Final Draft
Start-up Plan

Weak-Base Anion Exchange Chromium(VI) Removal Demonstration Facility

City of Glendale, California

AECOM Project No. 114116.01

Submitted to:
City of Glendale
141 N Glendale Avenue
Glendale, California 91206

Submitted by:

AECOM

300 Oceangate, Suite 700
Long Beach, California, 90802
(562) 951-2000

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START-UP PLAN
WEAK-BASE ANION EXCHANGE CHROMIUM VI REMOVAL DEMONSTRATION FACILITY
GLENDALE, CALIFORNIA

1.0 INTRODUCTION

This document details the start-up plan for the Weak-Base Anion Exchange Chromium VI Removal Demonstration Facility (WBA Facility). The start-up plan provides instruction for bringing the facility online following construction. It includes a monitoring and testing plan to assess whether the treatment conforms to design requirements and meets regulatory standards prior to connection to the municipal water supply.

The purpose of the start-up plan is to amend the existing drinking water permit for the Glendale Water Treatment Plant (GWTP) (Permit No. 04-15-00PA-000) to include weak-base anion exchange as a treatment method for chromium removal.

Operating procedures described or referenced herein are included in the WBA Facility Operation and Maintenance Manual (O&M Manual) and associated operating manuals supplied by the equipment manufacturers.

2.0 PROCESS DESCRIPTION

The WBA Facility consists of the following major components:

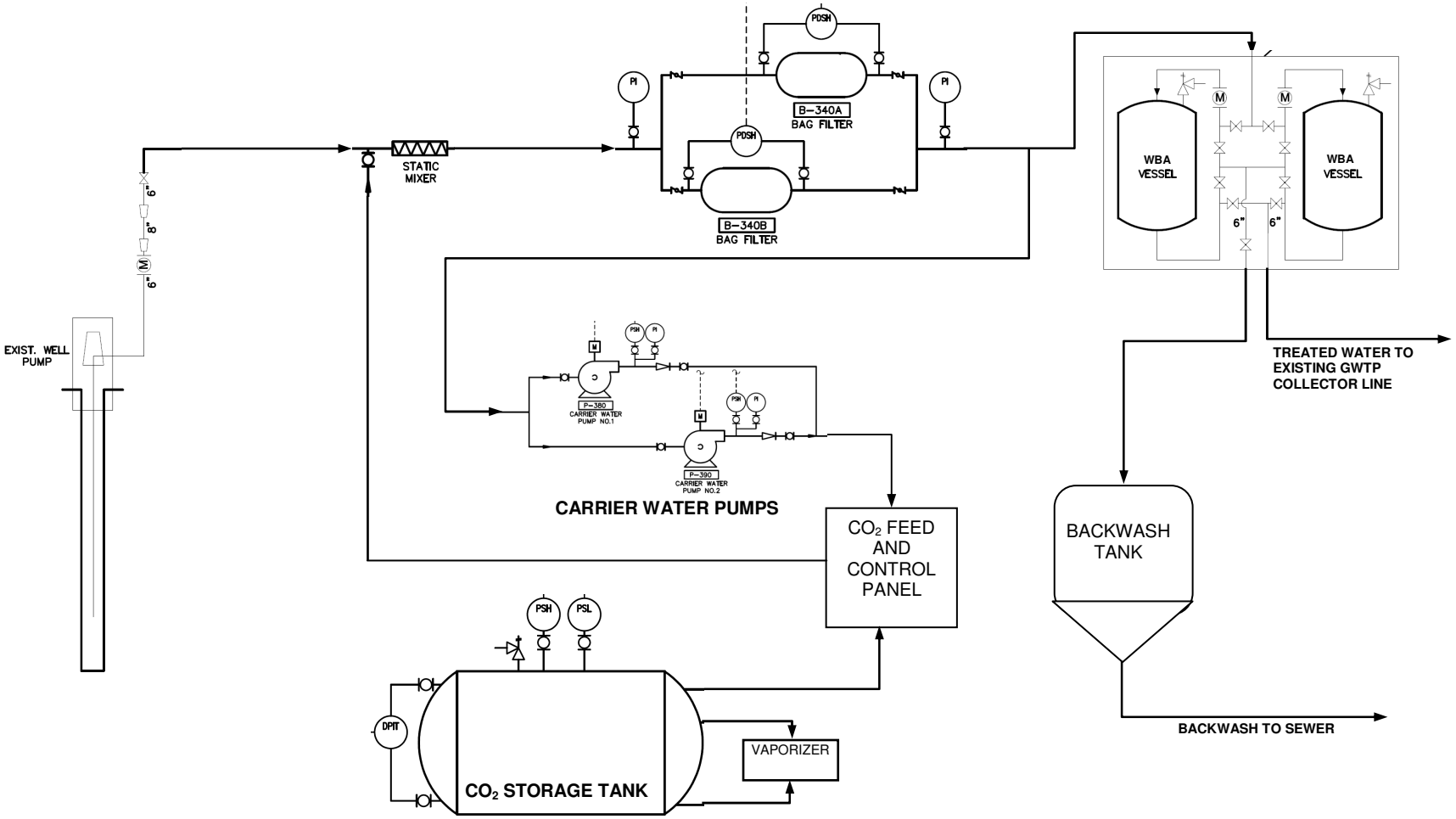
- Carbon dioxide (CO_2) pH control system,
- Bag filters for particulate removal,
- Existing GAC vessels retrofitted to use WBA resin, and
- Backwash system.

