# APPENDIX C – DRAFT PROCESS CONTROL NARRATIVE

# CITY OF IQALUIT
# WASTEWATER TREATMENT PLANT UPGRADE

# CONTROL PHILOSOPHY

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# 1 INTRODUCTION

The City of Iqaluit's Wastewater Treatment Plant (WWTP) is being upgraded to increase treatment capacity and capability to meet more stringent regulatory requirements and service a growing population. The new facility will consist of the following unit treatment processes:

1. Raw Wastewater Pumping
2. Fine Screening and Compaction
3. Primary Filtration
4. Moving Bed Biofilm Reaction
5. Dissolved Air Floatation Clarification
6. TWAS Dewatering
7. Polymer Preparation/Dilution and Dosing

## 1.1 Overview

The following is a brief overview, from the Controls perspective, of the site modifications and final facility operation.

## 1.2 Objective

This narrative depicts the functionality to be provided by the facility control system for the WWTP upgrades. Integration of Field Inputs and Outputs

## 1.3 Control System Platform

The existing plant topology is based on Allen Bradley Programmable Logic Controllers (PLC) SLC500 platform. The SLC500 platform, as of 2017, is still supported by the manufacturer but is end of life. The SLC500's successor, the ControlLogix line is in active development and will be supported for years to come. The plant upgrades have been based on the ControlLogix platform.

### 1.3.1 Integration of MCC IO

The design intent will be to utilize both 'hard wire' and 'soft wire' control for all Variable Speed Drives (VFDs). The primary control signals required for automatic control of the VFDs will be implemented using discrete and analog signals, whereas auxiliary information will be available to the PLC through Ethernet/IP communications. All full voltage starters will be directly wired between discrete inputs and outputs in the local PLC cabinets.

### 1.3.2 Hand-Off-Auto (HOA) and Emergency Shut Down (ESD) Switches

All motors, both VFD and FVNR driven, to have both a Hand-Off-Auto (HOA) switch and local Emergency Shut Down (ESD) switch. The HOA switch shall be located on the front panel of the starter location, typically at the MCC. The ESD will be located on a field-mounted junction box in close proximity to the motor. Unless otherwise specified, the following shall apply to all pumps and motors.

Local emergency stop switches for each motor shall prevent the motor from running in either auto or hand, and show an alarm on the SCADA system while engaged. The Hand-Off-Auto switch at the MCC shall dictate the following behavior:

- Switch in Off: Motor does not run and cannot be overridden through the motor starter keypad.
- Switch in Hand: Motor starts / stops based on input from the MCC keypad, and in the case of VFDs, operates at the speed indicated on the keypad. PLC input is ignored.
- Switch in Auto: Motor is started, stopped, and speed controlled through I/O from the PLC. Keypad input is ignored.

### 1.3.3 Integration of Field IO

The design intent will be to hard wire all field equipment with discrete and analog connections.

### 1.3.4 Integration to PLC based systems

The control system integration will be supported by an Ethernet network between the two PLC cabinets. The existing SLC5/05 PLC will converted to a ControlLogix PLC and will be connected into a network switch to bridge the communications between it and a new ControlLogix PLC.

### 1.3.5 Typical Data Creation

The control system will standardize on basic controls information passed back to operations. This includes Current Hour, Current Day, Previous Hour and Previous Day totals for every flow meter (flow) and run time (pumps). In addition to flow meters, monitored telemetry from all instrumentation will include instantaneous max and minimum data collected in the current and previous day, as well as average data (e.g. average dissolved oxygen in a bioreactor in the previous day). Exceptions will be indicated through the documentation.

### 1.3.6 PLC and HMI/SCADA Standards

TBD

# 2 INFLUENT PUMPING AND PRELIMINARY TREATMENT

## 2.1 Introduction

Raw wastewater from the City's collection system enters the pump station influent wet well (T-01-001). Three raw wastewater chopper pumps (P-01-110/120/130) located in the influent wet well operate in a lead/lag/standby mode to lift the raw wastewater to the fine screens (SCRN-01-210/220) located at the upper floor of the existing headworks building. Placement of the fine screens at this elevation allows for gravity flow through the rest of the WWTP's downstream treatment processes. Influent flow being pumped is monitored using magnetic flowmeter (FM-01-150) located at the pumps discharge header.

