft	$235,000
10. Existing Chemical Bldg	$325,000
TOTAL	$30,467,000


Lock Ave
Viking Dr
Richland
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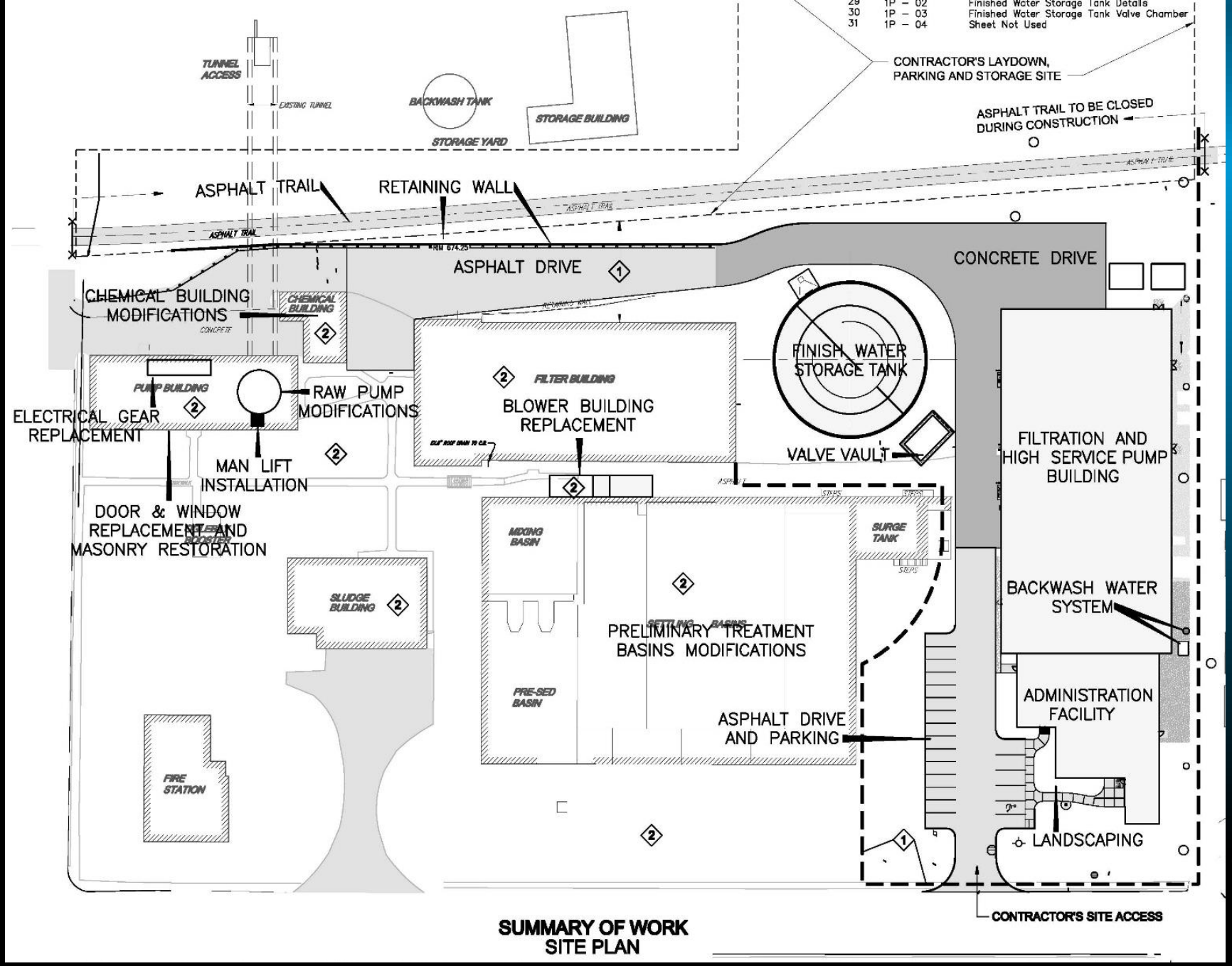
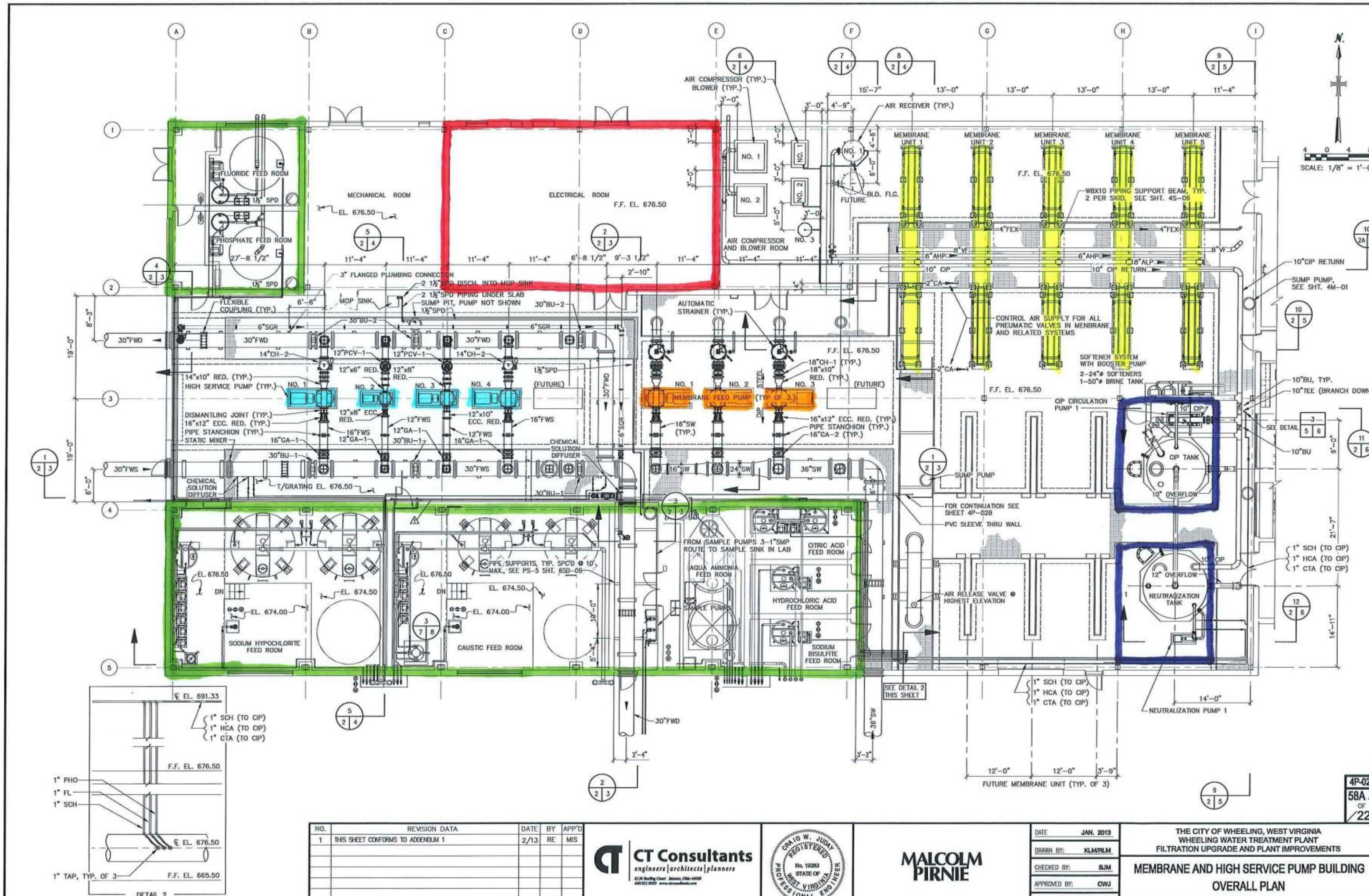