The WBA treatment process flow diagram is shown on Figure 1 and the facility layout is shown on Figure 2. The WBA Facility treats water produced from Well GS-3. Influent water is pH-adjusted by the addition of carbon dioxide from the initial pH of approximately 6.8 to a pH of approximately 6.0. The water is then filtered prior to flowing through the treatment vessels where chromium is removed by ion-exchange by the WBA resin. The treated water is then piped to the GWTP for treatment of volatile organic compounds. The design flow for the treatment system is 425 gpm.

3.0 ROLES AND RESPONSIBILITIES

The following is a list of persons and/or entities that must be present at start-up and associated roles and responsibilities:

- Glendale Water and Power: City operators will operate the facility and Well GS-3 and collect water samples for analysis.
- CDPH: Observe the start-up procedures and ensure it complies with permit requirements.
- Tomco$_2$ Equipment Company: Inspection, and start-up, and optimization of CO_2 pH control system.
- Siemens: Responsible for supplying and loading the resin into the reactor vessels and supplying dechlorinated water to load media by slurry method.
- Malcolm-Pirnie: As the designers of the facility, representatives from Malcolm Pirnie will attend start-up and address design or system questions and ensure the facility is operating as designed.
- AECOM: AECOM will oversee start-up operations and coordinate all activities and contractors.



Notes:
CO_2 = carbon dioxide
GWTP = Glendale Water Treatment Plant
WBA = weak-base anion

