Final Draft
Start-up Plan

Reduction, Coagulation, Filtration Chromium(VI) Removal Demonstration Facility

City of Glendale, California

AECOM Project No. 114116.01

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1.0 INTRODUCTION

This document details the start-up plan for the Reduction, Coagulation, Filtration Chromium (VI) Removal Demonstration Facility (RCF 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 test the system for effective treatment and adjust process parameters to achieve treatment requirements and optimize plant operation.

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

2.0 PROCESS DESCRIPTION

The RCF treatment process flow diagram is shown on Figure 1 and the facility layout is shown on Figure 2. In the RCF process, Cr(VI) is first reduced to trivalent chromium [Cr(III)] with the addition of excess ferrous iron (Fe^{+2}), which is oxidized to ferric iron (Fe^{+3}) by the electron transfer during the reduction of Cr(VI) and by dissolved oxygen present in the water. Ferrous iron doses found to be acceptable in Phase II testing ranged from 1.5 to 2.5 mg/L for reducing 100 µg/L of Cr(VI) to less than 5µg/L. Cr(III) either precipitates, forms a co-precipitate with the ferric iron, or adsorbs onto the ferric floc. The ferric iron/Cr(III) particles form larger flocs during the aeration and coagulation stages (with the use of a polymer).

Particles are then removed by filtration through two, dual-media filters arranged in parallel for alternate operation. A backwash system is used to periodically send water upflow through the dual-media filter not in use to clean the filter media and remove the floc particles. The demonstration-scale RCF system has a design capacity of 100 gpm. The system will initially treat water blended from the four North Operable Unit (NOU) wells. When the pipeline for GN-3 is completed (expected in December 2009), it will treat groundwater from Well GN-3.

2.1 Start-up Objectives

The first week of the demonstration-scale RCF study will be dedicated to system start-up. Engineers and operators will be onsite during the start-up period to perform critical tasks, including initial filling of the treatment chemicals, calibrating the system flow rate and chemical injection rate, testing all monitoring instruments, and verifying the communication and control systems on the RCF plant. Water quality and process-related parameters will be sampled more frequently than specified in Section 7 of the O&M manual. This is necessary to evaluate system performance during the start-up period.

The following are the start-up conditions for the RCF:

- 25:1 Fe to Cr(VI) ratio
- 45-minute reduction time
- 5-minute rapid mixing time (with polymer)
- 0.1 ppm polymer dosing (Ciba Magnafloc E38) into influent water
- 3 gpm/sf hydraulic loading rate for the dual media filters
- Backwash set on daily cycle
- 1 ppm polymer dosing (Ciba Magnafloc E38) into the spent backwash water