The fine screens are of the shaftless spiral type integrated with transport, compaction, and dewatering zones in the same unit. The fine screens operate in a duty/standby mode, with each capable of meeting the design peak hour flow. Screened raw wastewater flows by gravity from the fine screens to the primary filters (PF-01-310/320). Screenings removed by the fine screens are deposited in the screenings/primary sludge disposal trailer located in the lower floor of the headworks building.

### 2.1.1 Reference Information

| DWG NUMBER (RANGE) | TITLE | REV |
|---|---|---|
| P604 | Wet Well Piping and Instrumentation Diagram | 0 |
| P605 | Screening Piping and Instrumentation Diagram | 0 |

### 2.1.2 Control Philosophy

#### *2.1.2.1 Raw Wastewater Pumping*

The influent pump station wet well is equipped with low-low (LSLL-01-111), low (LSL-01-112), high (LSH-01-113) and high-high (LSLL-01-114) level switches and a level indicator transmitter (LIT-01-100) to monitor the wastewater level.

Each of the WWTP's three raw wastewater pumps (P-01-110/120/130) has a capacity of 75.5 L/s and is driven by a variable frequency drive and motor combination that operates based on the influent flow and corresponding wastewater level of the wet well in a Lead/Lag/Standby operation. One raw wastewater pump operates at low influent flows to the plant. Two raw wastewater pumps operate at high influent flows to the plant with a total combined capacity of approximately 151 L/s, to meet 2041's peak hour flow.

The lead raw wastewater pump starts to operate at a set point water elevation of 8.4 m in the wet well (refer to the Hydraulic Profile). Under normal operating conditions, only one raw wastewater pump is pumping; however, when influent flow increases beyond the maximum capacity of the pump and the wastewater level in the influent wet well reaches the predetermined elevation set point of 9.2 m, the lag influent raw wastewater pump starts automatically.

Staging equipment to shutdown includes evaluating both the main influent flow and level in the wet well; when influent flow decreases below 75.5 L/s, and the wastewater level in the wet well is confirmed below a predetermined elevation of 7.0 m, the system allows the shutdown of the lag raw wastewater pump.

Upon the discontinued operation request of a raw wastewater pump, the lead pump is shut down, the last raw wastewater pump brought on-line is placed in the lead duty sequence and remains operational, and the non-operating unit is placed in the second duty position. Manual operation is permitted through both the SCADA and locally at the MCC.

#### *2.1.2.2 Fine Screening*

Flow from the raw wastewater pumps is measured with flowmeter (FM-01-150) and manually directed to either shaftelss spiral screen (SCRN-01-210) or (SCRN-01-220). The screens operate in a duty/standby configuration. Each screen has a rated capacity of 151 L/s and 6 mm opening size. One screen can handle the peak hour flow to the plant. Upon a trigger to operate, the unit will run for an adjustable time as per the settings on the off-delay timer.

Each screen is equipped with high (LSH-01-211/221) and high-high (LSH-01-212/222) level switches to control the water level inside the unit. The influent flow from the raw wastewater pumps to the operational screen is shutdown if a high-water level condition is reached in the screen.

During the screening operation, an internal spray bar cleans the screen and the solids compaction zone of the unit utilizing non-potable water from the plant utility system. Solenoid valves (SV-01-112/114) provided for the spray system cycle per the setting on their own repeat timer whenever the motor is running.

Screenings from the fine screens flow to the screenings/primary sludge disposal trailer; the automated on/off valve (KV-01-112) allows the flow of screenings to the trailer during normal operation. The valve is closed when the fine screens are not operational and/or the trailer is not available to receive screenings.

# 3 PRIMARY TREATMENT

## 3.1 Introduction

Primary filters are used for ultra-fine screening and solids retention, and provide the same removal efficiency as conventional primary sedimentation. The primary filters (PF-01-310/320) receive raw wastewater flow by gravity from the fine screens (SCRN-01-210) or (SCRN-01-220). The primary filter unit contains a belt filter which captures influent grit and biological solids on a filter mat, increasing the removal of solids as the thickness of the filter mat increases.

Solids are thickened to 4% - 6% solids content on the belt of the primary filters and are removed as the filter mat rotates past an air knife. Primary sludge removed by the primary filters is deposited in the screenings/primary sludge disposal trailer located in the lower floor of the headworks building. Filtered primary effluent flows by gravity to the MBBR tanks.