Figure 1: WBA Treatment System Process Flow Diagram

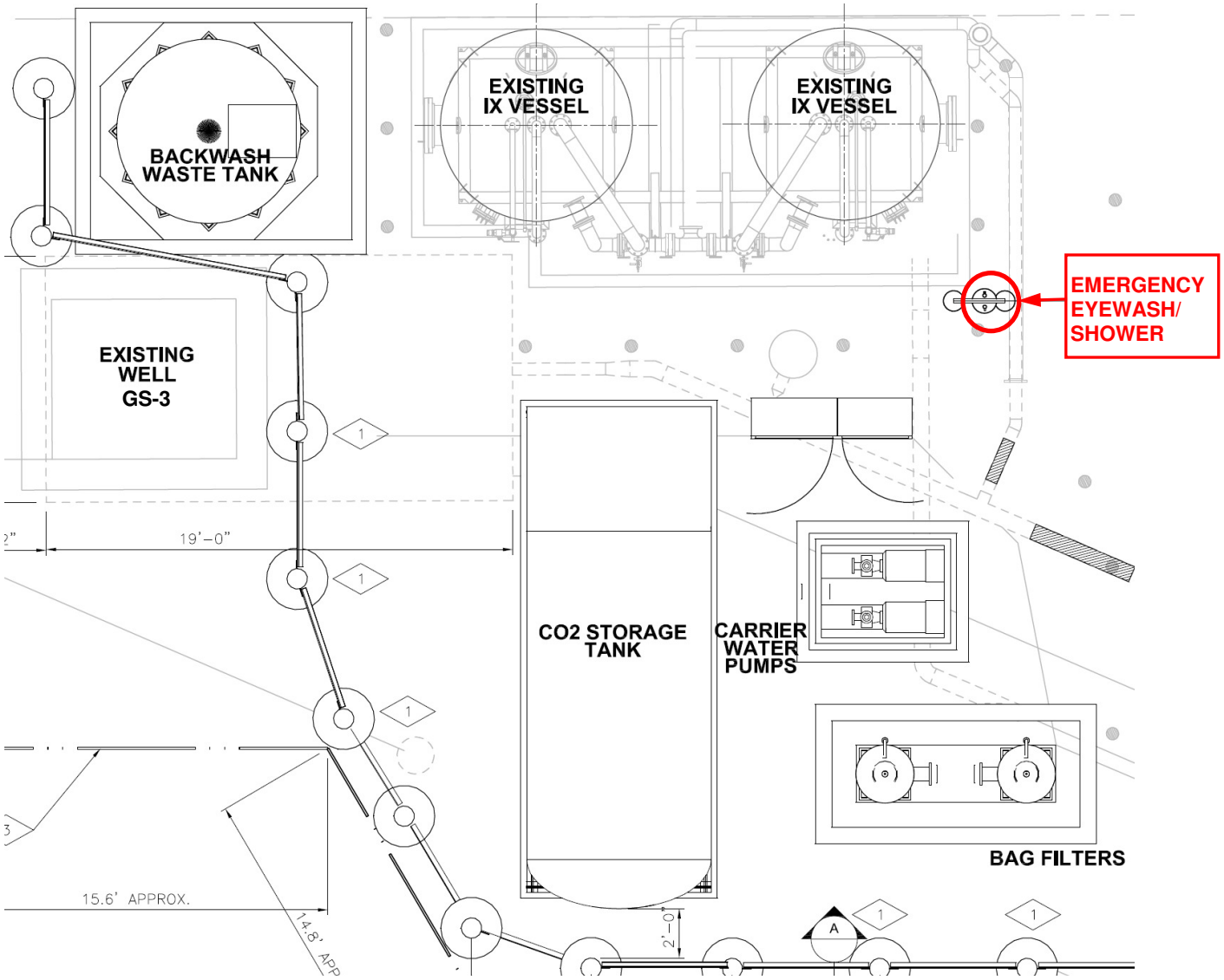


Figure 2: Facility Layout

4.0 DOCUMENTATION

The following documents and forms shall be obtained prior to start-up activities and on hand during start-up.

1. Draft CDPH permit
2. City of Los Angeles Sewer Discharge Permit
3. Draft O&M Manual
4. Forms and checklists to record activities and process parameters

5.0 PRE-START-UP PREPARATION

The following items will have been done prior to start-up as part of construction/commissioning activities:

1. Mechanical Inspection: Inspection of all mechanical equipment including, but not limited to valves, pumps, tanks, piping, etc. for damage or leaks that may cause unsafe or improper operating conditions.
2. Electrical Inspection: Inspection of all electrical equipment, instruments, and controls such as control panels, flow meters, pressure transmitters, etc. Programmable logic controllers, human-machine interface, and SCADA system have been programmed, control setpoints inputted, and tested. All alarms and interlocks have been tested and are functioning as intended.
3. All flow meters have been checked for accuracy. These include the flow meters on the WBA vessels (FE/FIT101 and FE/FIT102) and the flow meters/totalizer for the backwash system (FE/FIT103 and FE104).
4. Spark Testing: Vessels and piping have been spark tested to verify lining integrity and necessary repairs have been completed.
5. Pressure testing: All process equipment has been flushed and pressure tested in accordance with project requirements.
6. Commissioning of the TOMCO CO2 pH Control System has been completed and the system is ready to operate. The TOMCO start-up and commissioning checklist is included in Attachment 1.
7. System disinfection: The entire facility (including piping and appurtenances, reactor vessels, filter vessels, pumps, and all appurtenances that come in contact with water sent to GWTP) has been disinfected and tested meeting the requirements of American Water Works Association (AWWA). Standard C653-03, Disinfection of Water Treatment Plants and CDPH standards. The reactor vessels are ready to receive the WBA resin.
8. Mobilize two, 21,000-gallon water storage tanks to store forward flush water from facility. The storage capacity of the temporary tanks must be enough to hold all water generated during start-up testing before the plant is authorized to discharge to the GWTP. Tanks are needed to store facility effluent while testing of treated water is being conducted. The system effluent water will flow into the temporary storage tanks via hoses. The tanks are will be plumbed to the sanitary sewer and fitted with a valve to restrict the discharge to the sewer to 7 gallons per minute (gpm).
9. Have the necessary permits from CDPH to operate the facility and City of Los Angeles to discharge to the sewer.
10. Well GS-3 is ready for operation and has been flushed to remove rust and other substances that may have accumulated in the well during the extended shutdown and tested for bacterial contamination and the groundwater can be fed to the treatment plant.

6.0 START-UP PROCEDURES

The sequence of events required for facility start-up are summarized as follows and are treated in more detail in the subsequent sections:

1. Perform pre-operation activities and checks
2. Load media
3. Start-up well pump and pH control system
4. Sample effluent
5. Place facility on line

NOTE: Prior to operating the system or performing maintenance procedures, operators must be familiar with the procedures and instructions provided in the following resources: the treatment facility drawings, O&M Manual, and operation manuals provided by the equipment manufacturers.

6.1 Pre-Operation Checks

These tasks must be performed by the operator prior to placing the system, any portion of the system, or equipment in operation. The tasks must be performed at least 48 hours prior to beginning start-up operations in order to allow time for troubleshooting in the event of problems.

- Fill CO_2 storage tank and verify that all associated systems are functioning properly.
- Calibrate pH probe if necessary
- Check all valve positions to ensure they are in the proper orientation for the specific mode of operation as described in the operation and maintenance manual and the respective equipment supplier/manufacturer's operating manuals.
- Verify that all valves are operational and isolation valves on equipment are open. Verify that all isolation valves to process instrumentation are open.
- Check and clean filters and strainers.