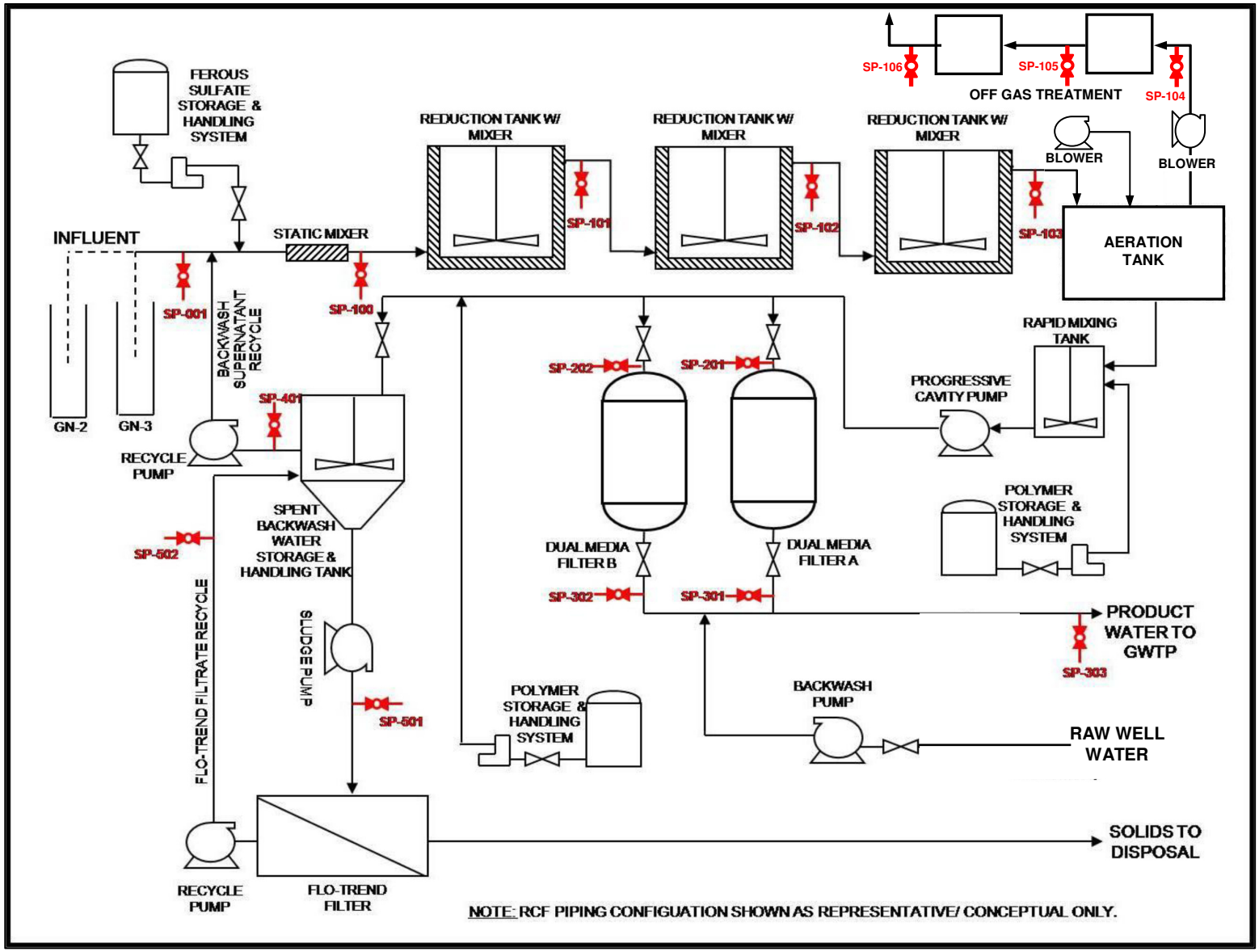

Figure 1: RCF Treatment System Process Flow Diagram

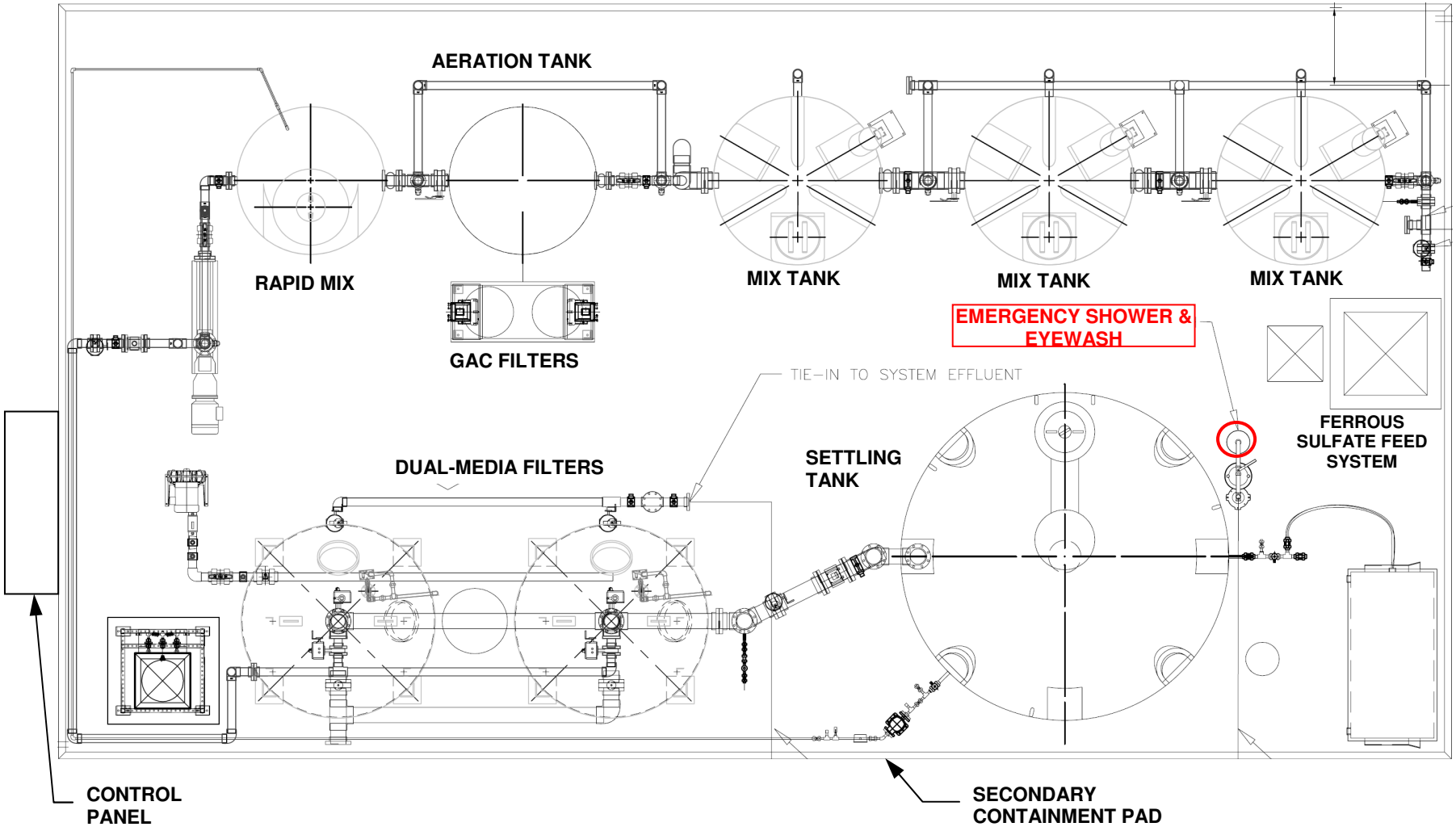

Figure 2: Treatment System Layout

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 Wells GN-2 and/or GN-3 and collect water samples for analysis.
- CDPH: Observe the start-up procedures and ensure it complies with permit requirements.
- Layne Christensen: Layne Christensen technicians will inspect the facility and make it ready for start-up, perform start-up and optimization of the facility. Responsible for supplying and loading the anthracite and sand into the filter vessels.
- 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.

4.0 PRE-START-UP PREPARATION

The following items will have been done prior to start-up as part of construction 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. All PLCs and HMIs have been tested and programmed. All alarms and interlocks have been tested.
3. Pressure testing: All process equipment will have been pressure tested in accordance with project requirements.
4. All chemicals and materials (i.e. ferrous sulfate, polymer) have been supplied to the facility. Filter vessels have been loaded with anthracite and sand. GAC filters are in place.
5. System disinfection: The entire facility will have been disinfected and tested meeting the required AWWA C651-99 and CDPH standards.

5.0 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. Start treatment system
3. Collect water samples and monitor the plant

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 construction drawings and specifications, O&M Manual, and by the equipment manufacturers. Equipment-specific O&M manuals are provided in the appendices.

5.1 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.

- Chemical analyses of raw water have been conducted as specified in the O&M manual for initial polymer preparation and chemical feed rates.
- Chemical feed systems are ready and storage tanks are full (i.e., ferrous sulfate, polymer).
- 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.
- Initial control set points have been entered into the PLC.
- Verify that all isolation valves to process instrumentation are open.
- Check flow meters for accuracy.
- Check and clean or replace filters and strainers.
- Well pump to supply feed water is running.

5.2 Start Treatment System

The treatment system will start depending on the water level in the Rapid Mix Tank in which is located the level transmitter that controls the influent valve (FCV500). When the plant is ONLINE and in AUTOMATIC mode, and the water level is below the setpoint, the valve will open to allow water into the system. When the liquid level in the Rapid Mix Tank reaches the setpoint, the VFD-controlled progressive cavity pump (P100) will modulate to maintain the level setpoint, pumping water through the filter vessels that is in service. Aeration blowers will start when the level control valve (FCV500) is in modulation control.

