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MIXED OXIDANT ADDITION SEQUENCE OF OPERATIONS

THE CONTRACTOR SHALL PROVIDE PROGRAMMING, FUNCTIONAL TESTING AND PERFORMANCE TESTING FOR THE FOLLOWING SEQUENCE OF OPERATION TO BE INTEGRATED INTO THE EXISTING DDC CONTROLLERS AT THE RESPECTIVE SITES. ALL OPERATOR ADJUSTABLE VALUES SHALL BE INPUT/ADJUSTABLE AT THE DDC INTERFACE.

BUILDING 173 SALEM PUMP HOUSE AND BUILDING 172 WVA PUMP HOUSE SEQUENCE OF OPERATIONS FOR MIXED OXIDANT ADDITION:

CHEMICAL FEED PUMPS SHALL OPERATE IN LEAD/LAG MODE. THE OPERATOR SHALL BE ABLE TO SELECT THE ACTIVE LEAD PUMP AND TO "LOCK OUT" EITHER PUMP FROM THE LEAD/LAG SEQUENCE FOR MAINTENANCE. ALTERNATE LEAD/LAG PUMPS AFTER EACH START OR AFTER 24 HOURS OF CONTINUOUS OPERATION (UNLESS ONE PUMP IS LOCKED OUT FOR MAINTENANCE).

THE DDC CONTROLLER SHALL INCLUDE A "REMOTE MANUAL" MODE TO ALLOW PUMP SPEED (DEFAULT VALUE = 50%, RANGE 0.0% TO 100.0%) TO BE SET IN THE DDC CONTROLLER AND A "REMOTE AUTO" MODE TO ALLOW PUMP SPEED TO BE CONTROLLED AS DESCRIBED BELOW.

TWO SEPARATE OPERATOR SELECTABLE MODES SHALL BE PROVIDED FOR THE MIXED OXIDANT ADDITION POINT: "PRIMARY ADDITION POINT MODE" AND "SECONDARY ADDITION POINT MODE". ONLY ONE MODE SHALL BE ACTIVE AT ANY TIME.

THE CHEMICAL FEED PUMPS SHALL BE CONTROLLED USING PROPORTIONAL-INTEGRAL-DERIVATIVE (PID) ALGORITHM OR AN INCREMENTAL ADJUSTMENT ALGORITHM AS PART OF A FEEDBACK LOOP TO MAINTAIN A TARGET FREE AVAILABLE CHLORINE (FAC) RESIDUAL AT THE CHLORINE ANALYZER SAMPLE LOCATION BY ADJUSTING THE CHEMICAL FEED PUMP STROKE RATE. THE TARGET FAC RESIDUAL SHALL BE AN OPERATOR ADJUSTABLE CONCENTRATION (MG/L) (DEFAULT VALUE = 2.00 MG/L, RANGE 0.25 MG/L TO 4.00 MG/L).

IF THE FAC RESIDUAL EXCEEDS AN OPERATOR ADJUSTABLE HIGH LEVEL CONCENTRATION (MG/L) (DEFAULT VALUE = 4.00 MG/L, RANGE 0.25 MG/L TO 4.00 MG/L) FOR A PERIOD OF MORE THAN 5 MINUTES, THE PUMPS SHALL BE INTERLOCKED UNTIL THE FAC RESIDUAL IS BELOW AN OPERATOR ADJUSTABLE SET CONCENTRATION (MG/L) (DEFAULT VALUE = 3.50 MG/L, RANGE 0.25 MG/L TO 4.00 MG/L) FOR AT LEAST 5 MINUTES AND AN ALARM GENERATED.

IF THE FAC RESIDUAL IS BELOW AN OPERATOR ADJUSTABLE LOW LEVEL CONCENTRATION (MG/L) (DEFAULT VALUE = 1.0 MG/L, RANGE 0.25 MG/L TO 4.00 MG/L) FOR A PERIOD OF MORE THAN 5 MINUTES, AN ALARM SHALL BE GENERATED AND THE PUMPS SHALL BE INTERLOCKED UNTIL THE ALARM IS CLEARED.

