ADDENDUM NO. 1

PREBLE COUNTY BOARD OF COMMISSIONERS & VILLAGE OF ELDORADO WASTEWATER TREATMENT PLANT IMPROVEMENTS

May 20, 2020

To: Planholders

From: Mote & Associates, Inc.
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Re: Preble County Board of Commissioners & Village of Eldorado
Wastewater Treatment Plant Improvements

This Addendum forms a part of the Contract Documents and modifies the original Contract Documents dated May, 2020. Acknowledge receipt of this Addendum in the space provided on the Bid Proposal form. Failure to do so may subject the Bidder to disqualification.

CHANGES/CLARIFICATIONS TO THE TECHNICAL SPECIFICATIONS:

1. SUBMITTALS & SUBSTITUTIONS, SECTION 01 33 00

   A. Article 1.02, A. shall be changed to read as follows: “Request for consideration of a substitution of an item of material or equipment shall be made to the Engineer prior to the commencement of the related construction at the Site during the Submittals phase. The Contractor shall contact the Engineer and request the process required for the consideration of any substitutions."

2. FRP GUARDRAIL & HANDRAIL, SECTION 06 82 20

   A. Article 1.01, A. shall be changed to read as follows: “This specification for a pultruded fiberglass railing system shall be in compliance with 2017 OBC and the latest OSHA regulations.”

3. HATCHES & ACCESS COVERS, SECTION 33 39 13

   A. This technical specification is being reissued and is attached hereto.

4. HYDRAULIC GATES, SECTION 40 05 59

   A. Article 3.05, Stop Gate Schedules shall be revised as follows:
      - UV disinfection bypass dimensions shall be changed from 24” x 40” to 24” x 42”

5. CONTINUOUS FLOW BATCH REACTOR SYSTEM, SECTION 46 53 53

   A. This technical specification is being reissued and is attached hereto.

6. ULTRAVIOLET DISINFECTION EQUIPMENT, SECTION 46 66 53

A. This technical specification is being reissued and is attached hereto.

End of Addendum

Attachments: Hatches & Access Covers, Section 33 39 13 (reissued)
Continuous Flow Batch Reactor System, Section 46 53 53 (reissued)
Ultraviolet Disinfection Equipment, Section 45 66 53 (reissued)

HATCHES & ACCESS DOORS
33 39 13

PART ONE – GENERAL

1.1. Summary

A. This Section contains information pertaining to the manhole frames and covers as shown on the Contract Drawings.

B. The contractor shall supply all access doors as specified in the contract drawings.

1.2. References

A. Section 03 30 00 – Cast-in-Place Concrete
B. Section 09 97 00 – Special Coatings

1.3. Submittals

A. The following shall be submitted in accordance with section 01 33 00.

PART TWO - PRODUCTS

2.1 Manufacturers

A. The manufacturer of the Access Doors shall be Halliday Products.

1. Model: Series F1R & S1R Access Doors

B. Or approved equal

2.2 Design Details

A. Design Specifications – F1R

1. Cover leaf: 1/4" (7mm) aluminum diamond plate.
2. Angle frame: 1/4" (7mm) aluminum raised curb style frame to be located over existing concrete opening. Units shall be installed to insure minimal water intrusion and/or odor resistance Reinforced to withstand a 10 foot (3M) column of stationary water.
3. Load rating: 625 lbs. psf (28kg. psm), Uniform live load.
4. Locking System: aluminum locking lugs welded to the frame and to the cover to work in conjunction with owner supplied padlock.
5. Cover equipped with the following Type 316 stainless steel features: heavy duty hinges, tamper proof attaching hardware, automatic hold open arm with aluminum latch.

6. Stainless Steel pressure locks.
7. Gasket: neoprene.
8. All aluminum hatches that make contact with concrete are required to have a manufacturer protective coating or finish.

B. Design Specifications – S1R

1. Cover Leaf (s): 1/4" (7mm) aluminum diamond plate.
2. Angle Frame: 1/4" (7mm) with continuous anchor flange.
3. Load Rating: 300 lbs. psf (1464 kg. psm) uniform live load.
4. Locking System: non-corrosive locking bar used in conjunction with an owner supplied padlock.
5. Cover equipped with the following: Type 316 stainless steel features: heavy duty hinges, tamper proof attaching hardware, automatic hold open arm with aluminum latch.
6. Guarantee: Access covers shall carry a lifetime guarantee against defects in material and/or workmanship

C. Protective Grating Panels

1. All access doors/hatches shall have protective grating panels.

2.3 Covers & Hatches Schedules

Location	*Dimensions (inches)*	*Halliday Products Model Type (or approved equal)*
Influent Flow Meter Manhole (1)	24” x 24”	F1R
SBR Pump Station Flow Meter Manhole (1)	24” x 24”	F1R
SBR Pump Station Pump Removal Hatches (3)	Size for pump removal	S1R
SBR Pump Station Valve Vault (1)	24” x 24”	S1R
SBR Submersible Mixers (2)	Field Verify	-

PART THREE – EXECUTION

3.1 Storage

A. Prior to installation, access covers should be stored in a dry area on the original shipping pallets.

3.2 Installation

A. Product shall be installed per the manufacturer’s installation instructions.

End of Section

CONTINUOUS FLOW BATCH REACTOR SYSTEM
46 53 53

PART ONE – GENERAL

1.01 Scope of Work

A. Furnish, deliver, and install a new and complete continuous batch reactor treatment System, also referred to as the Sequencing Batch Reactor (SBR) system. The Intermittent Cycle Extended Aeration System shall include furnishing and installing the necessary equipment and controls to provide an operating treatment system complete with air diffusion equipment, decant mechanisms, blower systems, air control valves, waste sludge pumps, instrumentation and control panel. The system supplier shall provide installation and start-up assistance training, and guarantee the process performance. It is the intent of these specifications that a single manufacturer-supplier, regularly engaged in the design, manufacture, assembly and production of sequential batch reactor systems of the type specified, shall have complete responsibility for the final design, furnishing, and coordination of all components in the sequential batch reactor system. Working drawings, including arrangement and erection drawings of the equipment and control equipment; schematic control diagrams, electrical connection diagrams, and complete description of the control systems; and equipment operating characteristics shall all be furnished.

1. The system supplier shall provide aftermarket services during the first year of operation, including additional visits by a qualified biological process engineer.
2. It is the intent of these specifications that a single manufacturer-supplier, regularly engaged in the design, manufacture, assembly and production of control panel systems for biological processes of the type specified, shall have complete responsibility for the final design and fabrication of the control panel, the biological process training and the aftermarket services.
3. Detailed drawings, including arrangement and installation of the mechanical equipment, electrical control system diagram with field connections identification, control system description, and equipment operating characteristics shall all be furnished.

1.02 Submittals

A. Submit required copies of manufacturer's literature, dimensional drawings, wiring diagrams, motor data, performance data, materials of construction, a description of the process design (Operational Description), a description of the control system software logic (Functional Design Specification), and any other information necessary to determine compliance of the equipment to the specification and project requirements.

B. Highlight project-specific model numbers and options in equipment data sheets.

C. Submittal drawings showing plan, elevation and cross sections of the equipment.

D. Component details of the aeration equipment showing diffusers, diffuser holders, gaskets, retainer rings, supports, threaded union and/or flanged joints and a purge system.

E. Materials and Manufacturing specifications.

F. Aeration System submittal information to include:
   1. Equipment data sheets.
   2. Performance data including oxygen transfer calculations.
   3. Certified SOTE curves from previous test runs on equivalent system shop transfer testing.
   4. Headloss calculations and pressure requirements.
   5. Customer contact list with telephone numbers (minimum of 10 contacts from similar size facilities).

G. Operation and maintenance manual with installation instructions. Submit after approval of equipment with equipment shipment.

H. Process Performance Guarantee.

1.03 Manufacturer

A. The batch reactor treatment system shall be manufactured by Xylem Inc. Sanitaire Products or engineer approved equal.
   1. Basis of Design: ICEAS – Intermittent Cycle Extended Aeration System (by Xylem Inc. Sanitaire Products)
   2. Or approved equal

A. Other manufacturers shall pre-qualify prior to bidding, by submitting 10 days prior to the bid date the following documentation to the engineer as specified below.
   1. Confirmation that equipment shall be furnished by a qualified and experienced in the production of similar equipment.
   2. Complete set of drawings, specifications, catalogue cut sheets, and detailed descriptive material of proposed major equipment items. This information shall identify all technical and performance requirements stipulated on each drawing and in each specification section.
   3. Process design calculations demonstrating the reactor sizing, hydraulic capacity and ability of the proposed system to meet the specified effluent quality, and verification of a minimum buffer zone of 3.75 ft between the settled sludge blanket and the bottom water line based on an SVI of 150.
   4. Detailed aeration calculations including data from shop testing per the ASCE Standard for the Measurement of Oxygen Transfer in Clean Water verifying that the specified standard oxygen transfer efficiency can be achieved.
   5. Submit control data to show compliance with the performance metrics in the instrumentation and process control section of this specification.
   6. Manufacturer's recommended spare parts.
   7. Process equipment electrical requirements and schematic diagrams.
   8. Detailed written documentation with discussion of all deviations of equipment from the Contract Documents.