1. Verify that all equipment HAND-OFF-HMI (HOH) switches on the CP are in HMI (automatic) mode.
2. Verify that air blowers for aeration tank or in AUTOMATIC and filter vessels are in ONLINE and AUTOMATIC mode in the HMI and the backwash cycle is in the desired mode (i.e. manual, flow throughput, or timer)
3. In Start RCF system from the control panel. Valve FCV-500 will open automatically allowing well water into the treatment system.
4. When the water level in the Rapid
5. Monitor flow control as water level in Rapid Mix Tank rises.

6.0 SAMPLING AND MONITORING

During the start-up period, RCF effluent samples will be collected twice daily (at the beginning and the end of each daily run) and sent to the laboratory for Cr(VI) and total Cr measurements. A 24-hr turnaround time is desired for those analyses so that engineers and operators can use the data to adjust the operating conditions in a timely fashion. Once the demonstration-scale RCF system can operate uninterrupted for at least 72 hours and effluent Cr(VI) and total Cr concentrations remain below 1 µg/L, engineers and operators can terminate the start-up period and switch to normal operation and sampling schedules at their discretion. Sampling and monitoring schedules are provided in Table 1 and

Table 2, respectively. Sample port locations are shown on Figure 1.

Table 1: Sampling Schedule

Sample Point	Laboratory Analysis				Field Analysis					
	Cr(VI)	Total Cr	TSS	VOC	Cr(VI)	Total Fe	Fe^{2+}	Turbidity	pH/Temp[1]	ORP
SP-001	1/W	1/W	—	—	1/W	1/M	1/M	1/M	Continuous	Continuous
SP-100	—	—	—	—	—	1/W	1/W	—	—	—
SP-101[2]	—	—	—	—	—	1/D, 1/W	1/D, 1/W	—	1/W	—
SP-102	—	—	—	—	—	1/M	1/M	—	1/W	—
SP-103[2]	1/W	—	—	1W	—	1/D, 1/W	1/D, 1/W	—	1/W	1/W
SP-104	—	—	—		—	—	—	—	—	—
SP-105	—	—	—		—	—	—	—	—	—
SP-106	—	—	—		—	—	—	—	—	—
SP-201	—	—	—	1/W	—	—	—	—	1/W	1/W
SP-202	—	—	—	—	—	—	—	—	1/W	1/W
SP-301[2]	1/D, 1/W	1/D, 1/W	—	—	1/W	1/D, 1/W	1/W	Continuous	1/M	1/M
SP-302[2]	1/W	1/D, 1/W	—	—	1/W	1/D, 1/W	1/W	Continuous	1/M	1/M
SP-303	1/W	1/W	—	—	1/W	1/W	1/W	Continuous	1/W	1/W
SP-401	1/W	1/W	—	—	1/W	1/W	1/W	1/W	1/M	1/M
SP-501	—	—	1/M	—	—	—	—	—	—	—
SP-502	1/W	1/W	—	—	1/M	1/M	1/M	1/W	1/M	1/M

Notes:
1/M = once per month
1/W = once per week
1/D = once per day
[1] pH and temperature will be monitored at the same frequency because the pH meter selected for the RCF study has temperature compensation function to ensure more accurate measurement.
[2] Samples collected daily for first week of operation and weekly thereafter.

Table 2: Monitoring Schedule

Equipment Tag No.	Process-related parameters	Frequency
FIT500	Influent water flow rate and total volume	Once Daily
LT800	Ferrous sulfate injection rate and liquid level	Once Daily
P810, LT810	Raw water polymer injection rate and liquid level	Once Daily
PI000	Dual media filter inlet pressure	Once Daily
PDIT101	Dual media filter differential pressure	Once Daily
PDIS401	Media trap differential pressure	Once Daily
FQI800	Drawdown flow rate and total volume	Once every backwash cycle
FIT600	Backwash water flow rate and total volume	Once every backwash cycle
P811, LT810	Backwash polymer injection rate and liquid level	Once every backwash cycle
FIT700	Backwash supernatant recycle flow rate and total volume	Once every backwash cycle
Sludge treatment vessel	Settled backwash solids total volume	Once every backwash cycle
Filtrate transfer sump	Flo-Trend filtrate recycle total volume	Once every backwash cycle
Sludge treatment vessel	Dewatered sludge total quantity	Once every off-site disposal
PI002	Off gas treatment inlet pressure	Once Daily
PI003	Off gas treatment influent pressure, temperature, and flow rate	Once Daily