4. Hardwire interlocks:
    a. The mixer is stopped and prohibited from starting if:
        1) Disconnect Auxillary contact is activated.
5. Smart starter interlocks:
    a. The mixer is stopped and prohibited from starting if:
        1) Smart starter common fault is activated.
    b. Smart starter interlocks must be manually reset at the local control panel via the RESET pushbutton.
6. PLC control:
    a. In PCIS AUTO, the mixer is controlled via the PLC:
        1) A 4-STAGE BARDENPHO/MLE selector switch is provided for each basin.
            a) When basin is selected for 4-STAGE BARDENPHO:
                (1) Mixers run continuously when the associated aeration basin is selected as online.
            b) When basin is selected for MLE:
                (1) Mixers are stopped when the associated aeration basin is selected as online.
7. Software interlocks:
    a. The mixer is stopped and prohibited from starting if:
        1) No software Interlocks
8. SCADA control:
    a. As indicated on the Drawings, Typical SCADA Point List, and specified in Section 41_61_15.
9. Indicators and alarms:
    a. As indicated on the Drawings**,** Typical SCADA Point List, and specified in Section 41_61_15.
10. Failure modes:
    a. As indicated on the Drawings**,** Typical SCADA Point List, and specified in Section 41_61_15.

F. Loop 33161, 33162, 33163, 33191, 33261, 33262, 33263, 33291, 33361, 33362, 33363, and 33391 - Title: Aeration Basin Air Control:
1. References:
    a. 33I01.
    b. 33I02.
    c. 33I03.
    d. 33I04.
    e. 33I05.
    f. 33I06.
    g. Section 46_51_47.
    h. Section 46_51_49.
2. Abstract:
    a. Aeration Blowers are used to supply the Aeration Basins with process air. A separate, independent control system provided by the Blower Vendor Control Panel will start and stop the blowers and will maintain header pressure. The aeration air flow is controlled to each basin, either by direct flow control, DO trim, or Ammonia trim.
    b. There are four independently controlled aeration zones:
        1) Combined zones 4, 5, and 6.
        2) Zone 7.

3) Zone 8.
4) Zone 9.

c. Overall basins can be selected for 4-Stage Bardenpho or MLE mode.
1) When selected for 4-Stage Bardenpho mode and the aeration basin is online the Zone 9 air system shall not operate.
2) When selected for MLE mode and the aeration basin is online the Zone 9 air system shall operate as described below.

3. Hardwired control:
a. Air Control Valves:
1) With the LOR switch in LOCAL position, the valve is controlled by the OPEN/STOP/CLOSE switch.
2) With the LOR switch in REMOTE position, the valve is controlled by the PLC.

4. Hardwired interlocks:
a. There are no hardwire interlocks.

5. PLC control:
a. In PCIS HAND, the Aeration Basin FCV is controlled via the PLC:
1) The operator can manually adjust the valve position via the SCADA interface.

b. In PCIS AUTO, the Aeration Basin FCV for each zone is controlled via the PLC:
1) A 4-STAGE BARDENPHO/MLE selector switch is provided for each basin.
a) When basin is selected for 4-STAGE BARDENPHO:
(1) When the associated aeration basin is selected as online, aeration basin air control shall close Zone 9 air valve and prohibit it from opening when in this mode.
b) When basin is selected for MLE:
(1) When the associated aeration basin is selected as online, aeration basin air control for Zone 9 shall be controlled in accordance with the description below.
2) If the operator selects Flow Mode via the FLOW/DO/AMMONIA software switch:
a) Primary Control – “Flow Mode”:
(1) A desired air flow header setpoint to each aeration basin is entered at the operator interface.