1.04 Equipment Warranty

A. The requirements of the General and Supplementary Conditions and the requirements as specified hereinafter shall apply.

B. Manufacturer shall guarantee all equipment furnished to be free from defects in materials and workmanship under normal use and service for a period of twelve (12) months after the data first placed in service, or eighteen (18) months after delivery, whichever occurs first.

1.05 Process Description

A. The SBR system shall incorporate continuous feed activated sludge technology with intermittent systems operation. The system shall use a single reactor in which the activated sludge is alternately aerated and mixed over a number of pre-determined cycles. Solids liquid separation shall occur during a settling phase of the cycle. After the settling phase, treated effluent shall be decanted or withdrawn from the liquid surface. Flow to the vessel is not interrupted at any time.

B. The functions of flow equalization, biological oxidation, nitrification, sedimentation and aerobic sludge stabilization shall all be carried out in a single reactor. Systems that require reactor bypassing during the settle and/or decant phases shall not be acceptable.

1.06 Influent Wastewater Characteristics

Maximum Month Flow	0.1	MGD
Maximum 4.8-hr Cycle Flow	0.215	MGD
Maximum 3.0-hr Cycle Flow	0.344	
Maximum 2.0-hr Cycle Flow	0.775	MGD
BOD5	142	lb/day
TSS	177	lb/day
TKN (estimated)	33	lb/day
TP (estimated)	6.7	lb/day
Temperature Range (Water)	10 – 20	ºC
Temperature Range (Air)	20 – 90	ºF
Site Elevation	1,150	ft

Sufficient alkalinity shall be provided by others, as required to maintain a basin pH of 6.8 and a residual alkalinity concentration of at least 100 mg/L.

1.07 ICEAS Effluent Quality Requirements

A. The following effluent limits shall be on a 30-day arithmetic average:

BOD5	10.0	mg/L
Total Suspended Solids	12.0	mg/L
Ammonia NH3-N – Summer (winter)	1.0 (3.0)	mg/L

B. Biological phosphorus removal shall be incorporated within the design of the treatment system, in the chance that a phosphorus limit is added to the facility in the future.

C. The treatment system has been designed on the assumption that the wastewater does not contain any threshold concentration of inorganic pollutants that are inhibitory to biological

treatment processes. Appendix A lists these threshold concentrations as published by the United States Environmental Protection Agency.

1.08 Process Design

A. In order to achieve specified effluent quality, the treatment process shall be designed using the following parameters:

F/M Ratio	0.046	lb BOD/lb MLSS-day
SVI (After 30 Minutes)	150	ml/g
Cycle Time		
Normal	4.8	hour cycles/day
High Flow	3.0	hour cycles/day
Very High Flow	2.0	hour cycles/day
Decanter		
Normal Cycle Time	72	min
Normal Decant Flow Rate	299	gpm
High Flow Cycle Time	45	min
High Flow Decant Flow Rate	478	gpm
Very High Flow Cycle Time	60	min
Very High Flow Decant Flow Rate	538	gpm
Waste Sludge Produced (Approx.)	69	lb/day/basin
MLSS at Bottom Water Level	3,713	mg/L

B. The ICEAS® has been configured as follows:

Number of Basins	2	
Width/Basin	14	ft
Length/Basin	42	ft
Water Depth at Top Water Level	15	ft
Water Depth at Bottom Water Level	11.33	ft

C. The aerobic digester has been configured as follows:

Number of Basins	1	
Width/Basin	11	ft
Length/Basin	29.5	ft
Water Depth at Top Water Level	14.5	ft
Telescopic Valve Lower Travel Level	8.75	ft

D. The multiple tank design, which utilizes the process parameters described in this specification, provides the ability to operate with one basin out of service, while maintaining F/M ratios and cell residence time within the endogenous respiratory phase of the biomass. This capability is useful for short time periods such as during basin and equipment maintenance.

E. In order for this system to function as designed, influent screening facilities have a maximum of 1/2" opening should be provided.

F. Equally divided influent shall be continuously and simultaneously received by all basins of the ICEAS system at all times, irrespective of the sequence of operation of the treatment

system. The system shall be designed so that the basin configuration prevents short circuiting of the influent during the decant sequence. A portion of the basin reactor shall contain a discrete pre-react zone formed by a baffled wall. This zone shall have an anoxic environment during settle and decant phases.

PART TWO - EQUIPMENT

2.01 Positive Displacement Blowers

A. Scope of Work

1. Provide all labor, material and equipment to furnish and install the positive displacement blower systems as specified herein and detailed on the drawings for the SBR basins. The blower systems shall be designed for the following operating characteristics:

	SBR & SHT	
Quantity	3	
Anticipated HP	10	hp
Air Flow*	167	scfm
Discharge Pressure	7.5	psig
Motor Shaft Power	8.7	bhp
Blower Shaft Power	7.9	bhp
Supply Power	460/3/60	V/Φ/Hz
Maximum Average Noise Level w/enclosure**	69	dB
Inlet/Outlet Sizes	2”	in
Ambient Temperature	85	ºF
Relative Humidity	80	%
Site Elevation	1150	ft

* measured at 14.7 psia (1bar), 68ºF (20ºC) and 36% relative humidity.

** measured at 6 locations at distance of 3 feet from the blower system. Noise level will be measured in a “free-field”.

2. Blower and accessories shall be furnished as a complete assembled package and must include all interconnecting piping, instrumentation and supports needed to ship the assembly as a complete unit. The blower packager shall be able to show that similar units have been in successful operation for five years.
3. Each blower package shall include the following components:
   a. Positive displacement blower.
   b. Motor with slide base.
   c. V-Belt drive.
   d. Flexible expansion joints.
   e. Drive guard.
   f. Common elevated structural steel base.
   g. Inlet filter.
   h. Inlet silencer.
   i. Discharge silencer.
   j. Pressure relief valve.
   k. Check valve.
   l. Pressure gauge (discharge).

m. Temperature gauge (discharge).
n. Vibration isolator pads.
o. Spare parts.
p. PTC Motor Thermistors.

B. Guarantee and Warranty
1. The manufacturer shall warrant the bare blower being supplied against all defects in workmanship and materials for a period of sixty (60) months from date of startup, not to exceed sixty-six (66) months from date of shipment from the manufacturer of the blowers. All other package components shall be warranted for a period of twelve (12) months from date of startup, not to exceed eighteen (18) months from the date of shipment.

C. Blower Construction:
1. The bare blower shall be mounted for vertical air flow, be of the oil-free, positive displacement, rotary three lobe type, designed for air or other inert gas service, and belt driven via electric motor.
2. The bare blower assembly must operate at the effective value for vibration velocity in frequency range A and B, according to VDI 3836.

D. Material:
1. AISI, ASTM, GJL, GLS, DIN, etc, numbers, types, and grades specified are typical of material composition and quality, equivalent materials will be considered.

E. Housing:
1. The casing shall be made of high strength, close grained, cast iron, and shall be adequately ribbed to prevent casing deflection and facilitate cooling. Casing shall be of EN GG 20 material.
2. The casing shall be precision machined to allow for minimum clearances.
3. The casing shall include channels integrated on the discharge to reduce blower pulsation and dampen noise.
4. The casing shall include threaded atmospheric vent ports between its air-side and oil-side labyrinth seals for safe separation of the conveying and oil chamber.
5. Inlet and discharge ports shall be drilled and tapped for studs to allow solid connection of mating surfaces. Through bolting shall not be allowed. Flange style blower ports, which may be subject to loading, causing cylinder distortion, shall not be allowed.
6. Bearing fits shall be precision machined to ensure accurate positioning of the rotors in the casing.

F. Rotors:
1. The rotors shall be precision machined out of a one-piece casting made of EN GGG 50 material. Stub shafts or two-piece impellers shall not be allowed.
2. The rotor assemblies shall be statically and dynamically balanced to ISO standard 1940/1- Q2.5 (turbine rotor). Modifications to the face of the rotors for balancing purposes are not acceptable.
3. The rotors shall be a tri-lobe design in order to minimize pulsation and noise.
4. The rotor must be solid or closed-end to prevent build-up of contaminants inside the rotor causing imbalance.

5. Cored rotors must be closed using threaded iron plugs which are permanently fixed. Impeller end caps of stamped sheet metal shall not be allowed.
6. The rotors shall have an integral sealing strip for improved efficiency.
7. The rotors shall operate without rubbing, liquid seals or lubrication in the air chamber.

