SECTION 13 1602 – WATER FEATURE CONTROLS

**PART 1 -** GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Pump Control
2. Sand Filter Backwash Control
3. Regenerative Filter Bump and Regeneration Control
4. Chemical Control
5. Secondary Disinfection (Ozone) System Control
6. Temperature Control
7. Backwash Tank Management
8. Underwater Lighting Control
9. System Alarms and Shutdown Trips

B. Related Sections:

1. SECTION 13 1502 – WATER FEATURE PUMPS AND MOTORS
2. SECTION 13 1503 – WATER FEATURE FILTERS
3. SECTION 13 1504 – WATER FEATURE CHEMICAL FEED SYSTEMS
4. SECTION 13 1505 – WATER FEATURE OZONE GENERATION AND INJECTION
5. SECTION 13 1506 – WATER FEATURE UV STERILIZERS
6. SECTION 13 1507 – WATER FEATURE HEATERS
7. SECTION 13 1508 – WATER FEATURE HYDRONIC SYSTEMS
8. SECTION 13 1510 – WATER FEATURE HEAT EXCHANGERS
9. SECTION 13 1511 – WATER FEATURE VALVES, GAUGES, AND METERS
10. SECTION 13 1513 – WATER FEATURE LOW PRESSURE AIR SYSTEMS
11. SECTION 13 1601 – WATER FEATURE GENERAL ELECTRICAL REQUIREMENTS
12. SECTION 13 1604 – WATER FEATURE FIELD INSTRUMENTS, SWITCHES, AND ALARMS
13. SECTION 13 1605 – WATER FEATURE CONTROL PANELS
14. SECTION 13 1606 – WATER FEATURE INSTRUMENT POWER SYSTEMS
15. SECTION 13 1607 – WATER FEATURE PROGRAMMABLE LOGIC CONTROLLERS
16. SECTION 13 1608 – WATER FEATURE UNDERWATER LIGHTING CONTROLS
17. SECTION 13 1609 – WATER FEATURE DISCONNECTS, MCC, AND STARTERS
18. SECTION 13 1610 – WATER FEATURE ELECTRICAL ACCESSORIES
19. SECTION 13 1611 – WATER FEATURE GROUNDING

**PART 2 -** PRODUCTS

2.1 NOT APPLICABLE

**PART 3 -** EXECUTION

3.1 FUNCTIONAL REQUIREMENTS

A. The System shall provide all the functions described herein for each system. Major equipment items are specified for each loop; however, all items of equipment, whether indicated or not, which are necessary to affect the required performance shall be provided.

B. Water Feature Control Systems (WFC): The WFC includes controlling and monitoring of pumps, water filtration, chemical feed systems, secondary disinfection systems, temperature control, and lighting. These systems shall be controlled via a Control Panel (CP-X) and/or a Motor Control Panel (MP-X). Refer to Contract Documents for panel designations.

3.2 PUMP CONTROL

A. All pump controls shall include the following:

1. HAND-OFF-AUTO (HOA) selector switch, as shown on the Contract Documents, at the Motor Control Center (MCC-X) and with appropriate disconnects.

a. When the switch is in the HAND position, the pump shall operate unless inhibited by PLC control safety interlock.
b. When the switch is in the OFF position, the pump shall stop.
c. When the switch is in the AUTO position pump control shall be determined by the Programmable Logic Controller (PLC) output relay in the PLC panel.
d. When in either HAND or AUTO, the pump shall be stopped by a PLC output relay in the PLC panel.

2. Each direct suction connected pump shall have a Vacuum Limit Switch (VLS) interlock as indicated on the drawings. The VLS will operate as follows:

a. The VLS shall be preset on site prior to commissioning to meet each pump's vacuum limit when pump suction is excessively restricted.
b. When the VLS is activated the PLC shall shut down the associated pump. The Human Machine Interface (HMI) will indicate that the pump has been shut down due to high vacuum condition.
c. Filtration Pump(s), (typically identified as Treatment Pump P-X01, …), shall include the following addition controls when the pump is turned off either with the associated HOA switch in the OFF position or through PLC interlock with the HOA in AUTO:

i. All associated Feature Pumps, Chemical Feed Pumps, Secondary Disinfection Systems, and temperature control operations will cease to operate regardless of their modes of operation.
ii. HMI indicates that each of the Feature Pump(s) and other ancillary systems operations are suspended while the Treatment Pump is not operational.

d. All Pumps with Emergency Stop Controls (E-STOP) shall include the following additional controls:

i. When the E-STOP is activated the associated pump will stop immediately.
ii. All pumps receiving water from the same feature as the pump listed above shall also stop.
iii. Notification will be sent to the HMI indicating that all pumping activities have been suspended due to the activation of the E-STOP.
iv. Operation of associated pumps cannot be continued until the E-STOP is reset and the fault acknowledged on the HMI.
v. When an E-STOP has shut down a Treatment Pump an 80 dBa alarm shall sound in conjunction with the pump shutdown.