SUMMARY OF WORK
SITE PLAN



NO.	REVISION DATA	DATE	BY	APP'D
1	THIS SHEET CONFORMS TO ADDENDUM 1	2/13	RE	MIS

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CRAIG W. JUDAY REGISTERED No. 19283 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER

MALCOLM PIRNIE

DATE	JAN. 2013
DRAWN BY:	KLM/RLM
CHECKED BY:	SJM
APPROVED BY:	CWJ
FILE No.	0406063-077

THE CITY OF WHEELING, WEST VIRGINIA
WHEELING WATER TREATMENT PLANT
FILTRATION UPGRADE AND PLANT IMPROVEMENTS

MEMBRANE AND HIGH SERVICE PUMP BUILDING
OVERALL PLAN

PROCESS

4P-02A
58A OF 222

Review of Construction

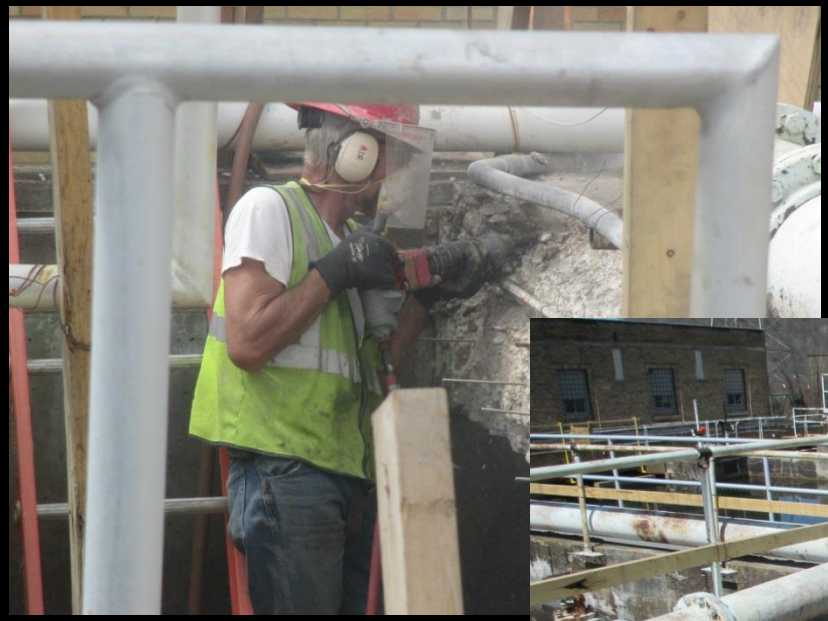
- Construction took two years
- Weekly construction Meetings
- On time and on budget

