SECTION 4.7
RAS SYSTEM

4.7.1 PURPOSE

The purpose of the RAS (return activated sludge) System is to control the depth of the settled RAS solids blanket within the clarifiers by pumping excess activated sludge back to the oxidation ditches.

4.7.2 RELATED SYSTEMS

The RAS system is part of the activated sludge system. Sludge settles in the clarifiers as supernatant is drawn off. This sludge is supplied to the RAS sump by the clarifier mechanism. RAS is pumped to the flow splitter box and mixed with raw degritted sewage to become mixed liquor before entering the oxidation ditches.

4.7.3 DESCRIPTION

Structural Mechanical

The RAS system consists of sumps, pumps, flow meters and associated piping as shown in record drawing C3, S401, S402, S403, M401 and M402. Each clarifier's RAS sump, pumps, and flow meter is situated adjacent to the clarifier. Flow meters 4FE01 and 4FE02 measure RAS flows from Clarifiers 1 and 2 respectively. Pumps 4P11 and 4P12 are located in the RAS sump at Clarifier 1, pumps 4P21 and 4P22 are located in the RAS sump at Clarifier 2. Design data for each RAS pump are as follows:

Type	Non-clog centrifugal, with submersible motor
Flow, minimum	271 gpm
Flow, maximum	1,740 gpm
Head, minimum	11 feet
Head, maximum	26 feet
Horsepower	17.5 hp
Drive	Variable Frequency

An 8-inch force main from each clarifier's RAS sump header leads to a 12-inch main line that connects to the flow splitter box as the normal flow mode.

Electrical

Electrical power to the RAS system is provided from the MCC panel in the Equipment Building, as shown on record drawings E3, E5, E7 and E401. Power supply and controls for the RAS pumps are summarized in Tables 4.7-1 and 4.7-2. Section 4.4 contains information on the flow meter power supply and controls.

4.7.4 OPERATION

Startup

1. Refer to the manufacturer's O&M manuals for equipment specific startup procedures.

2. Coordinate startup with operation of the activated sludge system as described in Section 4.5.

3. Check the RAS sump and pumps for general readiness.

4. Verify that the VFD and related pump controls are in the desired modes of operation. If in HAND mode, adjust the RAS pump speed settings and verify pump flows are as desired. Adjust RAS VFD settings as required.

5. Energize the RAS pumps.

Control

RAS Pumps

Pump operation is controlled by two switches mounted on the variable frequency drive (VFD) cabinet. The H-O-A switch controls the pump operation and the VFD-BYPASS switch selects the operation mode of the VFD. A touch pad on the VFD cabinet allows manual adjustment of the pump speed when the H-O-A switch is in HAND.

The RAS pumps can be controlled manually or automatically by setting the H-O-A selector switch on HAND or AUTO. On HAND the pumps will run continuously with the pump speed set manually at the pump VFD cabinet. On AUTO the pumps run continuously with the pump speed controlled by a signal from the Plant Control Computer. The computer varies the pump speed to maintain an operator settable flow ratio between the total RAS flow (4FE01 + 4FE02) and the plant flow at the Secondary Effluent Control Structure (6FE01). Pump protection is provided by float switches that signal a Low Level Alarm and cause Pump Cutoff if the level falls one foot below the Low Level Alarm signal level.

Because RAS pumps become worn and pump at different rates and because pumps can be partially plugged it is important to run the RAS pumps at full speed for at least 5 minutes each day. This will help ensure the flow from each clarifier is more equal. The pump wear parts are not identical as they become worn the pumps pump at different rates and the ratio set point for each pump will not equalize the flow from each clarifier. It is important to rebuild the pumps at the same time to keep the same hours on each pump so that the flow at equal RPMs. We have determined that the impeller and the wear parts should be replace once every 5 years.

The Plant Control Computer is programmed to operate the pumps in a lead/standby mode where only one pump in each RAS sump will run at a time and the standby pump will start if the lead pump fails. The operator must manually change the lead pump at the Plant Control Computer by stopping the present lead pump and starting the other one. The lead pump should be changed once a week to maintain equal run times.

The VFD cabinet has a VFD-BYPASS switch to enable or disable the VFD. In the BYPASS mode the VFD does not operate and the pump runs at full speed. In the VFD mode, the pump speed is controlled either by the Plant Control Computer or by the touch pad input at the VFD panel in the equipment building.

The RAS flow should be controlled at the minimum rate which holds the solids blanket between 2 and 13 feet below the clarifier weir elevation. If the blanket is more than 13 feet down, the RAS and WAS concentrations will be low and turbulence in the clarifier will likely be unnecessarily high. If the blanket is less than 2 feet below the clarifier weirs, then the sludge is very close to overflowing the weirs and fouling of the supernatant effluent is likely to occur.

Normally the solids blanket depth tends to increase as plant flows increase because more mixed liquor solids are carried into the clarifier at higher flows. In AUTO, the RAS pumping rate changes as plant flow changes which will minimizes the rise and fall of the solids blanket. In HAND the RAS pumping rate is constant at the rate set into the VFD through the touch pad and the solids blanket depth will tend to rise and fall with the plant inflow rate. With HAND control the RAS rate should be set high enough for the anticipated peak plant flow that may occur before the next manual adjustment to prevent the solids blanket from rising and overflowing the weir. HAND control often results in unnecessarily high RAS flows, low WAS concentrations and turbulence in the clarifier during lower plant inflow periods.