IN "PRIMARY ADDITION POINT MODE" THE CONTROLLER SHALL COMPUTE THE MASS FLOW OF MIXED OXIDANT, MEASURED AS FAC, AT THE CHLORINE ANALYZER SAMPLE LOCATION BASED ON INSTANTANEOUS FLOW RATE AND FAC CONCENTRATION. THE CONTROLLER SHALL USE THE PID ALGORITHM TO CALCULATE REQUIRED MIXED OXIDANT ADDITION MASS FLOW RATE, PUMP STROKE RATE AND CORRESPONDING VFD SPEED INPUT TO ACHIEVE THE TARGET FAC RESIDUAL BASED ON OPERATOR ADJUSTABLE NEAT MIXED OXIDANT STRENGTH (MG/L) (DEFAULT VALUE = 4,000 MG/L OR 0.4%, RANGE 1,000 MG/L TO 10,000 MG/L) AND OPERATOR ADJUSTABLE METERING PUMP VOLUME PER STROKE (GALLON/STROKE) (DEFAULT VALUE = 0.0097 GALLON/STROKE, RANGE 0.0001 TO 0.0100 GALLON/STROKE) FOR EACH PUMP.

IN "SECONDARY ADDITION POINT MODE" THE CHEMICAL FEED PUMP STROKE RATE SHALL BE CONTROLLED WITH A FEEDBACK LOOP USING AN INCREMENTAL ADJUSTMENT ALGORITHM USING OPERATOR ADJUSTABLE PUMP SPEED INCREMENTS (DEFAULT VALUE = 3.0%, RANGE 0.1% TO 10.0%) AND OPERATOR ADJUSTABLE TIME STEPS (DEFAULT VALUE = 2.0 MINUTES, RANGE 1.0 MINUTES TO 60.0 MINUTES). IF THE FAC RESIDUAL IS BELOW THE TARGET FAC RESIDUAL, THE PUMP SPEED SHALL BE INCREASED BY ONE INCREMENT FOR ONE TIME STEP AND VICE VERSA IF THE FAC RESIDUAL IS ABOVE THE TARGET FAC RESIDUAL. AFTER THE TIME STEP HAS COMPLETED, THE PROCESS SHALL REPEAT. AN OPERATOR ADJUSTABLE DEADBAND (MG/L) (DEFAULT VALUE = 0.10 MG/L, RANGE 0.00 MG/L TO 1.00 MG/L) SHALL BE INCLUDED IN THE FEEDBACK LOOP. IF THE FAC CONCENTRATION AT THE END OF THE TIME STEP IS GREATER OR LESS THAN THE TARGET FAC CONCENTRATION BY AN AMOUNT LESS THAN THE DEADBAND, THE PUMP SPEED SHALL NOT BE CHANGED.

BUILDING 174 STORAGE TANK SEQUENCE OF OPERATIONS FOR MIXED OXIDANT ADDITION:

CHEMICAL FEED PUMPS SHALL OPERATE IN LEAD/LAG MODE. THE OPERATOR SHALL BE ABLE TO SELECT THE ACTIVE LEAD PUMP AND TO "LOCK OUT" EITHER PUMP FROM THE LEAD/LAG SEQUENCE FOR MAINTENANCE. ALTERNATE LEAD/LAG PUMPS AFTER EACH START OR AFTER 24 HOURS OF CONTINUOUS OPERATION (UNLESS ONE PUMP IS LOCKED OUT FOR MAINTENANCE).

THE DDC CONTROLLER SHALL INCLUDE A "REMOTE MANUAL" MODE TO ALLOW PUMP SPEED (DEFAULT VALUE = 50%, RANGE 0.0% TO 100.0%) TO BE SET IN THE DDC CONTROLLER AND A "REMOTE AUTO" MODE TO ALLOW PUMP SPEED TO BE CONTROLLED AS DESCRIBED BELOW.

TWO SEPARATE OPERATOR SELECTABLE MODES SHALL BE PROVIDED FOR THE MIXED OXIDANT ADDITION POINT: "INCREMENTAL CONTROL MODE" AND "PID CONTROL MODE".

THE CHEMICAL FEED PUMPS SHALL BE CONTROLLED USING EITHER A PROPORTIONAL-INTEGRAL-DERIVATIVE (PID) ALGORITHM OR AN INCREMENTAL ADJUSTMENT ALGORITHM AS PART OF A FEEDBACK LOOP TO MAINTAIN A TARGET FREE AVAILABLE CHLORINE (FAC) RESIDUAL AT THE CHLORINE ANALYZER SAMPLE LOCATION BY ADJUSTING THE CHEMICAL FEED PUMP STROKE RATE. THE TARGET FAC RESIDUAL SHALL BE AN OPERATOR ADJUSTABLE CONCENTRATION (MG/L) (DEFAULT VALUE = 2.00 MG/L, RANGE 0.25 MG/L TO 4.00 MG/L).