Zone	Initial Setpoint (scfm)	Minimum (scfm)	Maximum (scfm)
AB1 (Zones 4, 5, & 6)	3000	500	2378
AB1 (Zone 7)	2500	500	3769
AB1 (Zone 8)	1,880	500	1800
AB1 (Zone 9)	1,880	500	1350
AB2 (Zones 4, 5, & 6)	3000	500	2378
AB2 (Zone 7)	2500	500	3769
AB2 (Zone 8)	1,880	500	1800
AB2 (Zone 9)	1,880	500	1350
AB3 (Zones 4, 5, & 6)	3000	500	2378
AB3 (Zone 7)	2500	500	3769

Zone	Initial Setpoint (scfm)	Minimum (scfm)	Maximum (scfm)
AB3 (Zone 8)	1,880	500	1800
AB3 (Zone 9)	1,880	500	1350

b) A PID control algorithm shall be utilized:
   (1) Set Point (SP): Operator Entered Air Flow Set Point.
   (2) Process Variable (PV): Measured Air Flow:
      (a) Note that measured air flow will need to be calculated for zones 8 and 9 based on air header configuration.
   (3) Controlled Variable (CV): Valve Position.

c) Maximum scfm limits shall be hardcoded based on the table above.

d) A most open valve control methodology shall be utilized to optimize system efficiency.

3) If the operator selects DO Mode via the FLOW/DO/AMMONIA software switch:

a) Secondary Control – "Dissolved Oxygen (DO) Mode":
   (1) A desired value of dissolved oxygen is entered at the operator interface.
   (2) In DO Mode, the flow rate set point for each aeration zone shall be automatically adjusted based on DO in a cascaded loop control algorithm.
   (3) Each aeration zone shall have an independent DO concentration set point adjustable from the operator interface. The DO set points shall be as follows:

Zone	Initial Set Point	Minimum (mg/L)	Maximum (mg/L)
AB1 (Zones 6)	3.0	0.2	4.0
AB1 (Zones 7)	2.0	0.2	4.0
AB1 (Zones 8)	1.0	0.2	4.0
AB1 (Zones 9)	1.0	0.2	4.0
AB2 (Zones 6)	3.0	0.2	4.0
AB2 (Zones 7)	2.0	0.2	4.0
AB2 (Zones 8)	1.0	0.2	4.0
AB2 (Zones 9)	1.0	0.2	4.0
AB3 (Zones 6)	3.0	0.2	4.0
AB3 (Zones 7)	2.0	0.2	4.0
AB3 (Zones 8)	1.0	0.2	4.0
AB3 (Zones 9)	1.0	0.2	4.0

   (4) The measured DO value for each diffuser zone in the basin shall be based on twelve (12) equally spaced readings from the corresponding DO probe over a time span of 2 minutes (operator adjustable from 1 to 120 minutes). This time-averaged DO value shall be referred to as "Actual DO".

(5) The flow set point for each aeration zone shall be adjusted in order to maintain the DO setpoint for the respective zone as follows:
(a) The flow set point for each aeration zone shall be adjusted based upon the “Actual DO”. The time delay between adjustments of the flow controller between each zone in the basin shall be 5 minutes (adjustable from 1 to 60 minutes). After the adjustment of the flow controller for the zone has been completed, and after a time delay of 15 minutes (adjustable from 1 to 120 minutes), the adjustment process shall repeat.
(b) No Deviation: If the difference between the “Actual DO” and the DO set point is less than the “DO Small Step Deviation” set point of 0.1 mg/L (adjustable from 0 to 0.6 mg/L), then the zone flow rate set point shall not be adjusted.
(c) Small Step Deviation: If the difference between the “Actual DO” and the DO set point is greater than the “DO Small Step Deviation” set point of 0.1 mg/L (adjustable from 0 to 0.6 mg/L), then the zone flow rate set point shall be adjusted by 50 scfm (adjustable from 0 to 250 scfm). The flow set point shall be increased if the “Actual DO” is less than the DO set point or decreased if the “Actual DO” is greater than the DO set point.
(d) Large Step Deviation: If the difference between the “Actual DO” and the DO set point is greater than the “DO Large Step Deviation” set point of 0.2 mg/L (adjustable from 0 to 0.6 mg/L), then the zone flow rate set point shall be adjusted by 100 scfm (adjustable from 0 to 500 scfm). The flow set point shall be increased if the “Actual DO” is less than the DO set point or decreased if the “Actual DO” is greater than the DO set point.
(e) The flow set point shall not be adjusted to a value lower or higher than the minimum and maximum flow rates, respectively, listed above.
(f) For basins out of service or for DO analyzer maintenance purposes, provide a selector switch to disable trim control and rely solely on primary flow control.