3. All feature pumps not associated with the filtration and chemical treatment of the water shall include a control timer within the PLC that may turn the pumps ON and OFF based on and operator adjustable set points adjustable through the HMI.

3.3 SAND FILTER BACKWASH CONTROL

A. Function: To monitor and control the Water Treatment Pumps (WTP), Filter Control Panel (FCP), and control the position of the Motorized Backwash Control Valve (MBCV).

B. Components:

1. WTP
2. FCP
3. MBCV
4. MBCV – AUTO-OFF-OPEN-CLOSE selector switch

5. PLC I/O in CP

C. Operation:

1. General:

a. The FCP controls the operation of the Filtration System and should be provided by the Filter Manufacturer.
b. When operated in MANUAL, filter backwashing may be accomplished manually.
c. When operated in AUTO, the FCP determines when a backwash is necessary, and when it may be allowed.
d. The normal mode of operation of the System shall be when the WTP is in AUTO and circulating water through the Filters to the features.
e. Normal mode of the FCP will be AUTO.

2. Manual Backwash:

a. For multiple filter tank operation each filter tank shall be backwashed separately. Only one filter shall backwash at a time throughout all systems in the mechanical room.
b. Operator shall manually change position of the valves located at the inlet and outlet of each filter element and position the MBCV (if so equipped). If inlet and outlet valves are not linked, then the Operator shall turn OFF the WTP while valve position is changed, then turn the WTP back ON.
c. The valve change allows the water to reverse flow through the filter and direct the backwash water to the Backwash Tank or sewer connection.
d. Backwash shall continue for sufficient time to fluidize the sand bed and flush the filtrate. Backwash progress may be monitored visually with the backwash sight glass. When water stream in the sight glass appears clear back wash may be stopped – valves returned to normal filtering position.
e. Repeat process sequentially for each filter in each system. Once all filters in each system have been backwashed the filter pressure drop is verified. If the differential pressure is not down to “Clean” filter conditions the backwash sequence should be repeated.

3. Automatic Backwash:

a. Automatic Backwash operation differs from Manual operation by automating the valve change sequence and allowing the FCP to configure and position the valves based on either an operator-initiated command to start the sequence or automatically due to measured pressure differential or elapsed time.
b. For multiple filters on a single system the FCP shall backwash each filter tank sequentially inhibiting multiple filters from backwashing simultaneously.
c. For the AUTO operation to occur, the following modes shall be assumed:

i. The WTP(s) operation HOA switch is in the AUTO position
ii. The FCP is in AUTO mode
iii. The BWCV local control switch is in the AUTO position

d. Backwash Sequence:

i. STEP 1: The PLC in the CP shall monitor the FCP “Stop Pump” output. When the FCP signals the PLC the corresponding WTP(s) shall be stopped.
ii. STEP 2: When the FCP signals the PLC for a backwash cycle to begin the PLC causes the MBCV to partially close (this position should be set during start-up with limit positioners on the MBCV actuator). The partially CLOSED MBCV provides a flow restriction in the outlet piping resulting in an increase flow through the filter element being backwashed. The MBCV shall remain in this partially closed position until all the elements in the filter bank have been backwashed sequentially.

iii. STEP 3: The FCP then repositions the inlet and outlet valves of filter #1 to Backwash position.
iv. STEP 4: FCP receives confirmation that valves are repositioned and signals the PLC to re-start the WTP(s).
v. STEP 5: When one filter element has been backwashed for a predetermined time, the FCP shall stop the WTP, reposition the backwashed filter element valves back to normal operating position, and re-position the valves on the next element to be backwashed to backwash position.
vi. STEP 6: Steps 4 and 5 are repeated sequentially for each filter element in turn until all filter elements have been backwashed.
vii. STEP 7: Once all the filter elements have been backwashed, the FCP shall signal the WTP to STOP, return the filter element valves to normal operating position, reposition the MBCV to full OPEN, and then allow the WTP to restart.