G. Cover Plates:
1. The gear-end and drive-end cover plates shall be high strength, close grained, cast iron made of EN GG 20 material. Aluminum cover plates shall not be allowed.
2. The cover plates shall have a precision machined sealing face.
3. The drive-end cover plate shall include at least two precision machined holes to allow for the use of fitting bolts to accurately align the opening for the input shaft seal.

H. Timing Gears:
1. The rotor timing gears shall be precision machined and ground from alloy steel made from case hardened 16 MnCr5 material.
2. Each timing gear shall be straight cut and beveled to quality standard 5f 21, which will eliminate axial bearing loads and ensure long life as well as quiet operation. Helical gears, which cause axial loading, shall not be allowed.
3. Each timing gear shall be manufactured in accordance with:
   a. DIN 3960, Specifications for Spur Gear Sets
   b. DIN 3961 & DIN 3962, Tolerances for Spur Gear Mesh
   c. DIN 3964, Specifications for Shaft Centering
4. The timing gear set shall be taper-mounted on the rotors. Keyed, hub mounted, taper-pinned, or splined shaft timing gear mounting designs are not acceptable.

I. Bearings:
1. All four rotor shaft support locations shall incorporate large, heavy-duty, full complement, cylindrical roller bearings with PEEK cages, designed with at least 5-times the dynamic capacity of ball bearings. Ball bearings shall not be allowed.
2. The bearing maximum speeds must be at least two times the maximum recommended blower speed.
3. The bearings minimum acceptable L10 design life shall be as follows;
   a. At least 40,000 hours at blower's maximum rated speed and maximum rated differential pressure.
   b. At least 100,000 hours at design conditions.

J. Lubrication:
1. Both the gear end and the drive end of the blowers shall be oil splash lubricated via a disc slinger for minimal maintenance and long service life. Grease lubricated bearings in the blower are not acceptable.
2. The lubrication design shall ensure adequate lubrication of the timing gears and bearings.
3. The drive-end and gear-end oil chambers must not be interconnected, and each oil chamber shall have a domed design sight glass to allow visual inspection of oil level and oil condition, viewable from the front of the blower.
4. Blower to be factory filled with a synthetic lubricating fluid that is rated for the design conditions specified.

K. Rotor Seal Assembly:
1. Each rotor shall include one labyrinth seal assembly on each end, four assemblies in total per blower. Each seal assembly shall consist of the following;
   a. Oil splash guard ring.
   b. Shaft guide wear sleeve with vent holes located between the dual air and oil ring seals. Wear sleeve shall protect the blower casing.
   c. Four piston ring type labyrinth seals made from heat treated GG/42CrMo4 material. Two seals located on the air side and two seals located on the oil side of the grooved rotor sleeve. The use of rubber lip seals shall not be allowed.
   d. Grooved rotor sleeve which will protect the rotor shaft and be used to hold the four piston ring seals.

L. Input Shaft Seal Assembly:
1. The input drive shaft seal shall be a high temperature radial lip type seal made from Viton elastomer. The seal shall prevent oil leakage from where the input shaft goes thru the drive end cover.
2. The seal design shall incorporate a replaceable wear sleeve on the input drive shaft.
   a. The sleeve exterior to be tungsten carbide coated to reduce friction and wear.
3. The input drive shaft seal shall be a high temperature radial lip type seal made from Viton elastomer. The seal shall prevent oil leakage from where the input shaft goes thru the drive end cover.

2.02 Motors

A. Drive Motor:
1. Motor shall be designed, manufactured, and tested in accordance with the latest revised editions of NEMA MG-1, IEC, DIN, ISO, IEEE, ANSI, and AFBMMA standards as applicable and shall be capable of continuous operation.
2. Motor must meet or exceed Energy Independence and Security Act (EISA 2007) standards for NEMA Premium efficiency. It shall also be marked with a Department of Energy Certification Compliance Number to assure compliance.
3. Motor shall comply with Low Voltage Directive 2006/95/EC or equivalent and be UL listed.
4. Motor must be inverter rated with impulse peak resistance in accordance with IEC 60034-1:2010 or equivalent for operation with an IGBT frequency converter or equivalent.
5. Motor horsepower nameplate rating shall not be exceeded at the design discharge pressure when operating at 60hz.
6. The temperature rise of the motor windings shall not exceed IEC and NEMA standards when the motor is operated continuously at the rated horsepower, rated voltage, and frequency in ambient conditions at 104ºF / 40ºC.
7. Motor shall be suitable for Full Load/Direct On-line starting, Solid State Ramp starting, VFD, and/or Wye-Delta reduced current starting.
8. Motor to be supplied, mounted and aligned by the blower package manufacturer.
9. Motor shall confirm the following:
   a. Motor voltage: 460v/ 3ph/ 60hz

b. Type: Squirrel cage induction
c. Speed: Single
d. Torque: Constant
e. Service factor: 1.15
f. Enclosure: TEFC
g. Mounting: Horizontal
h. Design: A
i. Duty Cycle: Continuous (24 hours a day)
j. Winding insulation: F
k. Temperature rise: B
l. Thermal motor protection: Positive Coefficient (PTC) thermistors (one per winding) wired in series. The use of thermostats is not allowed.
    1) Connection of the PTC thermistors to the control system and signal processing is not part of the blower manufacturer's scope of supply.
m. Conduit box location: Top
n. Wiring Connection: Terminal strip inside conduit box. Use of wire nuts for connection of motor wiring to power source shall not be allowed.
o. Bearing L10 life: >40,000 hours
p. Bearing lubrication: Grease
q. Bearing type: Permanently greased
    1) Lubrication fittings must be located towards the front of the blower package so that both bearings can be safely lubricated while the blower package is running.
    2) Grease drain holes to be closed for protection of the environment. A spent grease cavity in the bearing cover should be large enough to hold spent grease required for 40,000 operating hours.
r. Bearing design: Cantilever forces (belt drive)
s. Condensation winding 110v heater: No

10. Motor shall be as manufactured by Siemens.
11. Connection and control of the drive motor to the control system is not part of the blower manufacturer's scope of supply.

B. Sound enclosure ventilation fan motor:
1. Motor voltage: reference Performance data – Power supply voltage
2. Motor shall be UL listed
3. Motor starter/overload protection is the responsibility of the control system provider.
4. The fan motor should turn "on" when the main motor starts and turn "off" 10 minutes after the main motor stops. Controlling the fan motor via a thermostat shall not be allowed.
5. Connection and control of the fan motor to the control system is not part of the blower manufacturer's scope of supply.

2.03 Blower Package

A. Drive:
1. The blower shall be driven by the drive motor through a V-belt drive assembly designed to meet the blower conditions specified with a 1.2 or larger service factor.

a. V-belts shall have an XPZ/XPB profile with embedded low-stretch polyester tension cords. The v-belts shall be designed for high rotational speeds and be heat and oil resistance. Ribbed, banded, or multi groove belts shall not be allowed.
b. Sheaves shall have a SPZ/SPB profile and be balanced to G16 for below 30m/s and G6.3 for sheaves above 30m/s.
c. Keyed taper bushing shall be used for easy installation and removal. QD type bushings shall not be allowed.

2. The blower drive must have a fully enclosed guard which protects the operator when the blower package enclosure is open while in operation.
   a. Belt guard shall be OSHA approved.
   b. The belt guard made from the manufacturer's standard sheet metal, shall be designed to duct the cooling air flow from the drive motor fan across the front of the blower to supplement blower input shaft seal cooling.
   c. The mounting fasteners for the belt guard shall be retained on the housing to prevent loss during maintenance.
3. Belt tension shall be accomplished by the use of a motor swing base and automatic tensioning assembly.
   a. The drive motor shall be mounted on a pivoting swing base with an axial adjustment for proper alignment of the v-belts. The weight of the drive motor shall provide the primary belt tension. The use of a sliding motor mount shall not be allowed.
   b. A tensioning assembly consisting of a threaded rod with spring shall be used to adjust the v-belt tension to prevent belt slippage and efficiently transmit power to the blower. It shall include a visual indication showing whether or not the v-belt tension is within the correct belt tension range.
   c. Adjustment of the tensioning assembly shall be accomplished without removal of the guard or loosening of the motor mounting bolts.
   d. The design of the swing base with tensioning assembly shall prevent the swing base from falling and creating a personnel hazard in the event of a belt failure. The tensioning assembly adjusting nut shall raise the motor swing base facilitating v-belt changes without the use of pry bars or jacks.

B. Inlet Silencer:
1. An inlet silencer designed for the frequency range of the blower, shall be provided to reduce the noise of the blower package as specified.
   a. The inlet silencer shall be of carbon steel construction and be of the wear-free absorptive type, directly connection to the inlet port of the blower, and shall be mounted horizontally.
   b. The inlet silencer shall be lined with replaceable polyether absorptive material.
   c. The inlet silencer shall have an integral filter designed to protect the blower from particulates. It shall be located between the absorptive material and the blower inlet.
      1) The filter element shall be a washable and reusable polyester element for minimal pressure drop.
      2) The filter efficiency shall meet ASHRAE 52.2 MERV7 50-70%% @ 3-10 microns corresponding to EN779 G4.