4) If the operator selects AMMONIA Mode via the FLOW/DO/AMMONIA software switch:
a) Secondary Control – “Ammonia Mode”:
(1) A desired value of ammonia is entered at the operator interface.
(2) An operator adjustable ‘Ammonia Mode Maximum Flow Limit’ value in SCFM shall be entered when the zone is selected for Ammonia Mode. When this flow limit is exceeded during Ammonia based control the controller shall be prohibited from further increases to the flow set

point. The option to enable/disable this control via the HMI faceplate shall be provided.

(3) In Ammonia Mode, the flow rate set point for each aeration zone shall be automatically adjusted based on Ammonia in a cascaded loop control algorithm.

(4) Each aeration basin shall have an independent concentration set point adjustable from the operator interface. The Ammonia set points shall be as follows:

Zone	Initial Set Point	Minimum (mg/L)	Maximum (mg/L)
AB1 (Zone 6)	3.5	1.5	6.0
AB2 (Zone 6)	3.5	1.5	6.0
AB3 (Zone 6)	3.5	1.5	6.0

(5) The Ammonia probe can be located in the first pass or third pass of the aeration basin. The operator must select the pass that the ammonia probe is located.

(6) The measured Ammonia value in the basin shall be based on twelve (12) equally spaced readings from the corresponding Ammonia probe over a time span of 2 minutes (operator adjustable from 1 to 120 minutes). This time-averaged Ammonia value shall be referred to as “Actual Ammonia”.

(7) The flow set point for each aeration zone shall be adjusted in order to maintain the Ammonia setpoint for the respective zone as follows:

(a) The flow set point for each aeration zone shall be adjusted based upon the “Actual Ammonia”. The time delay between adjustments of the flow controller between each zone in the basin shall be 5 minutes (adjustable from 1 to 60 minutes). After the adjustment of the flow controller for the zone has been completed, and after a time delay of 15 minutes (adjustable from 1 to 120 minutes), the adjustment process shall repeat.

(b) No Deviation: If the difference between the “Actual Ammonia” and the Ammonia set point is less than the “Ammonia Small Step Deviation” set point of 0.15 mg/L (adjustable from 0 to 0.6 mg/L), then the zone flow rate set point shall not be adjusted.

(c) Small Step Deviation: If the difference between the “Actual Ammonia” and the Ammonia set point is greater than the “Ammonia Small Step Deviation” set point of 0.15 mg/L (adjustable from 0 to 0.6 mg/L), then the zone flow rate set point shall be adjusted by 50 scfm (adjustable from 0 to 250 scfm). ~~The flow set point shall be increased if the “Actual Ammonia” is less than the Ammonia set point or decreased if the “Actual Ammonia” is greater than the Ammonia set point.~~

(d) Large Step Deviation: If the difference between the "Actual Ammonia" and the Ammonia set point is greater than the "Ammonia Large Step Deviation" set point of 0.2 mg/L (adjustable from 0 to 0.6 mg/L), then the zone flow rate set point shall be adjusted by 100 scfm (adjustable from 0 to 500 scfm). ~~The flow set point shall be increased if the "Actual Ammonia" is less than the Ammonia set point or decreased if the "Actual Ammonia" is greater than the Ammonia set point.~~

(e) The flow set point shall not be adjusted to a value lower or higher than the minimum and maximum flow rates, respectively, listed above.

5) For basins out of service or for Ammonia analyzer maintenance purposes, provide a selector switch to disable ammonia control and rely solely on primary flow control.