### 3.1.1 Reference Information

| DWG NUMBER (RANGE) | TITLE | REV |
|---|---|---|
| P606 | Primary Filter 1 Piping and Instrumentation Diagram | 0 |
| P607 | Primary Filter 2 Piping and Instrumentation Diagram | 0 |
| P608 | Primary Filter Blowers | 0 |

### 3.1.2 Control Philosophy

#### *3.1.2.1 Primary Filters*

Each primary filter is sized for 121 L/s and will operate in a lead/lag mode of operation to meet the 2041 peak hour flow of 151 L/s. Under average flows to the plant, one filter will be operating. Each primary filter is equipped with a level switch (LE-01-115/125) located in the influent compartment of the unit. The primary filter belt operates based on the sensed level in that compartment. During high flow events, greater than average flows, the second primary filter is automatically engaged by opening automated knife gate valves (KV-01-11) or (KV-01-121) at the inlet of the unit.

The primary filter belt and the screw press are equipped with variable frequency drives to vary the operational speed of the units and regulate the filtration process. An air knife assembly connected to primary filter blowers (B-01-210/220) functions to continuously remove solids from the surface of the filter cartridge. A primary filter integrated sludge dewatering system, consisting of a wedge wire screen and screw press (SP-01-330/340), thickens, and dewaters the sludge. Dewatered sludge is deposited in the screening/primary sludge solids disposal trailer.

The whole operation of the primary filters including the air knife assemblies, the screw presses, the primary filter blowers, is controlled from the HMI provided for each unit.

Each primary filter is equipped with a non-potable hot water connection for internal flushing to remove fats, oils and grease from the filter belt that may build up over time and impede the filter operation. The non-potable hot water flow to the units is controlled by solenoid valves (SV-01-312/113) and the frequency of the non-potable hot water flushing operation is field-adjustable through the HMI of the unit.

A non-potable cold water connection to the primary filter and the screw press is also provided for automated internal cleaning of each unit. Like the hot water flushing, the non-potable cold water flow to the units is controlled by solenoid valves (SV-01-322/323) and the frequency of the non-potable cold water flushing operation is field-adjustable through the HMI of the unit.

#### *3.1.2.2 Primary Filter Blowers*

Two primary filter blowers (B-01-210/220) provide air to the primary filter air knife for removing solids from the primary filter belt. Each blower is sized to service one primary filter. The primary filter blowers operate in duty/assist like the primary filters.

# 4 SECONDARY TREATMENT

## 4.1 Introduction

Secondary treatment of the primary effluent is accomplished using a moving bed biofilm reactor (MBBR) followed by dissolved air flotation (DAF) units.

Two MBBR trains (T-02-210/220) are installed. Each MBBR train consists of two cells disposed within a bioreactor tank filled with carrier media suspended in the tank. An aeration system (B-02-110/120/130) provides the air required for biological treatment and functions to keep the media in constant suspension while periodically sloughing off accumulated biomass.

The MBBR is followed by high rate secondary clarification using DAF units (T-02-310/320). Dissolved air and sometimes polymer are added the mixed liquor, and suspended particles are removed from the liquid stream by bringing the particles to the surface, from where they are skimmed off to a collection tank. The collected thickened waste activated sludge is pumped to TWAS Storage Tanks (T-03-630/640) prior to the solids thickening process. Final clarified effluent from the DAF is discharged to the existing WWTP outfall.

### 4.1.1 Reference Information

| DWG NUMBER | TITLE | REV |
|---|---|---|
| P609 | Process Aeration Blowers Piping and Instrumentation Diagram | 0 |
| P610 | Moving Bed Biofilm Reactors Piping and Instrumentation Diagram | 0 |
| P611 | Dissolved Air Floatation 1 Piping and Instrumentation Diagram | 0 |
| P612 | Dissolved Air Floatation 1 White-Water Pumping Piping and Instrumentation Diagram | 0 |
| P613 | Dissolved Air Floatation 2 Piping and Instrumentation Diagram | 0 |
| P614 | Dissolved Air Floatation 2 White-Water Pumping Piping and Instrumentation Diagram | 0 |
| P615 | DAF Polymer System Piping and Instrumentation Diagram | 0 |
| P616 | DAF Polymer Dosing Pump System Piping and Instrumentation Diagram | 0 |

### 4.1.2 Control Philosophy

#### *4.1.2.1 Moving Bed Biofilm Reactors*

The MBBR is a flow-through process; the process is load based meaning influent flow rate variations. Each MBBR train is online and primary influent is continuously fed to both trains that work in parallel. Each MBBR train can treat the 75% of the 2041 maximum month flow or 45.3 L/s. Both MBBR trains operating can pass hydraulically the 2041 peak hour flow (151 L/s) to the plant.