3) The filter element integral to the silencer shall be supplied no matter if the inlet configuration of the silencer is ambient or piped. If required on piped inlet configuration, any additional filtration or screening at the inlet location of the piped inlet air source is not the responsibility of the blower manufacturer.

4) Filter element shall be removable without disconnecting the inlet duct.

d. The filter maintenance cover and element must be removable by hand (without the use of tools).

e. The pressure loss thru the inlet silencer assembly shall be accounted for in the motor horsepower selection of the blower package.

C. Base frame with integrated discharge silencer:

1. The blower base frame with integrated discharge silencer shall be designed for the frequency range of the blower, shall be provided to reduce the noise of the blower package as specified.

a. The blower base frame shall be of formed steel construction and designed for horizontal mounting of blower with vertical air flow. Flange-mounting only of the bare blower to the blower base frame shall not be allowed, additional support by use of the base frame shall be required; preventing the loading of the blower casing and discharge silencer shell.

b. The blower base shall incorporate the pivoting motor swing base and tensioning assembly to insure proper alignment of the drive assembly.

c. The discharge silencer shall be an integral part of the base frame.

d. The discharge silencer type shall be a combination of absorption, reflection and diffusion.

1) The design of the discharge silencer shall incorporate a solid outer and perforated inner cylinder with absorptive material in between the cylinders.

a) Absorptive material shall be long, flexible, knotted polyester fibers to allow for lowering the noise and heat emissions inside the sound enclosure. The use of mineral wool shall not be allowed.

2) The discharge silencer shall have connections ports for pressure relief, discharge pressure, and discharge temperature. Unused ports shall be capped or plugged.

e. The pressure loss thru the discharge silencer assembly shall be accounted for in the motor horsepower selection of the blower package.

D. Blower Sound Enclosure:

1. A sound enclosure shall be provided which fully covers the blower, motor, drive assembly, inlet silencer, blower base frame with integrated discharge silencer, and be shipped fully assembled.

a. The sound enclosure shall be the product of the blower manufacturer to insure proper integration of blower package components.

b. The sound enclosure shall meet the sound level specified.

c. The sound enclosure acoustic material shall comply to FMVSS 302 with a burning rate B or lower than 100 mm/min.

d. The sound enclosure assembly shall be of self-supporting bolted steel panel construction on a fabricated steel skid.
    1) All maintenance removable panels or doors shall be located in the front of the sound enclosure and must have a slotted key lock. A door key shall be provided. All maintenance panels shall meet OSHA weight requirements.
    2) The enclosure base shall be designed to enclose the full bottom of the sound enclosure and include fork lift guides for easy transportation and installation.
e. The sound enclosure ventilation cooling air circuit shall be separate from the process air circuit. Mixing of the two air circuits within the enclosure shall not be allowed.
f. The sound enclosure shall have a set of inlet louvers positioned on the blower-side of the enclosure to allow for the flow of ambient cooling air across the blower oil sumps.
g. A screened inlet louver shall be located on the back of the enclosure and designed to provide a laminar flow of ambient cooling air across the blower drive motor.
h. The sound enclosure ventilation air exhaust and the ventilation fan shall be located at the top of the sound enclosure.
    1) The ventilation fan shall be sized to provide adequate cooling of the blower package at all blower speeds.
    2) The ventilation fan voltage shall be as specified and run concurrent with the main motor. The ventilation fan shall not be controlled by a thermostat.
i. The back of the sound enclosure shall have predrilled holes with grommets for easy pass-thru of electrical wiring.
j. When installed outdoor, reference Blower Package Configuration Part 2.3. An outdoor stainless-steel weather hood shall be installed on top of the enclosure to protect the unit from the elements. The weather hood shall be designed to allow access to the sound enclosure and panel mounted instruments.

E. Blower Package Accessories:
1. Pressure Relief Valve
    a. The relief valve(s) shall be factory installed within sound enclosure. Relief valve may not be shipped loose for field installation in the discharge piping.
    b. The relief valve(s) shall be spring type and must be sized for 100% of the design flow specified. Weighted relief valves shall not be used.
    c. The relief valve(s) shall be set to protect the blower from excessive differential pressure based on the design conditions specified. A seal shall be affixed that must be broken if set point is changed.
    d. The relief valve(s) exhaust shall be vented out of the sound enclosure. Exhaust vented into the sound enclosure shall not be allowed.
    e. The relief valve shall be ASME Section IIIV, UV, CE, and PED certified.
    f. The relief valve shall be manufactured by Kunkle.

2. Check Valve
    a. A check valve to prevent back flow through the blower shall be factory installed and not shipped loose for field installation in the discharge piping.
    b. The check valve flapper shall be swing type made from a steel disc embedded in a high temperature silicone elastomer. The valve shall be designed so that, in the event of failure, the valve element is retained in the valve housing. Split disc or center hinged designs shall not be used.
    c. The check valve capacity shall exceed the blower package's maximum discharge pressure and temperature.
3. Flexible Connector
    a. An elastomeric compensator/flex connector shall be provided to isolate the connection of the blower package to the self-supporting system piping. Restraining rods shall not be used. Flex connectors located between the bare blower and silencers shall not be allowed.
    b. The flexible connector capacity shall exceed the blower package's maximum discharge pressure and temperature.
    c. Discharge connection
        1) 4" and smaller connection, a web reinforced silicone rubber sleeve with corrosion resistant clamps shall be provided.
4. Blower instrumentation gauges
    a. The following gauges shall be pre-piped and panel mounted on the front of the sound enclosure. Gauges shall not be shipped loose for field installation.
    b. Discharge pressure gauge
        1) The discharge pressure gauge shall measure the pressure at the discharge of the blower.
        2) The discharge pressure gauge shall be dual unit (English – PSI / Metric – Bar) with a range of 0 – 23 psi (0 – 1.6 bar). Minimum dial diameter shall be 2 ½", made with a stainless steel case and be glycerin filled for pulsation dampening.
    c. Discharge temperature gauge with adjustable switch
        1) The discharge temperature gauge shall measure the temperature at the discharge of the blower package.
        2) The discharge temperature gauge shall be dual unit (English - ºF / Metric - ºC) with a range from 32 – 392ºF (0 – 200ºC) and include an adjustable set point dial. Minimal dial diameter shall be 2 ½", made with a black plastic case and have a liquid filled measuring system that is converted by a Bourdon tube into a rotary movement of the pointer. The rotary movement of the pointer spindle shall operate a SPDT microswitch through a lever system. Voltage rating up 220v, 5amps.
        3) The high temperature set point shall be as recommended by the blower manufacturer.
        4) Connection of the switch to the control system is not part of the blower manufacturer's scope of supply. The switch shall be wired to shut down the blower package when actuated.
    d. Filter differential pressure gauge

1) The filter differential pressure gauge shall measure the pressure difference from ambient to the back side of the filter that is integral to the blower package's inlet silencer. When the filter starts to become dirty, the resistance shall be shown on a resettable red dial indicating when the filter shall be changed.

5. Oil Drains
   a. An oil drain from the blower drive-end and gear-end lubricating oil sumps shall be separately piped to the front of the blower base with flexible tubing. Common fill and drain shall not be allowed.
   b. Each oil drain shall include a drain valve installed for ease of maintenance. The drain valves shall be 90° stainless steel ball valves and include a fully retained gasketed threaded cap to prevent accidental discharge of the blower lubricant.
6. Vibration Isolators
   a. Vibration isolators shall be provided between the base frame with integrated discharge silencer and sound enclosure skid to prevent transmission of vibration to the foundation.
   b. A ground wire shall be installed between the blower base and the sound enclosure base to allow for grounding of the complete blower package.

F. Blower Package Accessories – the following options shall be supplied.
1. Inlet filter differential pressure switch.
   a. The blower package shall include an installed filter differential pressure switch that shall measure the pressure differential across the integral inlet silencer's filter.
   b. The filter differential pressure switch shall be field adjustable up to .73 PSI (50 mbar) and factory set at .5 PSI (35 mbar).
   c. The filter differential pressure switch shall be a SPDT switch, Voltage rating up to 250v, 10A
   d. Connection of the switch to the control system is not part of the blower manufacturer's scope of supply. The switch shall be wired to shut down the blower package when actuated.
2. Discharge pressure switch.
   a. The blower package shall include an installed discharge pressure switch that shall measure discharge pressure of the blower.
   b. The discharge pressure switch shall be field adjustable.
   c. The discharge pressure switch shall be a SPDT switch, Voltage rating up to 250v, 1A.
   d. Connection of the switch to the control system is not part of the blower manufacturer's scope of supply. The switch shall be wired to shut down the blower package when actuated.
3. Enclosure heater assembly.
   a. The blower package when installed where temperatures could be between 5 to 23º F shall include an installed 115v/1ph/60hz enclosure heater with a thermostatically controlled switch that shall heat the inside of the enclosure.
   b. The enclosure heater switch shall be field adjustable and be factory set to come on at 41 deg F (5 deg C).

c. Connection of the enclosure heater system to the control system is not part of the blower manufacturer's scope of supply.