6.2 Load Media

Load resin into disinfected vessels by slurry method using non-chlorinated water (Siemens will treat municipal water at their facility through GAC to dechlorinate prior to delivery). Media loading procedures are found in the O&M Manual.

Virgin media must be preconditioned by the supplier prior to delivery to the site. Preconditioning includes washing the media with a minimum of 30 bed volumes of non-chlorinated water to rinse the media of possible nitrosamines and to remove fines. The media is drained prior to transport to the site.

6.3 Begin Backwashing

A minimum of 3 bed volumes of backwashing is required to condition fresh media. Media backwash is performed on each vessel individually, while discharging the effluent to the sewer via temporary storage tanks. Configure the valves according to Table 1:

Table 1: Valve Configuration – Media Backwash

Valve	Valve Position to Backwash Vessel A	Valve Position to Backwash Vessel B
V1	CLOSED	CLOSED
V2	CLOSED	OPEN
V3	CLOSED	CLOSED
V4[1]	**CLOSED**	**CLOSED TO START**
V5 (BF10)	OPEN	OPEN
V6	OPEN	OPEN
V7[2]	**CLOSED TO START**	**CLOSED**
V8	CLOSED	CLOSED
V9	OPEN	CLOSED
V10	CLOSED	CLOSED

Notes:
[1] Flow control valve for backwashing Vessel B.
[2] Flow control valve for backwashing Vessel A.

6.4 Begin Forward Flush and Collect Water Samples

Once backwashing is complete, the treatment plant is placed on forward flush, discharging to the sanitary sewer (via temporary storage tanks). A minimum of 30 bed volumes of forward flushing is required to condition fresh media.

1. Configure valves on WBA vessels for parallel operation as listed in 2 with effluent going to the backwash line. The valve locations are shown on Figure 3 and on Figure 4.

Table 2: Valve Configuration – Media Forward Flush

Valve	Valve Position to Forward Flush Vessel A	Valve Position to Forward Flush Vessel B
V1	CLOSED	OPEN
V2	CLOSED	CLOSED
V3[1]	CLOSED	OPEN
V4	CLOSED	CLOSED
V5 (BF10)	CLOSED	CLOSED
V6	OPEN	OPEN
V7	CLOSED	CLOSED
V8[2]	OPEN	CLOSED
V9	CLOSED	CLOSED
V10	OPEN	CLOSED

Notes:
[1] Flow control valve for forward flushing Vessel B.
[2] Flow control valve for forward flushing Vessel A.

