City of Pinole

Pinole/Hercules WPCP Project

Technical Memorandum 17

Plant Control Strategies

March 1, 2013

PRELIMINARY
FOR REVIEW ONLY

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TM 17 - PLANT CONTROL STRATEGIES

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Introduction

The purpose of this technical memorandum (TM) is to describe the proposed control of the plant processes including control of levels, splitting of flows between multiple facilities such as primary clarifiers, control of pumps and process monitoring. In the final design these control descriptions will be developed into control strategies for each unit process.

Raw Sewage Flow and Screening

The raw sewage flows by gravity to the Headworks and through the primary screening equipment. The 18-in plant drain discharges into the Headworks upstream of the screens. The screening and screenings handling will be controlled by local control panels furnished by the screen manufacturer. Typically, screens will be cleaned either by differential level across the screen or based on a preset time interval or both. Either screen can be taken out of service and dewatered for maintenance. If both screens must be taken out of service there is a manual bypass line around the screening.

Low Lift Pumping

The influent pumping follows screening and consists of dual wetwells and submersible pumps. Normally both wetwells are in service, but either wetwell can be taken out of service for maintenance or cleaning. The influent pumps are variable speed (VFD) controlled. The level of each wetwell is measured. With both wetwells in service one level signal will be used to control the number and speed of the pumps to match the pumped flow to the influent raw sewage flow in order to maintain the wetwell level within a predetermined proportional level control band of approximately one foot. The user can select which pump is lead, lag, lag 1, etc. The lead pump will operate continuously at variable speed. If the wetwell level rises above the proportional band which indicates more flow than the current on-line pumps can handle the next pump in the sequence will be started. When more than one pump is on-line all on-line pumps will run at the same speed. If the pump speed command falls to a preset low the last pump on will be taken off line. If one of the wetwells is out of service the level signal in the other wetwell will be used to control the pumps in that wetwell in the same manner as for both wetwells. A separate lead, lag, lag 1 pump sequence will be developed for single wetwell operation.

Raw Sewage Grit Removal

Grit is removed from the raw sewage after influent pumping using a single vortex grit removal unit. This unit and the corresponding grit transfer pump and classifier will be controlled and monitored by local control panels furnished by the equipment manufacturer.

Primary Clarification

Screened and degritted raw sewage flows to the Primary Clarifier Distribution Box. Any flows over 12 million gallons per day (mgd) will bypass primary clarification and flow to the Primary Effluent Junction Box. The raw sewage flow is split between the Primary Clarifiers by weirs in the Primary Clarifier Distribution Box, flows into each Primary Clarifier and over the clarifier effluent weir to the Primary Effluent Junction Box. Sludge is pumped from each Primary Clarifier by dedicated Primary Sludge Pumps. These pumps are operated on an adjustable on-off timed cycle, typically 10-minutes during every 30 minute period.

Biological Nutrient Removal

Primary effluent flows to the Primary Effluent Junction Box where it can be mixed with return activated sludge (RAS) from the secondary clarifiers and then flows to the two aeration basins (AB) which are normally configured for biological nutrient removal (BNR). The flow is hydraulically split between the two aeration basins through the pipeline from the Primary Effluent Junction Box.

Aeration Blowers

There will be three blowers all piped to a common low pressure air (LPA) header and common LPA line to the aeration basins. The user can select lead and lag blowers. The on-line blower(s) will be automatically controlled to maintain setpoint dissolved oxygen (DO) levels in the three aerated zones in each train and to minimize electrical energy use by controlling low pressure air header pressure to the minimum needed to maintain required air flow for DO control. The DO in each controlled aerated zone will be maintained at setpoint by a slow acting DO control loop which will monitor the zone DO and will modulate the air control valve for that zone to control the zone DO. As an additional electrical energy saving measure the control system will monitor the position of each zone air control valve to be sure that at least one valve is open to a preset most open valve position to avoid the case where the control valves tend to slowly work more and more closed. If the most open valve position falls below the preset position, indicating too high of a header pressure, the blower speed will be reduced in small steps until the most open valve is at the preset position. If the most open valve is above the preset position, indicating too little header pressure, the blower speed will be increased until the most open valve is at the preset position. If the on-line blower reaches 100-percent speed for a preset time a second blower will be started. If the blowers reach a preset minimum speed for a preset time a blower will be taken offline. There will be a preset minimum speed at which a single on-line blower can operate and a minimum position for the air control valves in order to provide adequate mixing.

Secondary Clarification

Mixed liquor (ML) from the aeration basins flows to the Secondary Clarifier Distribution Box. Flow is split to each secondary clarifier by weirs in this structure, flows into each secondary clarifier, and over the clarifier effluent weir to the Chlorine Contact Basin for disinfection.

The secondary clarifier RAS pumps are variable speed with a pump or pair of pumps dedicated to each clarifier. The RAS pump for each on-line clarifier runs continuously and is paced to the effluent flow from zero to the capacity of the pump at 100 percent speed. Total RAS pumping is typically set to pump at about 75% of effluent flow. Waste sludge (WAS) is continuously pumped from the common RAS line typically to match a WAS flow setpoint flow rate.

Disinfection

Chlorine is fed to and mixed with the secondary effluent prior to entering the Chlorine Contact Basin. Flow is by gravity through the basin and the effluent flow rate is measured over weirs installed at the inlet to each contact basin half. Effluent flows from the contact chambers to effluent disposal/pumping.

Effluent Monitoring

Effluent is monitored prior to disposal and this is an existing facility adjacent to the inlet of the Chlorine Contact Basin.

Effluent Pumping

Normally the effluent from the Chlorine Contact Basin is pumped to the effluent force main by the effluent pumps. There are three variable speed effluent pumps with up to two on-line at a time. The level in the effluent pump wetwell is measured and used to control the pumping speed to match the pumping rate to the effluent flow from the Chlorine Contact Basin. The user can select the lead and lag pumps. Normally the lead pump runs continuously. The speed of the on-line pump(s) will be varied to maintain the wetwell level within a preset proportional control band of approximately one foot. If one pump is on-line and the wetwell level rises above the proportional band for a preset time the second pump will be started. If the pump speed drops to a preset low speed the second pump will be stopped. If the on line pumps can not handle the flow from the Chlorine Contact Basin the wetwell level will rise and the excess flow will overflow to the Emergency Outfall.

Sludge Thickening

Prior to anaerobic digestion, primary sludge (PS) and thickened waste activated sludge (TWAS) are blended in a Sludge Blending/Storage Tank. Sludge from Primary Clarifier No. 3 is pumped directly to the Sludge Blending/Storage Tank. Sludge from Primary Clarifiers No. 1 and 2 is normally pumped directly to the tank, but can also be pumped to the rotary screen thickeners. WAS is pumped to the rotary screen thickeners. Thickened sludge then flows to the sludge Blending/Storage Tank. Thickened sludge pumps pump the sludge to the on-line

anaerobic digesters, normally Anaerobic Digesters No. 1, 3 and 4 continuously, but on a rotating timed basis with a preset feed time to each digester.

Anaerobic Digestion

This process remains unchanged in this plant improvement project.

Sludge Dewatering

Digested sludge flows by gravity to and is stored in unheated Anaerobic Digester No. 2. Sludge is dewatered several days a week using centrifuges by pumping from Digester No. 2 to the centrifuge in use. This is a manual process and the centrifuges are controlled by local control panels furnished by the centrifuge manufacturer. The dewatered sludge is loaded in trucks for transport to disposal.