4. Instrumentation junction box.
   a. The blower package shall include an instrumentation junction box where all the provided instrumentation is wired to a terminal strip making for a central electrical connection point (except for the main blower drive motor).
   b. Connections from the instrumentation junction box to the control system are not part of the blower manufacturer's scope of supply.

G. Nameplates:
1. The blower package shall have at least two weather proof corrosion resistant type nameplates which includes the manufacturer name, phone number, model number, year, capacity, max end pressure, max pressure difference, blower speed, equipment number, part number, serial number, voltage, phase, HP, motor Hz/ rpm, and FLA attached on the outside and inside of the blower package.

H. Anchor bolts and hardware:
1. Anchor bolts, washers, hex nuts, and all other fastening hardware shall be stainless steel and be supplied by the contractor.

I. Paint specification:
1. The blower manufacturer is responsible for surface preparation, priming and finish coating of the blower package and components requiring paint in accordance with the manufacture's standard procedures. Field painting of blower equipment or supplying components that are only prime painted is not acceptable.
   a. Cast parts are to be painted with a two-part gray epoxy primer and two-part top coat.
   b. Fabricated parts are to be painted with a two-part gray epoxy primer and two-part top coat.
   c. Sound enclosure parts are to be powder coated.
      1) Panels and base paint finish shall be pretreated by de-greasing and phosphate cleaning, then powder coated to a thickness of 70 µm - 100 µm on both sides.
2. The blower package to be painted the blower manufacturer's standard colors.

2.04 Manufacturer

A. Blowers shall be furnished by Kaeser Compressor or engineer approved equal.
1. Basis of Design: Kaeser Compressor BB69C, Omega 22P, 10 hp.

2.05 Installation

A. The blower package shall be handled and installed in accordance with the manufacturer's recommendations and instructions as shown in the location on the drawings.

B. Contractor shall field verify all dimensions and elevations. The engineer shall be notified of any specific differences.

C. The blower package shall arrive on site ready for installation. Aligning, adjusting and filling the blower with lubrication shall not be required by the contractor.

2.06 Field Quality Control

A. Furnish the services of a manufacturer's authorized representative for proper installation to inspect and approve the installation, and to supervise a test run of the blower package.

B. After the installation and test run has been completed; the blower package shall be given a field test in the presence of the Engineer to verify that operation is satisfactory and in compliance with the Specification. If the blower package does not meet the Specification, corrective measures shall be taken or the package shall be removed and replaced with a package which satisfies the conditions of the Specifications.

2.07 Training

A. Furnish the services of a manufacturer's authorized representative, who will instruct plant personnel in the operation and maintenance of the blower package. All procedures shall be covered including preventive maintenance, method of controlling the blower package and troubleshooting.

2.08 Air Control Valves

A. Scope of Work

1. The SBR supplier to furnish the following motor operated air flow control valves to control aeration in the SBR basins.

Valve Location	SBR	
Valve Quantity	2	
Valve Diameter	4	inch
Actuator Power Supply	120/1/60	V/Φ/Hz
Actuator Type	Open/Close	

B. Construction – Valves

1. The valves shall be butterfly valves, wafer body style, EPDM-seat, tight-closing type for installation between two (2) ANSI Class 125/150 standard flanges.
2. The valves shall be rated at 50 psi (345 kPa) and provide drop tight shutoff at differentials up to 50 psi.
3. Valve bodies shall be cast iron (ASTM A126, Class B) and have two flange bolt guides to center the body in the pipeline. Valves shall be provided with power actuators.
4. The seat shall be tongue-and-grove design and act as a body liner to prevent flow from contacting the body casting. The seat shall also provide a positive seal without use of flange gaskets. Seats shall be of EPDM suitable for use with compressed air and shall be field replaceable.
5. The disc shall be aluminum bronze (ASTM B148-954). The disc-to-shaft connections shall be direct drive double "D" design requiring no disc screws or pins to connect shaft to disc. Outside diameter of disc shall be designed that when opened, it will not interfere with adjacent piping.

6. Shafts shall be one piece and shall be 416 stainless steel (ASTM A582 Type 416). Shafts shall be finish ground to minimize bearing and shaft seal wear. Shaft seals shall be provided to prevent leakage and to protect bearings from internal or external corrosion.
7. Valves shall be furnished with self-adjusting stem seal and non-corrosive Acetal bushings for smooth, low torque operation.

C. Construction – Electric Motor Actuators
1. All electric actuators shall conform to the requirements of AWWA Standard C-540.
2. Power actuated valves shall be furnished with electric motor actuators. The valve actuators are to be sized for design pressure with flow in reverse direction plus a 1.5 safety factor. The actuators shall include, geared travel limit switches, torque limit switches, manual handwheel, condensation heater, terminals for motor power and controls and drive nut.
3. The motor shall be specifically designed for actuator service. The motor will be of the induction type with class F insulation and protected by means of thermal switches imbedded in the motor windings. Motor enclosure will be totally enclosed, non-ventilated.
4. The entire actuator enclosure should be NEMA 4 watertight.
5. Travel limit switches will be provided to de-energize the motor control circuit when the actuator reaches the limits of travel in the open and close directions.
6. Mechanical dial position indicator will be furnished on all valves.
7. The motor shall have an operating speed adjustment.

D. Acceptable Manufacturers
1. Valves shall be Bray Series 30 Resilient Seated Butterfly or approved equal.
2. Actuators shall be AUMA model SG or approved equal.

2.09 Fine Bubble Aeration

A. Scope
1. Furnish all materials, equipment, services, and testing for the fine bubble aeration system.

B. Equipment Components Included
1. Stainless steel droplegs, supports, and anchors.
2. PVC manifolds, air distributors, diffuser holders, and retainer rings.
3. Bolts, nuts, and gaskets for aeration system flange connections.
4. Air distributor purge systems.
5. Membrane disc diffusers with integral O-ring gaskets.

C. System Design and Performance
1. Design aeration system to transfer not less than the following pounds of oxygen per day in clean water at 14.7 PSI, 20ºC and zero dissolved oxygen at the specified submergence, air rate and pressure.

Tank	SBR	SHT	
Std. 02 Transfer Rate (SOTR)	20	20	$lbsO_2/hr$
Volumetric Air Rate	90	140	SCFM
Operating Pressure at Top of Dropleg	7.1	7.5	psig
Diffuser Submergence (@SWD)	14	14.5	ft
# of Diffusers/Tank*	57	96	each

*Number of Diffusers per tank may be adjusted by engineering during submittal process.

2. Design air distributors with centerline spacing not to exceed 4 feet to maximize oxygen transfer efficiency and mixing efficiency and to minimize solids deposition between air distributors.

D. Materials, Fabrication, and Finishing

1. Stainless Steel – Pipe, Fittings, and Supports
   a. Fabricate all welded parts and assemblies from sheets and plates of 304L stainless steel with a 2D finish conforming to ASTM A240, 554, 774, 778.
   b. Fabricate non-welded parts and flanges from sheets, plates or bars of 304 stainless steel conforming to ASTM A240 or ASTM A276.
   c. Welds & Welding Procedure
      1) Weld in the factory using latest standards according to AWS. Continuously weld both sides of face rings and flanges to eliminate potential for crevice corrosion.
   d. Corrosion Protection and Finishing clean all welded stainless-steel surfaces and welds after fabrication by using the following procedure:
      1) Preclean outside and finish clean all interior and exterior welds and piping by full immersion pickling and rinse with water to remove all carbon deposits and contaminants to regenerate a uniform corrosion resistant chromium oxide film per ASTM A380 Section 6.2.11, Table A2.1 Annex A2 and Section 8.3.
2. Natural Rubber – Furnish all fixed and expansion joint O-ring gaskets of natural rubber/SBR with a Shore A durometer of 45 ± 5.
3. Polyvinyl Chloride (PVC) – Pipe and Fittings
   a. Produce all PVC pipe and fittings from PVC compound with a minimum tensile strength of 48,000kPa.
   b. Provide lower drop pipe, manifold and air distributors as follows:

Diameter	Wall Thickness	ASTM
4 in	SDR 33.5	D3915, 3034, 124524
6 in & larger	Schedule 40	D1784, D1785, D2466, 12454-B

   c. Design air distributors and manifolds to withstand 54° C mean wall temperature.
   d. Add two parts by weight of titanium dioxide per 100 parts of resin to PVC compounds for manifolds, air distributors, joints and PVC diffuser assembly components to minimize ultraviolet light degradation.
   e. Factory solvent weld all PVC joints and fittings. Field solvent welding will NOT be permitted.