Man-Machine Interface

The RAS screen of the Plant Control Computer displays the following process parameters for each RAS pump:

Pump on/off status
Pump over temperature alarm
Pump seal leak alarm
Pump failed to start alarm
Pump run time
Discharge check valve position

The screen also displays the actual RAS flow from each clarifier, the flow at the secondary effluent control structure, and the sum of the RAS flow from the two clarifiers. The current ratio of total RAS flow to secondary effluent is calculated and displayed as a percentage.

The RAS screen allows the operator to start and stop each RAS pump using a pop-up push button. The RAS screen also allows adjustment of the RAS flow ratio set point when the H-O-A switch is in AUTO, using the computer keyboard to enter a new value.

Power Failure

During a power failure wastewater continues to flow through the clarifiers by gravity even through the RAS pumps and the clarifier mechanism have stopped operating. When power is restored the pumps and clarifier mechanism start automatically if the H-O-A switch is still set to HAND or AUTO. Although most solids will tend to settle in the oxidation ditches during a power outage, some solids will settle in the clarifiers. If the layer of solids builds up during an extended power outage and approaches the clarifier weir elevation, some of these solids should be removed

before the clarifier restarts to prevent them from being washed over the weir by the additional turbulence of the clarifier arm operation. This may require the use of a portable engine-driven pump to send these solids back to either the in-plant pump station or the flow splitter structure. After power is restored the solids level in the clarifiers can be returned to a normal level by temporarily running the RAS pumps at a high rate and then returning to a slower rate after the normal solids level is achieved. The RAS system can be supplied with standby power during long power outages by the use of a portable generator being plugged into the portable generator connection on the exterior wall of the equipment building. See Section 7.2.

Shutdown

The RAS system for a given clarifier should not be completely shut down unless that clarifier is also shut down. One pump may be removed from a system using the following steps:

1. Refer to the manufacturer's O&M manual for equipment specific shutdown procedures.

2. Coordinate shutdown with operation of the activated sludge system as described in Section 4.5.

3. Verify that the remaining pump is operational and in the HAND or AUTO setting.

4. Turn off power and close the isolation valve for the shutdown pump.

5. Remove pump.

4.7.5 OPERATING PRINCIPLES

RAS Flow

The RAS flow rates should be controlled primarily to optimize effluent quality. Monitor the height of the solids blankets regularly to determine the optimum heights for effluent quality, and then adjust the RAS flow ratio to keep the blanket between these heights. At some plants the RAS rates are controlled to provide thickening of solids within the clarifier. However at Snoqualmie thickening in the clarifier should be a secondary consideration since the solids can be thickened in the lagoons. The EIMCO Carrousel A^2C System Process Operating Manual contains a detailed discussion of the overall treatment process and RAS flow control.

4.7.6 MAINTENANCE

1. Refer to the manufacturer's O&M manuals for equipment specific maintenance.

2. Refer to Section 2.4 for general maintenance information.

4.7.7 SAFETY

1. Refer to Section 2.6 for general safety information.

TABLE 4.7-1.
POWER SUPPLY AND CONTROLS FOR RETURN ACTIVATED SLUDGE (RAS) PUMPS

Equipment No.	Power Source 480 V, 3-Phase, Normal	Reference Drawings
4P11	Main MCC	E5
4P12	Main MCC	E5
4P21	Main MCC	E5
4P22	Main MCC	E5
Local Control Devices		
1. Three-pole safety disconnect switch at pump		E401
Motor Starter Equipment		
1. 70A, 480V, 3P circuit breaker		E11
2. VFD with by-pass contactor		
3. HOA selector switch. On AUTO VFD is driven by 4-20 ma signal. In HAND mode VFD is driven by potentiometer setting set manually		
4. VFD - By-pass selector switch		
Plant Control Panel		E12, E13
1. Input: VFD on status, VFD failure, seal leak, over temp., check valve status		
2. Output: 4-20 ma DC speed control signal from PLC, Start/Stop		
3. Control: Proportional to the following: 4P11 & 4P12 = (4FE01 + 4FE02)/6FE01 4P21 & 4P22 = (6FE01 + 4FE02)/6FE01		
Loop Reference		
TSI Drawings #4660-E038, -E039, -E040, & -E041		P6

TABLE 4.7-2.
POWER SUPPLY AND CONTROLS FOR RAS SUMP LEVELS

Equipment No.	Power Source 120 V, 1-Phase, Standby	Reference Drawings
4LE02	Panel EB, ckt-31	E8
4LE03	Panel EB, ckt-31 & Generator MCC	E8
Local Control Devices 1. Miltronics display unit in Equipment Bldg.		E7, E401
Plant Control Panel 1. Input: 4-20 ma from 4LE02 and 4LE03 to PLC 2. Output: Low sump level alarm to PLC 3. Control: None		E12, E13
Loop Reference TSI Drawing #		P6