Low Service Pump Motors and VFDs

Sludge Collection Equipment

Sludge Collection Replacement

Basin Walkway Replacement



Walking Beam Flocculators

New Blower Room

Membrane Filters

HS Pumps Discharge Pipe

HS Pump Area Floor Concrete

HS Pumps

Chemical Room Concrete Pour

Clearwell Construction

Clearwell Construction

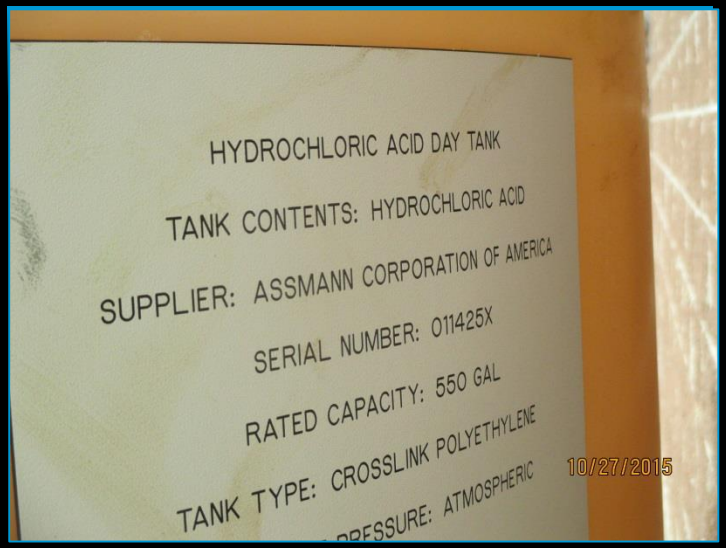
HS Transmission Main

Acid Spill

- Leak of valve on site glass – 4/15/15
- Fumes noticed – reported to General
- Investigated on Monday, 4/18/15
- Lots of damage

HCl Tank


12/08/2014


HYDROCHLORIC ACID DAY TANK
TANK CONTENTS: HYDROCHLORIC ACID
SUPPLIER: ASSMANN CORPORATION OF AMERICA
SERIAL NUMBER: 011425X
RATED CAPACITY: 550 GAL
TANK TYPE: CROSSLINK POLYETHYLENE
10/27/2015

HCl Spill

HCl Spill

Link-Seal Installation

- Pipe connection to Settling Basins
- Performed during plant shutdown
- Slight alignment problem
- Couldn’t get link-seal to fit

Link-Seal

Start-up

- Pumped to waste
- Pumped to system 7/17/2015
- Customers relate complaints to WTP
- WTP Staffing – Class IV Plant with 6 Class IV’s and 4 Class III’s

Sonic (Integrity) Test

- Air hold test performed every 24 hours
- 7,400 fibers/module; 240 modules/train; 5 trains → 8.9 million fibers
- Sonic test performed monthly
- As of Feb, 224 Fibers have been pinned – Appears fibers will last > 10 yrs

Clean in Place

- CIP performed monthly (720 hours)
- Winter CIP every 550 hours (TMP higher)
- CIP is acid wash followed by chlorine
- 1 hr Cl2 maintenance wash daily
- 1 hr acid wash weekly
- Air/Water Backwash every 25 minutes

Finished Water Quality

- Turbidity 0.01 – 0.02 NTU's
  - Old plant ~ 0.06 NTU's
- TTHM's LRAA ~ 60 ug/L
  - No longer pre-chlorinating in basins
  - Larger clearwell provides sufficient disinfection CT
- Wheeling continues work with Fontus Blue and dashboard analysis
- Wheeling is an ORSANCO monitoring site

What’s next

- Raze old filter building
- On-going small plant projects
- Distribution system replacements
- A lot of wastewater work

Take Aways

- Plan for timeline
- Consider a procurement process
- Membranes produce high quality water
- A great team will promote a great project outcome

Questions?

- Contact:
- Brian Bisson
- 330.272.9338
- bbisson@ctconsultants.com

Time Lapse