4. EPDM – Membrane Diffusers and Gaskets
    a. Manufacture circular membrane diffuser discs with integral O-ring of EPDM synthetic rubber compound with precision die formed slits. Thermoplastic materials (i.e. plasticized PVC or polyurethane) are not acceptable.
    b. Quality Control – Test diffuser using primary sampling criteria outlined in Military Standard 105E.

E. Fine Bubble Aeration System Components
1. Droplets - Provide a 304L stainless steel dropleg from the air main connection to the dropleg connection on the manifold.
2. Manifolds - Provide PVC manifolds for connection to the air distribution headers.
    a. Fabricate manifolds with 4 inch diameter fixed threaded union positive locking anti rotational or flanged joints for connection to the air distributors.
3. Air Distributors and Diffuser Holders - 4 inch diameter PVC air distributors perpendicular to the air manifold
    a. Fabricate distributors with single diffuser holders solvent welded to the crown of the air distributor for complete air seal and strength.
    b. Provide 4 inch diameter threaded removable end caps complete with gasket, threaded coupling and end plate for clean out at the end of each distributor.
4. Air Distributor and Manifold Connection Joints
    a. Join air distributor sections with positive locking anti rotational fixed threaded union or flange type joints for all submerged header joints to prevent blow apart and rotation.
    b. Design flanged joints with a 150 lb drilling angle face ring, follower flange and stainless steel hardware.
5. Supports - Provide each section of manifold and air distributor with a minimum of two (2) supports.
    a. Limit maximum support spacing to 2.5 meters.
    b. Design all supports to allow for thermal expansion and contraction forces over a temperature range of 52° C and to minimize stress build up in the piping system.
6. Diffuser Assemblies - Furnish diffuser assemblies including diffuser, diffuser gasket, holder, retaining ring and air flow control orifice.
    a. Membrane Diffuser
        1) Incorporate an integral check valve into the membrane diffuser.
    b. Design and test diffusers for a dynamic wet pressure (DWP) of 12 inches ± 20% water column @ 1.0 SCFM/diffuser and 2 inches submergence.
    c. Visual Uniformity – Observe diffusers for uniform air distribution across the active surface of the diffuser at 1.0 SCFM/diffuser and 2 inches submergence. Active surface is defined as the perforated horizontal projected area of the diffuser.
    d. Quality Control – Test diffuser using primary sampling criteria outlined in Military Standard 105E.
7. Diffuser Holders and Retainer Rings
    a. Design holder with air flow control orifice. Holder to provide peripheral support for the diffuser.

b. Design retainer ring to seal the diffuser and O-ring in the holder to prevent air leakage around gasket.
c. Design retainer rings threads with minimum cross section of 1/8-inch and allow for one complete turn to engage threads.

8. Anchor Bolts
   a. Provide a mechanical 304 SS expansion anchor bolts for embedment in 4000 psi concrete with a pullout safety factor of 4.
9. Liquid Purge System
   a. Provide a liquid purge system to drain the entire submerged aeration piping system for each aeration grid including airlift purge eductor line and control valve. The purge system shall use a solenoid valve for automatic operation coordinated with the SBR operation. Package spare parts in a separate container clearly marked as "Spare Parts" and provide inventory list on exterior of the container.

F. Installation Procedures
1. Follow equipment manufacturer's recommendations and O&M manual for of equipment installation.

G. Acceptable Manufacturers
1. Xylem Inc. Sanitaire Products or engineer approved equal.

2.10 Submersible Mixers

A. Scope of Work
1. The SBR system supplier shall furnish submersible mixer(s) in each tank as listed in the table below. Each mixer shall be equipped with a submersible electric motor with submersible cable (SUBCAB) suitable for submerged mixer applications. All cables shall be oil resistant chlorinated polyethylene rubber jacketed. Each mixer shall be fitted with an appropriate length of stainless steel cable of adequate strength to permit raising and lowering the mixer. Leak sensors shall be used to sense water presence in the oil and stator housings.

Tank	SBR	
Mixers per Tank	1	
Mixer Model	4640	
Drive Type	Direct	
Thrust in clean water at design point	630	N
Input power in clean water at design point	3.71	Hp
Propeller Diameter	13.6	inches
Propeller Rpm at design point	19	rpm
Submersible Cable Length	30	Feet
Lifting Chain Length	25	Feet
Motor Power Supply	460/3/60	V/Φ/Hz
Motor Power	4.0	HP

B. Mixer Design

1. The mixer(s) shall be capable of handling raw, screened sewage. The mixer(s) shall be able to be raised and lowered and shall be easily removed for inspection or service without the need for personnel to enter mixing vessel or reactor tank. A sliding guide bracket shall be an integral part of each mixer unit. The entire weight of each mixer unit shall be guided by a single bracket which must be able to handle all thrust created by the mixer. Each mixer, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 ft.

C. Mixer Construction

1. Each mixer shall be of the integral gear, close coupled, submersible type. All components of the mixer, including motor and gearbox shall be capable of continuous underwater operation while the mixer blade is completely submerged.
2. All surfaces coming into contact with the mixed media, other than stainless steel and fiberglass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with an epoxy finish coat on the exterior of the mixer.
3. Major mixer components shall be of 304 Stainless Steel construction. The oil housing cover plate shall be of corrosion resistant composite. All exposed fasteners shall be of stainless steel. In order to insure that the low velocity area around the motor remains impervious to low PH solids and or liquid attack, the motor housing exterior shall be made of 316 Stainless Steel.

D. Elastomers

1. All mating surfaces where watertight sealing is required shall be machined and fitted with a double set of Nitrile rubber or Viton O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces, resulting in controlled compression of the o-rings without requiring a specific torque limit. No secondary sealing compounds, rectangular gaskets, elliptical O- rings, grease, or other devices shall be used.

E. Cable Entry

1. The cable entry housing shall be an integral part of the back plate. The cable entry shall have a double set of elastomer grommets in order to ensure a redundant system in the event of a cable entry failure. Single sealing systems will not be deemed acceptable. The cable entry shall be comprised of two cylindrical elastomer grommets, each flanked by washers and a ferrule designed with close tolerance fit against the cable outside diameter and the entry inside diameter. This will provide a leak proof seal at the cable entrance without the need for specific torque requirements. The assembly shall bear against a shoulder in the stator casing opening and be compressed by a gland nut threaded into it. Interaction between the gland nut and the ferrule should move the grommet along the cable axially instead of with a rotary motion. The junction chamber and motor compartment shall be separated by a terminal board which shall protect the motor interior from foreign material gaining access into the mixer top. Connection shall be made between the threaded compressed type binder posts thus securely affixing the cable wires to the terminal board. The use of the

terminal compressed type post and a terminal board O-ring shall render the motor compartment leak proof from any liquid which may enter the terminal compartment.

2. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

F. Motor (Non-explosion proof)

1. The multi-pole motor shall be directly connected to the propeller (gearbox designs are not acceptable). The mixer motor shall be squirrel cage, induction, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The motor shall be designed for continuous duty, capable of no less than 30 evenly spaced starts per hours. The rotor bars and short circuit rings shall be made of aluminum. Thermal sensors shall be used to monitor stator temperatures. The stator shall be equipped with three (3) thermal switches embedded in the end coils of the stator winding and set for 284°F (140°C). These shall be used in conjunction with, and supplemental to, external motor overload protection, and wired to the control panel.

G. Propeller

1. The propeller shall be of 316 stainless steel, dynamically balanced, non-clogging backward curved design. Each blade shall be laser cut and welded to the hub to ensure that the propeller is properly balanced.
2. The propeller shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in normal sewage applications.

H. Bearings

1. All bearings shall have a minimum B-10 or L-10aa rated life of 100,000 hours and shall have inner and outer races of metal construction. Bearings with races made of nonmetallic construction will not be deemed acceptable or meeting the load handling and environmental requirements of this application. The outboard propeller bearing shall be an angular contact bearing. The motor shaft end shall be supported by two bearings. A roller and an angular contact ball bearing shall take up the axial and radial loads while an angular contact ball bearing shall take up the axial loads. The bearings shall be pre-loaded by a bearing loading nut located on the motor end of the shaft in order to reduce shaft deflection and increase bearing life and seal life. Mixers (and pumps) without pre-loaded bearings will not be considered acceptable or equal.

I. Mechanical Seals

1. The standard inner mechanical seal is corrosion resistant Tungsten Carbide/Aluminum Oxide. The outer seal faces are Tungsten Carbide/Tungsten Carbide. One face of the inner seal ring pair shall have spiral grooves laser etched in it, to provide a pumping action to move leakage from the stator housing back into the oil chamber. In order to avoid seal failure due to sticking, clogging, and misalignment from elements contained in the mixed media, only the seal faces of the outer seal assembly and its retaining clips shall be exposed to the mixed media.