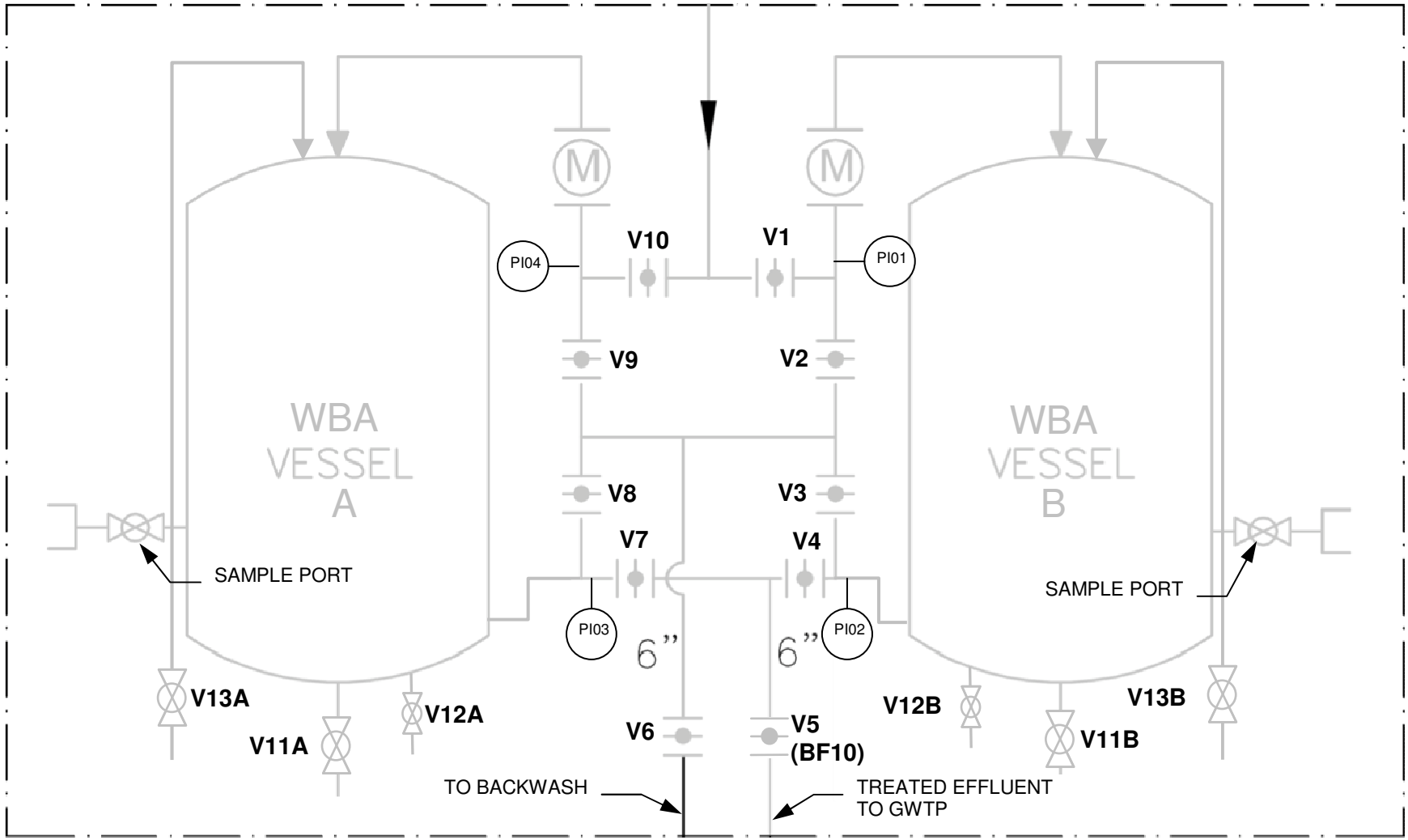


Figure 3: Valve Configuration for WBA Vessels

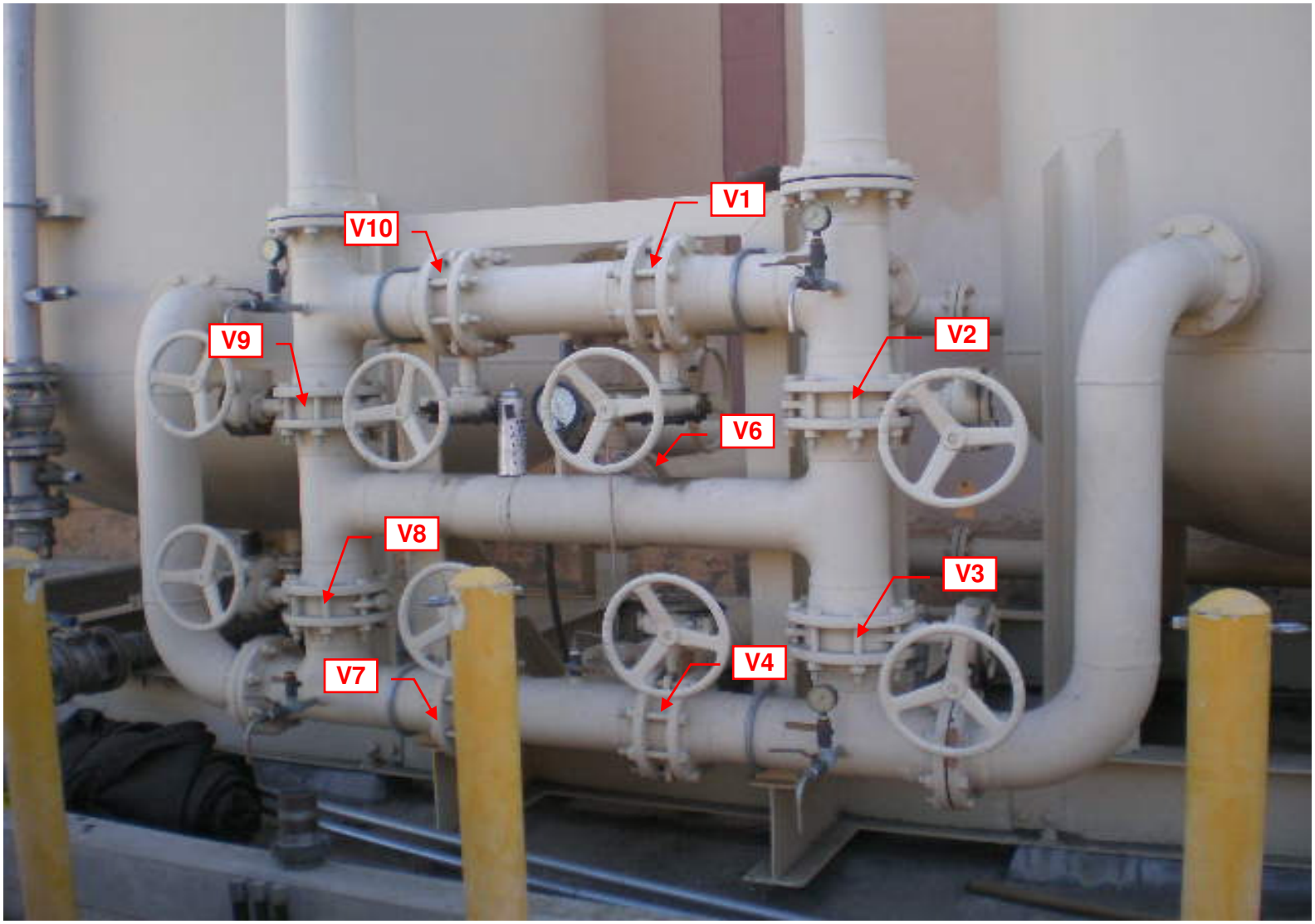


Figure 4: Photograph of WBA Vessel Valve Tree with Valve Identification Tags

2. Connect a hose to the 4-inch connection on the backwash discharge line (with sample port). Close valve BF12 and open valve BF13. Connect the other end of the hose to the inlet connection on the temporary storage tanks ((i.e., two, 21,000-gallon tanks connected in series).
3. Start Well GS-3 and increase flow rate to 425 gpm with water going through IX vessels and effluent going to temporary storage tanks and discharging to sewer at a maximum rate of 7 gpm.
4. Start CO_2 pH control system and carrier water pump (assisted by TOMCO technician).
5. Collect water samples at the effluent from the lag vessel following the sampling schedule in Table . Six samples will be collected at 0, 19, 38, 57, 76, and 95 minutes.
6. Shutdown Well GS-3 after the last sample is collected and close valve V5/BF10 on the WBA vessel effluent to prevent draining the vessels. The amount of water generated in 95 minutes at 425 gpm is approximately 40,375 gallons. Continue to discharge the water collected in the tanks to the sewer until drained.
7. Submit samples to the laboratory for analysis.
8. Submit laboratory results to CDPH for review.

6.5 Place Facility On-Line

Upon approval to deliver from CDPH:

1. Ready facility for start-up (conduct Pre-Operation Checks).
2. Configure IX vessels for lead-lag operation. Note: Maintain the same configuration as previous. Follow start-up procedures in O&M Manual and manufacturers' operation manuals.
3. Start Well GS-3 with plant effluent discharging to temporary storage tanks.
4. Start CO_2 system and monitor pH at inlet to IX vessels.
5. Collect lag vessel effluent samples at 0 and 95 minutes and submit for analysis to see if nitrosamines leached out of resin during waiting period for analytical results and assessment.
6. Deliver facility effluent to GWTP immediately after collecting the second sample. Discharge storage tanks to sewer.

7.0 SAMPLING AND MONITORING