Primary effluent flows from the primary filters (PF-01-310/320) to the MBBR reactors by gravity. Flow is split into two MBBR trains (T-02-210/220). Flow splitting is not entirely equal as splitting occurs through pipelines of different length to each MBBR train due to the location of the primary filters in the headworks building, the location of the MBBR units in the secondary treatment area and the configuration of the existing plant building.

The system has the option to operate a single train during low loading conditions to save energy and avoid nitrification. The second MBBR train is put into idle mode with the aeration off most of the time and pulsed using an on/off timer to keep biomass alive. When this condition continues for longer durations, the MBBR train is alternated to keep biomass nourished. Alternation is accomplished through the actuated open/closed valves (KV-02-211/221) installed at the inlet of each MBBR train.

Each MBBR reactor train is split into two cells. Sieves are used to retain the carrier media in the MBBR cells, while allowing the treated effluent to flow downstream to the DAF units.

Each MBBR cell is equipped with dissolved oxygen (DO) sensors/transmitters (AIT-02-211/212/221/222) to monitor the oxygen level in the system. The desired DO set point is fixed by operator and a DO control loop is used to modulate the process air feed flow from the process aeration blowers (B-02-110/120/130) to the cells through the actuation of modulating process air control valves (BFV-02-150/155).

A minimum air feed flow is set, which corresponds to the minimum flow required to keep MBBR media in suspension. This minimum air flow is referred to as the minimum mixing intensity. The DO probes are automatically cleaned using a blast of compressed air at fixed intervals set on a timer.

The control of the MBBR units is closely integrated with the control of the DAF units. Each cell of each MBBR train is equipped with high water level switches (LSH-02-213/214/223/224). A high level detection leads to a high priority alarm requiring operator intervention. High level within the MBBR reactors could be caused for instance by closed DAF inlet isolation valves (BFV-02-312/332). A high level detection stops feed to the MBBR unit by closing the respective actuated open/closed valve (KV-02-211/221) installed at the inlet of the MBBR train.

If actuated open/close valves (KV-02-211/221) need to be closed at the same time, (this could happen when both MBBR trains cannot receive additional influent flow) and the shaftless spiral screen (SCRN-01-210 or 220) and the primary filters (PF-01-310/320) must be kept operational due to high influent flows to the plant, the automated secondary emergency bypass valve (KV-01-001) opens during the high flow event allowing the primary effluent to flow to the outfall.

Walls separating the cells of each MBBR train are provided with penetrations at the bottom to be able to fill both cells at the same time avoiding rupture of such walls due to hydrostatic differences. Blockage of the penetrations is detected by a difference of more than 500 mm in the water level within the cells. Differences between water level readings of level switches installed in cell 1 and cell 2 of each MBBR train generate a high priority alarm.

#### *4.1.2.2 MBBR Blowers*

Aeration to the MBBR trains is provided by three positive displacement process aeration blowers (B-02-110/120/130) (two duty/one standby) located in the upper level of the secondary treatment area. The blowers provide 10 $m^3$/min at 46 kPa to each MBBR train. The MBBR blowers also provide process air to the TWAS storage tanks (T-03-630/640) (3.1 $m^3$/min at 46 kPa to each TWAS storage tank) to keep the TWAS solids in suspension and very sporadically to the DAF units (T-02-310/320) for bottom sludge agitation.

Each process aeration blower is provided with a variable frequency drive to vary the air flow being supplied to the MBBR system and the TWAS storage tanks as per requirements from the process.

#### *4.1.2.3 Aeration System*

A coarse bubble aeration system within the MBBR cells covers the tanks bottom surface. The aeration system provides optimum oxygen transfer to the fixed biomass and maintains homogenous MBBR media mixing over the reactor cell volume.

#### *4.1.2.4 Dissolved Air Floatation Units*

The DAF units (T-02-310/320) are used for total suspended solids (TSS) removal from the MBBR trains (T-02-210/220) effluent. Mixed liquor from the MBBR trains flows into the DAF units by gravity. Each DAF unit is comprised of a floatation tank, inlet distribution plate, air distribution nozzles, an anti-vortex floatation system, a treated water collector pipe system and a mechanical sludge scraper (DDR-02-311/321).