All other components shall be contained in the oil housing. The mixer shall be equipped with a seal shield that prevents fibrous material from winding up around the shaft and outer seal. The shield shall be welded to the propeller hub and extend towards the motor. The shield shall rotate with the propeller and there shall be a radial micro-gap between the shield and oil-housing.

J. Oil Housing
1. The oil housing shall contain two compartments consisting of an inner and an outer section with four ports to connect and facilitate oil flow. In the event that the mixed media bypasses the other seal, this design will allow the outer compartment to collect the heavier (denser) fluids by means of a simple gravity process. Mixers which require propeller removal for oil change shall not be acceptable. Separate fill and drain plugs shall be provided to facilitate oil replacement.

K. Gear Unit (for gear driven units)
1. The gearbox shall be a two-stage, cylindrical, helical gearbox equipped with high precision, low loaded gears designed for infinite life. The motor shaft shall be provided with an integral driving gear. The gearbox intermediate shaft containing the first driven gear shall mate with the motor shaft driving gear. The intermediate shaft shall rotate in two spherical roller bearings and contain the second driving gear. The propeller shaft shall contain the second driven gear and rotate in one single row and one double row, angular contact set of ball bearings.

L. Mounting Mast Assembly
1. Mast shall be constructed of 316 stainless steel.
2. Mast shall enable the operator to position and lock the mounting mast and mixer at different operating angles along the horizontal and vertical planes respectively.
3. Mixer mounting system shall be designed to accommodate tanks with sloped walls and floors.
4. For deep tanks, mixer mounting masts will include the use of additional intermediate mast mounting brackets, preventing mast deflection.
5. For closed tanks, utilizing the adjustable 316 stainless steel cable, the mixer shall be supported at the desired operating level, allowing the davit's lifting cable to be slackened and removed from the winch. This feature shall enable the portable davit to be removed from its mounting socket and stored, while the davit's lifting cable may be secured below the roof of the tank. This in turn permits the tank roof doors to be closed during mixer operation.

M. Davit and Winch Assembly
1. A socket for mounting a portable davit crane shall be provided at each mast assembly station to raise and lower the mixer(s) [and pumps(s)] for installation and service. One (1) portable davit crane shall be provided, consisting of a lifting davit, winch, hook and 40 feet of 316 stainless steel lifting cable.

N. Performance Testing
1. Mixer performance testing included in Part 4 performance Testing section.

O. Acceptable Manufacturers
1. Xylem Inc. Flygt Products or approved equal.

2.11 Decant Mechanism

A. Scope of Work

1. The SBR supplier to furnish decanter assemblies with drive actuator for each SBR basin. The decanters shall be designed to remove clarified effluent.

Tank	SBR	
Decanter Quantity	2	
Decanters per Basin	1	
Decanter Weir Length	3	ft
Decanter Material of Construction	304L SS	
Actuator Quantity	2	
Actuator per Basin	1	
Actuator Power Supply	460/3/60	V/Φ/Hz
Actuator Power	1/4	hp

B. Design Parameters

1. The maximum ICEAS decanter loading at Normal Flow Mode condition shall not exceed 20 ft^3/ft/min. The maximum ICEAS decanter loading at High Flow Mode condition shall not exceed 325 ft^3/ft/min (2.8 m^3/m/min).
2. The decanter weir and trough shall always be visible from the basin side wall thereby providing the operator with a visual check of the effluent quality during the decant phase of the cycle.
3. The decanter shall be parked above the design top water level during aeration and settling phases, thereby eliminating any possibility of solids carryover during these phases. Decanters floating on the liquid surface during aeration and settling, with the weir of entry ports submerged below the surface shall not be allowed.
4. At top park position, the decanter shall provide 'fail safe' overflow protection in the event of a power failure. Settled supernatant will flow via gravity, under the scum guard, over the weir, and into the decanters.
5. The decanter shall be designed with a scum guard mechanism to prevent the discharge of scum and floatables during decanter or overflow operation.
6. All in-basin seals and bearings shall be maintenance free.
7. Decanter assembly components requiring routine maintenance shall be accessible from the walkway and shall not require confined space entry into the basin.
8. The drive mechanism or actuator shall be designed for a continuous duty, variable speed mode of operation thereby producing a uniform effluent flow rate throughout the decant phase.
9. Actuator limit switches and motor shall be integrated with process control system to prevent blower operation during the decant phase of the cycle.
10. The decanter assembly shall not require effluent valves, valve vaults, flex joints, throttling capabilities, or dewatering supports.

C. Equipment

1. The decanters shall be supplied with the following components:
   a. Upper collection trough with integral, overflow weir.
   b. Scum guard mechanism.

c. Downcomer pipes.
d. Collector pipe (for decanters >6ft).
e. Swivel Joint and Seals & bearings, as required.
f. Electro-mechanical actuator.

2. The drive mechanism or actuator shall consist of an electro-mechanical screw jack with protective boot and end position limit switches. The actuator shall be equipped with a VFD rated motor suitable for continuous duty in an outdoor, moist environment. The motor shall be driven by a variable frequency drive allowing the controls to vertically lower the decanter at a continuous and uniform rate.
3. The decanter shall not require spring loaded valves, flexible joints, and/or throttling effluent valves to control discharge rate.
4. The decanter must be self-supporting when the basin is drained.

D. Controls
1. Decanters shall be operated per the hydraulic controller described in the controls section.

E. Materials
1. All in-basin welded decanter components, except seals and bearings, shall be constructed of corrosion and ultra-violet resistant stainless steel. All fasteners shall be constructed of stainless steel.
2. The decanter seals and bearings shall be constructed of maintenance free, synthetic materials for longest possible service life. All seals and bearings shall be shipped factory assembled, simplifying installation.

F. Fabrication and Finishing
1. All decanter welding must be conducted by welders certified under ASME Code 9.
2. All joints to be finish tested for integrity by either air pressure (3.0 psi) or dye penetrate methods.
3. All finished decanter units to be fee of abrasions, damage, flaws, carbon contamination and discoloration. All weld burn and discoloration shall be removed with pickle paste. All stainless-steel surfaces shall be passivated and shall have a pleasing and uniform passivated appearance. Decanters shall be power washed for final cleaning prior to shipment.

G. Acceptable Manufacturers
1. Xylem Inc. Sanitaire Products or engineer approved equal.

2.12 Waste Sludge Pumps

A. Scope of Work
1. The SBR supplier to furnish submersible non-clog wastewater pump(s), in each SBR basin. Leak detectors shall be used to sense water presence in the oil and stator housings.

Pump Location/Duty	ICEAS / WAS	
Pump Quantity	2	
Pumps per Basin	1	
Pump Model	DP-3069/473	

Design Flow Rate	108	gpm
Design TDH	13.6	ft
Design Shut Off Head	19	ft
Submersible Cable Length	30	ft
Lifting Chain Length	25	ft
Motor Power Supply	460/3/60	V/Φ/Hz
Motor Power	2.4	hp

B. Equipment

1. Each pump shall be equipped with a submersible electric motor with submersible cable (SUBCAB) suitable for submersible pump application. The power cable shall be sized according to NEC and ICEA standards. The pump shall be supplied with a mating cast iron 3-inch discharge connection. Each pump shall be fitted with lifting chain or stainless-steel cable. The working load of the lifting system shall be 50% greater than the pump unit weight.

C. Pump Design

1. The pump(s) shall be automatically and firmly connected to the discharge connection, guide by no less than two guide bars extending from the top of the station to discharge connection.

D. Pump Construction

1. Major pump components shall be of grey cast iron, ASTM A-48, Class 30B, with smooth surfaces devoid of blow holes or other irregularities.
2. All O-rings shall be of Nitrile Rubber. The lifting handle shall be stainless steel. Cast iron impellers shall be sprayed with primer.

E. Bearings

1. The upper bearing shall be a single row ball bearing. The lower bearing shall be a two-row angular contact ball bearing. Motor bearings shall be permanently grease lubricated.

F. Mechanical Seal

1. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies.

G. Cable Entry Seal

1. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable.

H. Impeller

1. Impellers available for this pump model shall be either single-vaned, totally enclosed or multi-vaned, vortex type.

I. Wearing Rings
   1. A wear ring system shall be used to provide efficient sealing between the volute and suction inlet for totally enclosed impellers. Each pump shall be furnished with a leaded red brass ring insert that is drive fitted to the volute inlet.

J. Volute
   1. Pump volute (s) shall be single-piece grey cast iron, Class 30, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified.

K. Acceptable Manufacturers
   1. Xylem Inc. Flygt Products or engineer approved equal.

2.13 Process Performance Optimizer

A. Scope of Work
   1. The SBR supplier to furnish a complete control system. This shall include a master control panel with a Graphic Operator Interface, Programmable Logic Controller, Motor Starters, Variable Frequency Drives.
   2. Local control stations shall be included for the Decanters.
   3. Motor Starters and Variable Frequency Drives shall be included in a separate control panel.