Sampling and monitoring will follow the requirements outlined in Section 7 of the O&M manual plus those additional requirements listed in the start-up sampling plan summarized in Table 3. The sampling and handling requirements outlined in the Quality Assurance Project Plan (QAPP) included in the O&M Manual must be followed. Table 4 provides additional sampling, handling, and analysis requirements not included in the QAPP. Sample locations are shown on Figure 5.

Table 3: Start-Up Sampling Plan

Sampling time (min)	Bed Volumes	Sample Location	Analytes	Turn-around Time
Baseline				
0	0.0	SP1 Raw Water (before CO_2 addition)	Total Cr Cr(VI) Sulfate (SO_4^{-2}) Nitrate (NO_3^-) Phosphate (PO_4^{-3}) Silicon Dioxide (SiO_2) Iron (Fe) Alkalinity Conductivity	7 days

Sampling time (min)	Bed Volumes	Sample Location	Analytes	Turn-around Time
			Turbidity	
0	0.0	SP1 Raw Water (before CO_2 addition)	pH Temperature	NA
0	0.0	SP2 WBA Influent (after CO_2 addition)	Total Cr Cr(VI) Sulfate (SO_4^{-2}) Nitrate (NO_3^-) Phosphate (PO_4^{-3}) Silicon Dioxide (SiO_2) Iron (Fe) Alkalinity Conductivity Turbidity Nitrosamines[1] BNA SVOC[2] Aldehydes/ketones	7 days
0	0.0	SP2 WBA Influent (after CO_2 addition)	pH Temperature	NA
Set No. 1: Initial start-up testing				
0	0.0	SP6 Lag Vessel (Plant) Effluent	Total Cr Cr(VI) Sulfate (SO_4^{-2}) Nitrate (NO_3^-) Phosphate (PO_4^{-3}) Silicon Dioxide (SiO_2) Iron (Fe) Alkalinity Conductivity Turbidity Nitrosamines[1] BNA SVOC[2] Aldehydes/ketones	7 days
0	0.0	SP6 Lag Vessel (Plant) Effluent	pH Temperature	NA
19	6.4	SP6 Lag Vessel (Plant) Effluent	Nitrosamines Cr(VI)	7 days
38	12.7	SP6 Lag Vessel (Plant) Effluent	Nitrosamines Cr(VI)	7 days
57	19.1	SP6 Lag Vessel (Plant) Effluent	Total Cr Cr(VI) Sulfate (SO_4^{-2}) Nitrate (NO_3^-) Phosphate (PO_4^{-3}) Silicon Dioxide (SiO_2) Iron (Fe) Alkalinity Conductivity Turbidity Nitrosamines[1] BNA SVOC[2] Aldehydes/ketones	7 days
76	25.4	SP6 Lag Vessel (Plant) Effluent	Nitrosamines Cr(VI)	7 days
95	31.8	SP6 Lag Vessel (Plant) Effluent	Nitrosamines Cr(VI)	3 days
Set No. 2: After approval from CDPH to operate system				
0	0.0	SP6 Lag Vessel Effluent	Total Cr Cr(VI) Sulfate (SO_4^{-2})	7 days