The DAF tanks contain different specific zones. Inflow occurs in the upper part of the entry zone and underflows a watertight wall to the white-water injection zone. The clarified water overflows from the white-water injection zone to the flotation zone and is discharged to the clarified water evacuation zone by a collector located at the bottom of the flotation zone. The floated sludge (TWAS) in the flotation zone is brought to the surface and then to the sludge collection zone by the scrapper mechanism (DDR-02-311/321). TWAS is sucked from the sludge collection zones of the DAF units by the TWAS pumps (P-02-610/620) and sent to the TWAS storage tanks (T-03-630/640).

Each DAF unit is also equipped with a white-water flotation system which includes a white-water pumping system (P-02-410/420/430/440/450/460) followed by white-water solids removal system with strainers (STR-02-510/520/530/540). In the white-water flotation system, a portion of the water from the DAF flotation zone is pressurized and recirculated to the white-water injection zone of the DAF units to produce microbubbles used to obtain the solids flotation effect in the system.

Each DAF unit can treat the 2041 maximum month flow of 60.4 L/s and both DAF units can treat the peak hour flow of 151 L/s. The DAF units are provided with Local Control Panel (LCP) with PLC for control integration of the control operation of the MBBR trains, DAF units, white-water pumps, and strainers. The LCP is also integrated to the Control Plant System.

Under normal operating conditions the MBBR and DAF processes act as a treatment train with MBBR train 1 coupled with DAF unit 1 and MBBR train 2 coupled with DAF unit 2. Under abnormal operating conditions, when one DAF unit is out of service, the other DAF unit has the hydraulic capacity to pass the peak hour flow coming from both MBBR trains with effluent water quality that could be degraded during this period.

The DAF units use automatic level control. The control loop measures the DAF water level in the flotation zone using level indicator transmitters (LIT-02-331/341) and modulates flow to keep the level constant with the use of motorized modulating valves (BFV-02-309/310/329/330). Water level outside of a pre-set range (too low or too high) generates a level alarm. This condition can be caused due to a dysfunction of the flow control loop, for instance a mechanical problem with the modulating valves; this condition requires operator attention as a low water level impacts sludge scraping capacity while a high water level can lead to water overflow into the float sludge zone.

The DAF units are also provided with high water level switches (LSH-02-332/342) to raise a high priority alarm when a severe problem occurs with the level control system, for instance if the maximum design flow of the plant is sent to a single DAF unit with the effluent level control weir stuck in a high level position. In this case, the sludge outlet valve closes to prevent flooding of the sludge holding tank and all flow passes through the DAF unit and overflows over the effluent weir. At this point the unit is out of service, the influent automated isolation valve (BFV-02-312/332) closes and the second DAF unit automatically starts if not already in operation.

White-water for each DAF unit can be generated using either one or two white-water pumps. When influent flows are low as measured by the DAF effluent flowmeter (FIT-02-317/327) installed at the discharge side of the DAF units, running with a single white-water pump can produce operation savings. The second white-water pump starts when flows increase, at a threshold rate set by operator. Each DAF unit is provided with a third white-water pump as an installed standby. Activation of the standby pump requires operator intervention to open and close manual isolation valves upstream and downstream the white-water pumps.

When a single white-water pump is running, only half of the white-water injection nozzles located in the injection zone are used; this is achieved automatically by closing the automated white-water injection valve (BFV-02-625/645).

The white-water system in each DAF unit includes the following control items:

- A white-water flowmeter (FIT-02-317/327) installed at the suction side of the white-water pumps to measure the white-water flow rate to confirm it is always either 50% or 100% of a fixed value. Lower flowrates indicate clogging of the white-water circuit or lower pumping capacity, which could be caused by too much air inlet flow and is detrimental for process efficiency. A low flow system alarm is triggered while the system remains in operation, requiring operator investigation of the cause of the reduced flow.

- Each white-water pump (P-02-410/420/430/440/450/460) use manual air inlet valves on the air inlet to adjust air flow.

- Strainers (STR-02-510/520/530/540) are provided for each DAF unit white-water system to protect the injection nozzles from blockage. The operation of the strainers is controlled through automated valves (BFV-02-511/521/531/541). Automated strainer cleaning valves (BFV-02-512/522/532/542) are actuated on a periodic basis by timer to flush the strainers for a couple of seconds. Operator sets the timer sequence.