IF THE FAC RESIDUAL EXCEEDS AN OPERATOR ADJUSTABLE HIGH LEVEL CONCENTRATION (MG/L) (DEFAULT VALUE = 4.00 MG/L, RANGE 0.25 MG/L TO 4.00 MG/L) FOR A PERIOD OF MORE THAN 5 MINUTES AN ALARM SHALL BE GENERATED.

IF THE FAC RESIDUAL IS BELOW AN OPERATOR ADJUSTABLE LOW LEVEL CONCENTRATION (MG/L) (DEFAULT VALUE = 1.0 MG/L, RANGE 0.25 MG/L TO 4.00 MG/L) FOR A PERIOD OF MORE THAN 5 MINUTES, AN ALARM SHALL BE GENERATED.

IN "INCREMENTAL CONTROL MODE", THE CHEMICAL FEED PUMP STROKE RATE SHALL BE CONTROLLED WITH A FEEDBACK LOOP USING AN INCREMENTAL ADJUSTMENT ALGORITHM USING OPERATOR ADJUSTABLE PUMP SPEED INCREMENTS (DEFAULT VALUE = 3.0%, RANGE 0.1% TO 10.0%) AND OPERATOR ADJUSTABLE TIME STEPS (DEFAULT VALUE = 60 MINUTES, RANGE 1 MINUTES TO 10,000 MINUTES). IF THE FAC RESIDUAL IS BELOW THE TARGET FAC RESIDUAL, THE PUMP SPEED SHALL BE INCREASED BY ONE INCREMENT FOR ONE TIME STEP AND VICE VERSA IF THE FAC RESIDUAL IS ABOVE THE TARGET FAC RESIDUAL. AFTER THE TIME STEP HAS COMPLETED, THE PROCESS SHALL REPEAT. AN OPERATOR ADJUSTABLE DEADBAND (MG/L) (DEFAULT VALUE = 0.10 MG/L, RANGE 0.00 MG/L TO 1.00 MG/L) SHALL BE INCLUDED IN THE FEEDBACK LOOP. IF THE FAC CONCENTRATION AT THE END OF THE TIME STEP IS GREATER OR LESS THAN THE TARGET FAC CONCENTRATION BY AN AMOUNT LESS THAN THE DEADBAND, THE PUMP SPEED SHALL NOT BE CHANGED.

IN "PID CONTROL MODE", THE CONTROLLER SHALL COMPUTE THE MASS FLOW OF MIXED OXIDANT, MEASURED AS FAC, AT THE CHLORINE ANALYZER SAMPLE LOCATION BASED ON INSTANTANEOUS FLOW RATE, INCLUDING BOTH THE TANK INFLUENT LINE AND THE TANK RECIRCULATION LINE, AND FAC CONCENTRATION. THE CONTROLLER SHALL USE THE PID ALGORITHM TO CALCULATE REQUIRED MIXED OXIDANT ADDITION MASS FLOW RATE, PUMP STROKE RATE AND CORRESPONDING VFD SPEED INPUT TO ACHIEVE THE TARGET FAC RESIDUAL BASED ON OPERATOR ADJUSTABLE NEAT MIXED OXIDANT STRENGTH (MG/L) (DEFAULT VALUE = 4,000 MG/L OR 0.4%, RANGE 1,000 MG/L TO 10,000 MG/L) AND OPERATOR ADJUSTABLE METERING PUMP VOLUME PER STROKE (GALLON/STROKE) (DEFAULT VALUE = 0.0097 GALLON/STROKE, RANGE 0.0001 TO 0.0100 GALLON/STROKE) FOR EACH PUMP. THE PID ALGORITHM INTEGRAL VALUES SHALL BE ADJUSTED TO ACCOUNT FOR THE DELAY BETWEEN THE MIXED OXIDANT ADDITION POINT ON THE TANK INFLUENT LINE AND THE SAMPLE POINT ON THE TANK EFFLUENT LINE. THE DELAY INCLUDES APPROXIMATELY THREE (3) HOURS OF MIXING TIME WITHIN THE TANK.

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