Sampling time (min)	Bed Volumes	Sample Location	Analytes	Turn-around Time
			Nitrate (NO_3^-) Phosphate (PO_4^{-3}) Silicon Dioxide (SiO_2) Iron (Fe) Alkalinity Conductivity Turbidity Nitrosamines[1] BNA SVOC[2] Aldehydes/ketones	
95	31.8		Nitrosamines Cr(VI) BNA SVOC[2] Aldehydes/ketones	7 days

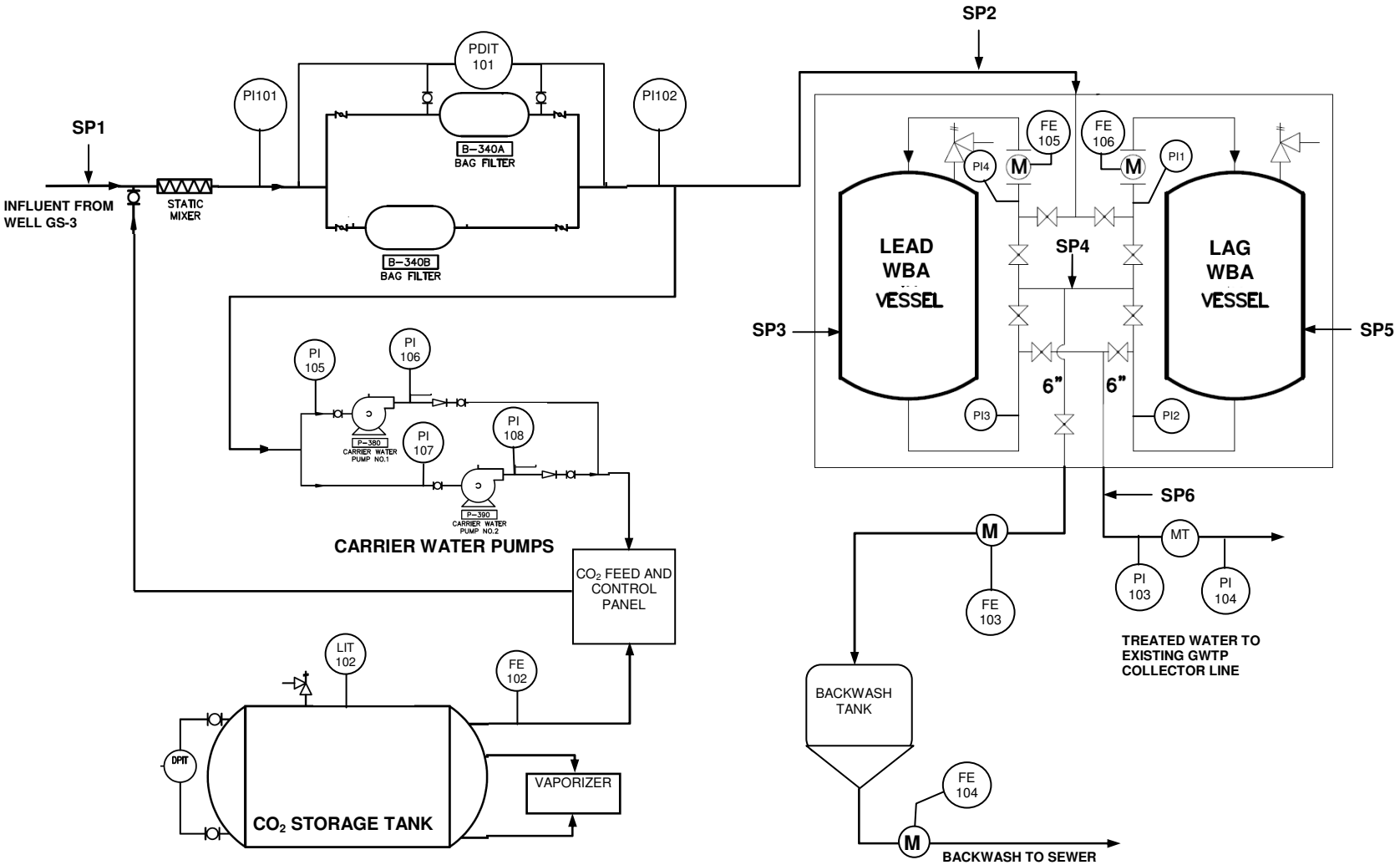
Notes:
% = percent
µg/L = micrograms per liter
BNA SVOC = base, neutral, acid semi-volatile organic compounds including phenol
BV = bed volume (1,272 gallons)
CO_2 = carbon dioxide
Cr = chromium
NA = not applicable
pH = negative log of the hydrogen ion concentration