- The white-water pressure is to be quite constant at around 550 kPa in the white-water header. A deviation from this target means something is wrong with the white-water system operation. Pressure is monitored with pressure transmitters (PT-02-527/547) installed at the discharge side of the strainers. A high pressure alarm is generated if for instance the white-water nozzles are beginning to clog, or if white-water injection valve is not opening properly. A low pressure alarm means clogged strainers, requiring cleaning by operator, or reduced pumping capacity.

The sludge scraper (DDR-02-311/321) of each DAF unit runs automatically when the DAF unit is in operation. The scraper motor runs on VFD; the scraper operation is either at constant speed set by operator or based on an on/off timer set also by operator.

The sludge collection zone of each DAF units is equipped with low (LSL-02-333/343) and high (LSH-02-332/342) level switches to monitor sludge level.

The number of DAF units in operation (one or two) is controlled according to DAF feed flow as measured by the flowmeter (FQIT-02-328) installed on the water effluent line to the outfall. At flows lower than an operator setpoint, a single unit is in operation. This is undertaken by closing the on/off automated inlet valve (BFV-02-312/332) to the second DAF unit.

Fully manual operation of the DAF units is difficult due to the modulating DAF level control system. Manual operation requires the operator to manually modulate the DAF effluent weir to maintain a more or less constant water level in the unit; this is possible if the influent flow rate is relatively constant. Other systems that can be operated manually are the sludge scraper and the white-water pumps.

#### *4.1.2.5 DAF Polymer Preparation/Dilution System*

Polymer addition increases total suspended solids removal performance in the DAF units. Polymer is not required continuously. Polymer may be required for the DAF system when mixed liquor flow and/or suspended solids concentrations reach above average levels.

Dry polymer is delivered to site in 25 kg bags. A polymer preparation/dilution system (PDS-04-700) is available to automatically prepare a homogeneous polymer solution at approximately 0.3%. The system is an automatically controlled, sequentially batching unit consisting of a hopper suited with a vacuum loading station, high shear, first stage pre-wetting system, medium shear transition mixer, a mix tank with a low shear mixer and an aging tank. All the elements of the DAF polymer preparation/dilution system are controlled from the local control panel supplied with the unit. The system can be operated automatically or manually.

A polymer dosing pump skid composed of three DAF Polymer Dosing Pumps (P-04-770/780/790) is available for polymer solution pumping from the polymer preparation/dilution system to the influent water pipelines to the DAF units. Each of the two duty polymer dosing pumps pump polymer solution to each DAF unit with a common shared spare dosing pump.

The DAF units are equipped with online effluent total suspended solids (TSS) sensors/transmitters (AIT-02-334/344) to continuously measure total suspended solids in the effluent. When final effluent TSS is higher than an operator input setpoint, typically slightly lower than the 20 mg/L target for the plant, polymer dosage is activated at polymer setpoint dosage established by operator. If effluent TSS remains higher, polymer dosage is increased by the operator.

Polymer dosage can also be regulated based on flow, according to the final effluent flow measurement from the plant effluent flowmeter (FQIT-02-328).

Dilution water lines for polymer post-dilution as required are available at the discharge headers from the polymer dosing pumps conveying the polymer solution to the DAF influent pipeline.

#### *4.1.2.6 Effluent Flow Metering Chamber*

Final effluent flows by gravity from the DAF units to the outfall and it is discharged to the ocean. Effluent flow is monitored by a magnetic flowmeter (FQIT-02-328) installed on the effluent water line for such a purpose.

# 5 SOLIDS HANDLING

## 5.1 Introduction

Thickened waste activated (TWAS) sludge accumulated in the sludge collection zones of the DAF units is pumped by the TWAS pumps (P-02-610/620) to two TWAS storage tanks (T-03-630/640). The TWAS storage tanks are provided with coarse bubble aeration to keep the solids in constant suspension and prevent the sludge from going anaerobic while being stored prior to dewatering.

Belt filter press feed pumps (P-03-630/640) pump the TWAS from the storage tanks (T-03-630/640) to the belt filter press (BFP-03-650) for dewatering. Dewatering takes place three days a week for seven hours per day, at maximum month flow design conditions.

The belt filter press uses a perforated belt and mechanical compression zone to filter and separate the liquid fraction in the sludge from the solids fraction. Dewatered sludge discharges directly into a dewatered solids disposal trailer located on the lower floor of the secondary building. The filtrate (waste liquid from the dewatering process) is returned to the wet well pumping station (T-01-001) in the headworks building for primary treatment.