6. Software interlocks:
   a. No software interlocks
7. SCADA control:
   a. As indicated on the Drawings**,** Typical SCADA Point List, and specified in Section 40_61_15.
8. Indicators and alarms:
   a. As indicated on the Drawings**,** Typical SCADA Point List, and specified in Section 40_61_15.
9. Failure modes:
   a. As indicated on the Drawings**,** Typical SCADA Point List, and specified in Section 40_61_15.

G. Loop 36101, 36201, 36301- Title: Carbon Addition:
1. References:
   a. 36I05.
   b. Section 43_33_10.02.
   c. Section 43_41_43.
2. Abstract:
   a. The Carbon Addition system is comprised of three Carbon Stock storage tanks and three carbon feed pumps.
   b. There are three duty carbon feed pumps, one dedicated to each aeration basin. Through manual piping and valving each pump can feed any of the three aeration basins, to either the first or second anoxic zone.
   c. Two different external carbon addition chemicals are available, 80 percent Acetic Acid and Weak Wort. These chemicals have different carbon concentrations, with 80 percent acetic acid at 7.5 pounds COD per gallon (lbs COD/gal) and weak wort ranging from 0.3 to 0.6 lbs COD/gal.
   d. The Carbon Storage tank overflow vents will be sealed to prevent fume leakage by filling the overflow vent elbow with water. The level of water in the elbow will be monitored by a level switch. When the level is low the switch will turn on a solenoid valve filling the elbow with water and sealing off the escape of fumes.
   e. Feeder PMP36101 functions as a duty feeder for basin 1 and is flow paced off the influent flow meter. If the pump fails, the condition will be alarmed at SCADA. The operator must manually adjust valves in the field before switching to an alternate feeder.

f. Feeder PMP36201 function as a duty feeder for basin 2 and is flow paced off the influent flow meter. If the pump fails, the condition will be alarmed at SCADA. The operator must manually adjust valves in the field before switching to an alternate feeder.
g. Feeder PMP36301 function as a duty feeder for basin 3 and is flow paced off the influent flow meter. If the pump fails, the condition will be alarmed at SCADA. The operator must manually adjust valves in the field before switching to an alternate feeder.
h. Based on operator selection the dosing of External Carbon can be achieved by:
    1) Direct flow control where the operator sets the feed flow rate manually (gallons per hour), with operator selection of chemical.
    2) Direct dose control where the operator sets the feed dose rate of carbon (lbs COD/hour) manually, with operator selection of chemical.
    3) Effluent nitrate paced control where the operator selects a desired dose and the control system adjusts the chemical feed rate to dose based on process flow, chemical concentration (operator selected chemical, and effluent nitrate concentration.

3. Hardwired Control:
    a. Feed pump hardwired control:
        1) With the AUTO/MANUAL mode control switch at the VCP in the MANUAL position, the feeder is controlled by the VCP.
        2) With the AUTO/MANUAL mode control switch at the VCP in the AUTO position, the feeder is controlled by the PLC.
    b. Dilution water solenoid hardwired control:
        1) With the HAND/OFF/AUTO mode control switch at the LCP in the HAND position, the solenoid is open.
        2) With the HAND/OFF/AUTO mode control switch at the LCP in the OFF position, the solenoid is prohibited from opening.
        3) With the HAND/OFF/AUTO mode control switch at the LCP in the AUTO position, the solenoid is controlled by the PLC.
    c. Tank overflow solenoid hardwired control:
        1) The tank overflow solenoid shall open when:
            a) Low level is detected in the respective overflow vent elbow.
4. Hardwired Interlocks:
    a. The chemical feeder is stopped and prohibited from starting if:
        1) Leak detection switch is activated.
5. PLC Control:
    a. In PCIS AUTO, the chemical feed pump is controlled via the PLC:
        1) The operator will select the Aeration Basin they want the pump to feed to via the AB1/AB2/AB3 software switch. Note that all valving must be adjusted manually.
        2) The operator will select the type of chemical that will be supplied from the selected pump via the WORT/ACETIC ACID software switch. Note that all valving must be adjusted manually.
        3) The operator will select which Nitrate probe to utilize for control via the ZONE 3/ZONE 9 software switch.
        4) If the operator selects FLOW via the FLOW/DOSE/NO3 software switch:
            a) The PLC shall run the pump at the operator entered set point flow.