3.4 REGENERATIVE FILTER CONTROL

A. Function: To monitor and display the function of the Regenerative Filter System Controller (FCP) and coordinate control of WTP operation during regeneration and rinse cycles.

B. Components:

1. Water Treatment Pump(s) WTP
2. Regenerative Filter FCP
3. PLC I/O in CP

C. Operation:

1. General:

a. The FCP provided by the Filter Manufacturer controls the operation of the regenerative filter including regeneration cycles, Rinse and Pre-coat cycles and vacuum transfer of media into the filter.
b. Filter regeneration and rinse cycles may be manually or automatically initiated.
c. When operated in AUTO, the FCP determines when a regeneration cycle is necessary, and when it may be allowed.
d. The normal mode of operation of the System shall be when the WTP is in AUTO and circulating water through the Filters to the features.
e. Normal mode of the FCP will be AUTO.

2. Operation

a. During media transfer the WTP is turned “OFF”.
b. FCP will initiate regeneration as needed or when manually initiated signaling CP to stop the WTP. FCP will then set all necessary pneumatic actuated valves and process the cycle signaling the CP to re-start WTP for pre-coat and will return the system to normal operation when cycle is complete.

3.5 CHEMICAL CONTROL

A. Function: To monitor and control the water pH and ORP of the closed loop water systems.

B. Components:

1. Chemical Controller (CC).
2. Chlorine Chemical Feeder (CCF).
3. pH Chemical Feeder (PCF).
4. PLC I/O in CP.

C. Operation:

1. General: The CC shall sample and monitor the chemical properties of the system water. The CC shall control the CCF and the PCF via switching relays in the CC.
2. The PLC shall monitor the WTP for the system and shall inhibit any chemical injection or feed unless the WTP is ON. If the WTP is ON, the PLC relay shall energize the CC to adjust the chemistry of the water.

3.6 SECONDARY DISINFECTION (OZONE) SYSTEM CONTROL

A. Function: To monitor and control the Ozone Generation and Injection, which provide additional water disinfection in association with the Chlorine Feed System.

B. Components:

1. Ozone Booster Pump (OBP)
2. Ozone Generator (OZ)
3. Ozone Air Preparation System (OAP), when required
4. ORP Controller (ORPC)
5. Ozone Destruct Unit (DU)

C. Operation:

1. General: The OBP provides flow through the ozone side stream loop, which includes a venturi injector that injects the Ozone gas provided the OZ. The ozonated water flows into a pressurized vessel, Ozone Contact Tank, where the ozone is allowed to react with the water and any undissolved ozone gas is collected and off gassed through the DU. The water in the Ozone Contact tank discharged back into the main system water line. In the main line the ORP is monitored by the ORPC and provides feed back to the OZ, the ORP Probe should be located after the Ozone loop reconnects to the main line, but prior to the injection of the Chlorine Feed System.
2. The OBP shall be interlocked to the operation of the WTP. The OBP shall not operate when the WTP is OFF.
3. The PLC shall monitor the OZ and provide a display of the operation of the OZ, including the ORP reading from the ORPC.
4. Ozone destruct is a passive system wherein a catalyst converts undissolved ozone to oxygen. No control is required but the unit does require power to run a small heater to prevent condensation within the catalyst bed.

3.7 TEMPERATURE CONTROL

A. Function: To monitor the temperature of the system water leaving the mechanical room and insure that temperature is never more than 104 ˚F (40 ˚C).

B. Components:

1. Temperature Probe (TP) – located on the main outlet pipe after the Heater connections.
2. Temperature display at the location of the TP.
3. PLC I/O in CP-X.
4. Heater (H).

C. Operation:

1. General: The TP shall monitor the temperature of the water going out of the mechanical room and back to the water feature. If the temperature of the water every exceeds 104 ˚F (40 ˚C) the PLC will de-energize the Heater.
2. The temperature set point will be adjustable on the HMI.

3.8 BACKWASH TANK MANAGEMENT

A. Function: To monitor the water level in the backwash holding tank and permit backwashing operations only when the backwash holding tank has sufficient storage capacity to contain new backwash effluent.