[1] Testing for nitrosamines includes the following compounds, N-Nitrosodimethylamine (NDMA), N-Nitrosomethylethylamine (NMEA), N-Nitrosodiethylamine (NDEA), N-Nitrosodi-n-propylamine (NDPA), N-Nitrosomorpholine, N-Nitrosopyrrolidine (NYPR), N-Nitrosopiperidine (NPIP), N- Nitrosodi-n-butylamine (NDBA)
[2] Including reporting tentatively identified compounds (TICs) and unknown gas chromatography/mass spectrometry (GC/MS) peaks

Table 4: Sample Handling Requirements

Analysis	**Analytical Method**	**Sample Size**	**Container Type**	**Preservative**	**Holding time**
BNA SVOC (including phenols)	USEPA 625 or USEPA 8270	2 L	Amber glass	none	7 days
Aldehydes/ketones[1]	USEPA 556	2 x 40mL	Amber glass	$CuSO_4$	7 days

Note:
$CuSO_4$ = copper sulfate
USEPA = United States Environmental Protection Agency
mL = milliliter
L = litre
[1] including reporting tentatively identified compounds (TICs) and unknown gas chromatography/mass spectrometry (GC/MS) peaks



Notes:
CO_2 = carbon dioxide
GWTP = Glendale Water Treatment Plant
FE = flow element
PI = pressure indicator
PDIT = pressure differential indicator/transmitter
LIT = level indicator/transmitter
SP = sample port
WBA = weak base anion (resin)

Figure 5: Sampling Locations for Water Quality Parameters

7.1 Monitoring

Process-related parameters will be recorded at the start and throughout the start-up period following the procedures in the O&M manual. The process-related parameters are listed in Table 5.

Monitor pressure at inlet to lead vessel. **Maximum is 100 psig.**

Monitor pressure drop across IX vessel. **Maximum is 30 psig.**

Actions: Decrease the flow rate if any of the maximum values are reached.

Table 5: Monitoring Schedule for Process-Related Parameters

Equipment Tag No.	Process-related parameters	Frequency
PI101, PI102, PDIT101	Filter influent, effluent, and differential pressures	Once Daily
FE105, FE106	Plant influent water flow rate and total volume from WBA vessel flow meters	Once Daily
NA	Position of each vessel (lead or lag)	Once Daily
V1, V10	Influent valve position on both vessels	Once Daily
ΔPI1-2, ΔPI4-3	Pressure differential across each vessel	Once Daily
PI1, PI4	Vessel influent pressure	Once Daily
PI2, PI3	Vessel effluent pressure	Once Daily
PI103, PI104	Media trap influent, effluent, and differential pressures	Once Daily
PI201	CO_2 solution injection pressure	Once Daily
FI102, LIT102	CO_2 injection rate and liquid level	Once Daily
PI105,106 PI107, 108	Carrier Water Pump inlet and outlet pressures	Once Daily
FE103	Backwash water flow rate and total volume	Once every backwash cycle
FE104	Spent backwash water total volume	Once every backwash cycle

Notes:
NA = not applicable
ΔPI1-2 = differential pressure between PI1 and PI2

Attachment 1
TOMCO CO_2 pH Control System

TOMCO_2 Equipment Company

3340 Rosebud Road, Loganville, GA 30052

1-800-832-4262 Fax (770) 985-9179 (770) 979-8000

REQUIREMENTS FOR CARBON DIOXIDE EQUIPMENT STARTUP

1. Invoice on the equipment less retainage for startup has been paid.
2. Minimum **two weeks** notice **prior** to date required.
3. Carbon dioxide storage tank installed.
4. Safety relief valve for storage tank installed.
5. Wiring to/from storage tank complete.
6. Piping from storage tank to feed equipment complete.
7. Piping from feed equipment to diffuser complete.
8. Diffuser installed in correct orientation.
9. Wiring to/from feed equipment complete.
10. Carrier water at design pressure and flow available. Not required on Gas Feed System
11. Plant ready for operation at typical flow rate.
12. Carbon Dioxide delivery scheduled during the first day of our visit.
13. Plant personnel available for training. (Not on the first day)

NOTE: If the above items have been met, the Carbon Dioxide System can be started and completed in the contracted trip(s). If additional trips are required the charges are as follows: $1000.00/day plus expenses.

Upon completion of above items, please return a signed copy to Fred Roy, fax.

770-985-9179

_____ Date:_____

Comments:_____
_____
_____
_____
_____