5) If the operator selects DOSE via the FLOW/DOSE/NO3 software switch:
   a) The PLC shall use the flow pacing algorithm described in Section 40_61_15.
      (1) The PLC shall adjust the pump speed to match the operator entered set point dose based on the following variables:
         (a) Flow pacing process variable in (MGD) shall be calculated as: $\frac{\text{Aeration Basin Influent Flow Meter}}{\text{\# basins online}}$
         (b) Concentration: Concentration in (lb/gal) shall be selected based on the WORT/ACETIC ACID selection.

6) If the operator selects NO3 via the FLOW/DOSE/NO3 software switch:
   a) The PLC shall use a diurnal curve in conjunction with the Nitrate analyzer to set the dose set point for carbon feed.
      (1) The PLC shall adjust the pump speed to match the calculated dose based on the following variables:
         (a) Dose Set Point:

$$Carbon\ Feed\ (\frac{gal}{\text{hr}}) = \frac{\text{COD: N Ratio} * \text{Influent Flow (MGD)} * \text{Target Nitate Reduction} \left(\frac{\text{mg}}{\text{L}}\right) * 8.34}{24 \left(\frac{\text{hr}}{\text{day}}\right) * \text{Chemical COD Concentration} \left(\frac{\text{lbs}}{\text{gal}}\right)}$$

         (b) Nitrate Diurnal Curve: Operator entered diurnal curve showing the expected NO_3 values over a 24 period of time. The diurnal curve will be made up of 24 separate set points, one for each hour.
         (c) Nitrate Analyzer: The PLC shall utilize the selected nitrate probe (via the ZONE 3/ZONE 9 software selector switch) for comparison to the diurnal curve.
         (d) COD:N Ratio: Ratio of lbs COD to lbs Nitrate desired to be removed. Operator adjustable range of 3 to 5, initially set to 4.
         (e) Target Nitrate Reduction: Selected Nitrate Analyzer value minus the Nitrate Diurnal Curve value.
         (f) Influent Flow: $\frac{\text{Aeration Basin Influent Flow Meter}}{\text{\# basins online}}$
         (g) Chemical COD Concentration: Concentration in (lb/gal) shall be selected based on the WORT/ACETIC ACID selection. Weak Wort concentration shall be operator adjustable between 0.2 to 1.0 lbs/gal, initially set to 0.3 lbs/gal. Acetic Acid chemical concentration shall be an operator adjustable percentage between 50 and 80, initially set to 80 percent. 80 percent acetic acid has a chemical COD concentration of 7.5 lbs/gal, within the range the value shall be automatically calculated based on the formula COD concentration (lbs/gal) = 9.375 lbs/gal * Acetic Acid %

b. In PCIS AUTO, the dilution water solenoid is controlled via the PLC:
   1) The dilution water solenoid shall open when Acetic Acid is selected via the WORT/ACETIC ACID software switch and the flow of the associated pump is below an adjustable flow set point.

6. Software Interlocks:

a. The chemical feed pumps are stopped and prohibited from starting if:
    1) Flood detected via LSH36111.
    2) High pressure detected on associated pump discharge pressure switch.

7. SCADA control:
    a. As indicated on the Drawings, and specified in Section 40_61_15.
8. Indicators and alarms:
    a. As indicated on the Drawings**,** and specified in Section 40_61_15.
9. Failure modes:
    a. As indicated on the Drawings**,** Typical SCADA Point List, and specified in Section 40_61_15.

3.02 DEMONSTRATION AND TRAINING

A. As specified in Section 40_61_00.

END OF SECTION