B. Components:

1. Backwash Tank Level Monitoring System (LMS).
2. Backwash Drain Valve (BDV) or Pump (BDP), when specified.
3. All associated WTP Systems that contribute backwash water to the tank.
4. PLC I/O in CP-X.

C. Operation:

1. General: The LMS shall monitor the level of the water in the backwash holding tank. If a BDP is used the pump will turn OFF and ON based on levels with the tank to meter water out to the sewer system. If a BDV is used the valve position will be set at start-up to ensure that the maximum flow out of the backwash holding tank is not greater than the site capacity. The position of the BDV shall be constant.

a. If the water level in the tank is below the low-level setpoint (LLS), the BDP shall not operate. If BDV is used there is no LLS.
b. While backwash water is being discharged into the holding tank the PLC shall monitor the water level. When the level reaches the LLS (to be determined at start-up) the BDP shall automatically start, sending water to the site sewer. The BDP shall continue to operate, until the water level reaches the Low-Level Shutdown (LLD), which shall be determined at start-up.
c. Should the water level rise to the High-Level Alarm (HLA), approximately 6-inches (150mm) below the top of the tank, all WTP System associated with the backwash holding tank shall be stopped and an alarm relayed to the HMI. WTP operation shall not be allowed until the water level in the backwash holding tank decreases to an acceptable level.

3.9 LIGHTING CONTROL

A. Function: To automatically turn the feature lights ON and OFF.

B. Components:

1. PLC I/O in CP-X
2. Feature Light Fixtures
3. Photocell

C. Operation: The Photocell will be mounted in a remote area adjacent to the associated water feature. The Photocell will activate the lights with a relay through the PLC.

3.10 SYSTEM ALARMS AND SHUTDOWN TRIPS

A. Mechanical Room High Water Trip

1. Function: To monitor high water levels on the mechanical room floor and shut down electrical power.
2. Components:

a. Floor Water Level Switch (FLS)
b. Shunt Trip on MCC Main Circuit Breaker
c. Alarm Notification in the door of CP-X

3. Operation:

a. The FLS shall be installed near the floor as shown in the Contract Documents.
b. Should the FLS actuate, the Main Breaker shall trip, de-energizing all water feature equipment in the mechanical room. An audible alarm and Operator notifications shall be initiated.
c. Resetting the alarm shall occur when the MCC circuit breaker is reset.

4. Pump Restart Time Delay

    a. Function: To delay restarting all motors and allow a staggered starting after Utility Power Failure.
    b. Components: Timing Relays in CP-X.
    c. Operation: When CP-X is energized, several timing relays shall begin timing, each relay shall be set for a five (5) minute cascaded delay. Various large pump loads shall not be allowed to start until the time delay for that pump is complete. The relays shall reset on loss of control power at CP-X.

B. Motor Control Center – Phase Failure Trip

1. Function: To monitor the incoming AC power to the 3-phase MCC and trip all motors on loss of any phase.
2. Components:

    a. Phase Failure Sensing Relay in the MCC.
    b. Shunt Trip on the MCC Main Circuit Breaker.
    c. Operation:

        i. The relay shall be installed in the MCC.
        ii. The relay shall monitor incoming AC power.
        iii. Should the incoming AC power feeder have a low voltage condition occur on any one of the three phases, the MCC main circuit breaker shall trip, de-energizing the MCC
        iv. There is no indicator or horns for this alarm. Resetting the alarm shall occur when the MCC main circuit breaker is reset.

C. Ambient Ozone Alarm

1. Function: To monitor the status of the Ambient Ozone monitor and shut down ozone generation in event of a high limit alarm condition.

2. Components:

    a. Ambient Ozone Monitor [AOM]
    b. Ozone Generator(s) [OG]
    c. Ozone Booster Pump(s) [OBP]
    d. Ambient Ozone Alarm Indicator Strobe Light (SL)
    e. CP HMI
    f. Control Logic and I/O of the CP

3. Operation

    a. The “Alarm Output” relay in the AOM signals the CP that an alarm condition exists.
    b. CP shuts down all OG within the mechanical space monitored by the AOM but leaves OBP and other water treatment equipment operating.
    c. CP activates the SL and signals operator of the alarm condition and that OG(s) are shut down via the HMI.
    d. Operator acknowledges the Alarm condition on the AOM and takes steps necessary to correct the issue causing the fault.
    e. CP deactivates the SL and enables operation of the OG when the Operator resets the Fault condition on the CP through the HMI .

END OF SECTION