### 5.1.1 Reference Information

| DWG NUMBER (RANGE) | TITLE | REV |
|---|---|---|
| P617 | TWAS Pumps and TWAS Aerated Storage Tanks Piping and Instrumentation Diagram | 0 |
| P618 | BFP Pumps and Belt Filter Press Piping and Instrumentation Diagram | 0 |
| P619 | Belt Filter Press Polymer Dosing System Piping and Instrumentation Diagram | 0 |
| P620 | Belt Filter Press Polymer Dosing Pump System Piping and Instrumentation Diagram | 0 |

### 5.1.2 Control Philosophy

#### *5.1.2.1 TWAS Pumps*

Each DAF unit is provided with a duty TWAS pump (P-02-610/620). The TWAS pumps are required to allow for transfer of TWAS from the sludge collection zones of the DAF units (T-02-310/320) to the TWAS storage tanks (T-03-630/640).

The control of the TWAS pumps is integrated with the control of the DAF units. The operation of the TWAS pumps is continuous as per the sludge production from the DAF units. The TWAS pumps are linked and protected by low and high level switches (LSL-02-333/343) installed in the in the sludge collection zones of the DAF units.

*5.1.2.2 TWAS Storage Tanks*

The two TWAS storage tanks (T-03-630/640) provide storage and coarse bubble aeration to the TWAS prior to dewatering. The two tanks are interconnected via a high-level opening between the tanks. TWAS can be stored in each storage tank for approximately 5 days. The tanks can be operated independently, one tank can be operated while the other is in standby if required.

Aeration to the TWAS storage tanks is provided by the process aeration blowers (B-02-110/120/130) at a rate of approximately 3.1 $m^3$/min at 46 kPa. The air flow to the TWAS storage tanks is controlled with an automated modulating air control valve (BFV-02-170) that opens or closes depending on the water level in the tanks monitored by level transmitters (LIT-03-111/121).

*5.1.2.3 Belt Filter Press Feed Pumps*

Duty/standby belt filter press feed pumps (P-03-630/640) transfer TWAS from the TWAS storage tanks (T-03-630/640) to the belt filter press (BFP-03-650) for dewatering. The pumps are provided with VFDs with capacity to vary the TWAS feed flow to the BFP.

The belt filter press feed pumps are protected by the low low (LSLL-03-113/123) and high high (LSHH-03-112/122) water level switches installed in the TWAS storage tanks.

*5.1.2.4 Belt Filter Press*

The control of the belt filter press pumps (P-03-630/640), belt filter press (BFP-03-650) and belt filter press polymer dosing system (PDS-04-900) is integrated to the Plant Control System.

The operation of the belt filter press feed pumps and the belt filter press equipment is manually initiated by operator. The belt filter press equipment including, the belt filter press feed pumps, the air compressor, the water booster pumps and the belt filter press are controlled from the local control panel located on the belt filter press skid. Once the belt filter press operation is initiated, the polymer dosing pump system operation is also started.

*5.1.2.5 Belt Filter Press Polymer Preparation/Dilution System*

Polymer is required for the TWAS thickening operation. Dry polymer is delivered to site in 25 kg bags. A polymer preparation/dilution system (PDS-04-900) is available to automatically prepare a homogeneous polymer solution at approximately 0.5%. The system is an automatically controlled, sequentially batching unit consisting of a hopper suited with a vacuum loading station, high shear, first stage pre-wetting system, medium shear transition mixer, a mix tank with a low shear mixer and an aging tank. All the elements of the DAF polymer preparation/dilution system are controlled from the local control panel supplied with the unit. The system can be operated automatically or manually.

A polymer dosing pump skid composed of two pumps (P-04-970/980) (duty/standby) is available for polymer solution pumping from the polymer preparation/dilution system (PDS-04-900) to the belt filter press (BFP-03-650). The polymer dosing pumps are equipped with variable frequency drives for the operator to manually adjust the polymer flow to the belt filter press during the dewatering operation. The control of the polymer dosing pump system is integrated with the controls of the belt filter press system.

Polymer solution flow to the BFP unit is measured with the flow indicator-transmitter (FIT-04-999). Dilution water lines for polymer post-dilution as required are available at the discharge header from the polymer dosing pumps conveying the polymer solution to the belt filter press.