B. Control Panel
   1. The control panel enclosure shall be a heavy duty, NEMA 4X, enclosure with a flange mounted disconnect if three-phase power is required. The panel shall be made of 10-gauge steel and fully braced. The doors shall be heavy duty 3-point latching doors with a lockable handle. The master circuit breaker disconnect shall be on the far right, and be interlocked with the doors.
   2. Control power shall be provided by a transformer if three-phase power is required. In addition, a voltage filter and surge protective device shall be used for PLC and HMI power supply. The voltage filter will combine active tracking technology with UL listed surge protection against the full spectrum of voltage transients and surges. It must continuously track the input AC line power and respond instantly upon detecting extraneous high frequency noise and high voltage transients. The device must be UL1449 and UL1283 listed.
   3. All control voltage branch feeders shall be protected by circuit breakers or fuses.
   4. Control relays shall be electromechanical with touch safe screw terminals.
   5. Motor starters shall be UL Listed as a self-protected control device type of combination starter [rated at 42,000 AIC].
   6. Terminal blocks shall be high-density type, rated for 600 VAC, 30 amp minimum. Ten percent spare terminals shall be provided. All devices shall be clearly marked and identified on the inside of the panel. All terminals and wires shall be clearly tagged in accordance with the schematic and wiring diagrams.

C. Programmable Logic Controller (PLC)
   1. The Programmable Logic Controller (PLC) shall have a built in Ethernet port for network communications.
   2. Acceptable Manufacturers: Rockwell Automation / Siemens or approved equal

3. Human Machine Interface (HMI)
4. A Graphic Operator Interface Terminal (HMI) shall be mounted on the front of the panel for control of the SBR as a means of controlling the system and shall provide graphic display of the process parameters and equipment status on a color display. The HMI shall also allow for entry of setpoint changes for system control. The display shall be 15.5" widescreen touchscreen, aspect ratio 16:9. The display shall be connected to a DIN rail mounted industrial computer.
5. Minimum HMI functions shall include:
    a. Graphical display of all status information available for each device in the biological treatment system in the form of a pop-up window for quick and easy access.
    b. Display all smart sensor status information available from the sensors.
    c. Electronic O&M Manuals for all hardware provided by the SBR manufacturer shall reside on the HMI and be quickly obtained by pushing a button.
    d. Alarm screen that allows the operator to select an alarm and push a button to display troubleshooting tips for that alarm.
    e. Easy navigation set up with control mode select buttons for each basin along the left and HMI screen navigation buttons along the top.
    f. Maintenance dashboard screen with quick read gauges of maintenance life span for all biological treatment devices requiring maintenance.
    g. Historical trend screen displays 10 days of key process variables, logged once per minute, including, where applicable, each basin's DO, Temp, DO Setpoint, Level, Clock, Waste pump running and air valve opened signals.
    h. HMI software shall provide a minimum of one (1) secure client, one (1) web client and one (1) SMA client license for operation staff use.

D. Remote Connection
1. A webport with a built in four-port Ethernet switch shall be provided to allow direct access for online technical support via a standard internet connection.
2. A customer account shall be set up by the supplier to allow operations staff access to view the plant HMI via the client licenses using a computer or other portable electronic device for the duration of the supplier's warranty period. Starting at the expiration of the warranty period an annual fee shall be assessed by the biological treatment supplier to maintain the customer account/access.

E. Control Logic
1. The SBR controls shall operate on a time cycle basis. The process elapsed time will be displayed on the display terminal. Each pair of SBR tanks will operate on a complimentary basis, so that while one tank is in aeration the other tank is in settling or decant phase. The cycle will automatically adjust for high flow conditions to increase the throughput capacity in high flow conditions. In automatic operation, the processor shall at all times maintain the proper sequence of operation even in the event of power failure. All phases of the process and equipment shall be interlocked so that the process cannot be upset. If an equipment failure takes place an alarm will be displayed on the operator terminal until cleared. The display will indicate the time of the alarm and status.
2. Time critical sequences and other process variables can be adjusted via the operator interface terminal as follows:

a. SBR Sequences shall consist of [1] Aeration blower run time, [2] The waste sludge pump start time and running time, [3] The decanter lowering rate, and [4] Special process variables such as DO or SIMS control setpoints if required.

b. Digester Sequences shall consist of [1] React (aeration and mix) run times, [2] Settling time, [3] The decanter lowering rate, [4] Special process variables such as DO, ORP, or DINO (Potassium control) setpoints if required.

3. UV Interface: Each ICEAS decanter will have a non-mercury float switch mounted from the end of the weir. The float switch will trip when the decanter weir comes in contact with the water. Through the SBR control system a PLC digital output contact shall close signaling the UV system that effluent flow is occurring. When the decanter weir is removed from the water and the float is no longer tripped the PLC output contact will open. The SBR operator interface shall have a selection on the set point screen which shall enable/disable the PLC output.

4. Chemical Feed (future use): The SBR control system shall provide a PLC output contact that shall be used to turn on a chemical feed system. From the SBR operator interface there shall be the following set point selections.

   a. Chemical Feed — Enable/Disable
   b. Chemical Feed Start Time — Minute (determined by basin clock)
   c. Chemical Feed Run Time — Minute, Seconds

   A PLC digital output contact that will close when the chemical feed is enabled and the start time set point equals the basin clock. The PLC output contact will remain closed until the run time is elapsed. This process will repeat itself every basin cycle.

5. The control system will include the following controllers, as well as instruments for monitoring process parameters, as detailed subsequently in this specification:

   a. Hydraulic Controller
   b. Decanter Controller
   c. Aeration Controller

F. Acceptable Manufacturers

1. Xylem Inc. Sanitaire Products or engineer approved equal.

G. Power Equipment

1. Panel Mounted Power Equipment

   a. Scope of Work: The aeration equipment supplier to furnish the following Motor Starters and/or Variable Frequency Drives (VFDs) for the motors associated with the mechanical equipment described below:

Equipment	Type	Count	Size HP	Power Supply V/Φ/Hz
ICEAS Blowers	ACQ580	1	Per blower HP	460/3/60
Digester Blowers	ACQ580	1	Per blower HP	460/3/60
Spare Blower	ACQ580	1	Per blower HP	460/3/60
Submersible Mixers	ACQ580	2	Per Mixer HP	460/3/60

Waste Sludge Pumps	Motor Starter	2	Per Pump HP	460/3/60
Decanters	ACQ580	2	Per Decanter hp	460/3/60

b. Equipment
   1) Motor starters shall be UL Listed as a self-protected control device type of combination starter [rated at 42,000 AIC].
   2) VFD package shall incorporate internal common mode cores. No additional external cores are required to keep common mode noise from disrupting sensitive electronics.
   3) VFD package shall incorporate an internal EMC filter to meet environmental standards without requiring additional panel space.
   4) Three control modes available for VFD: Vector Control with FORCE Technology, Sensorless Vector and V/Hz control.

c. Acceptable Manufacturers
   1) ABB ACQ 580 or engineer approved equal.

H. Instrumentation and Process Control

1. Scope of Work

a. The SBR supplier to furnish, configure and commission the instrumentation for the SBR system. In addition, the SBR supplier shall furnish the control algorithms and instrumentation detailed below to control the process:

	Location	No. per Zone	Total Count
Terminal/Controller	Transferable	-	1
DO	Aerated Zones	1	2

2. Terminal/Controller

a. The analyzer shall be a digital multi-channel, multi-parameter system capable of controlling up to 20 sensors, in any combination, for the determination of water and wastewater parameters.
   1) The controller must be configurable to include the following measurements: COD, TOC, DOC, SAC, BOD, pH, ORP, NH4-N, NO3-N, PO4-P, Conductivity, DO, Turbidity, TSS, Temperature and Sludge Level Monitor.
   2) The controller shall receive 4 to 20 mA signals from third party instruments.
   3) Communication between controller and sensor shall be digital, allowing cable runs up to 3,000 feet without further amplification.
   4) The system will provide up to 20 programmable analog outputs (max. load 500 ohms) and 20 programmable alarm relays (rated to 5A at 250VAC). System shall also be capable of Ethernet/IP or Profinet communication.
   5) 90VAC-264VAC power required.
   6) Enclosure is NEMA-4X rated.

7) Entire system including the sensors shall have built in lightning and surge protection.
8) Ambient operating temperature –20°C to +55°C.
9) System diagnostics shall be standard.
10) System shall also have a USB interface port, data storage capability, and 3 levels of security.
11) System must have integrated lightening and overvoltage protection.
12) Backup controller function to increase reliability.

b. The terminal controller shall be YSI/WTW model 2020 IQ Sensor Net.
c. All instruments associated with the biological system must be connected to the terminal/controller communication network back to the Control Panel.
d. Universal Mounting Kits with all necessary hardware shall be provided for each sensor.
e. A sunshield and mounting bracket shall be provided for the system display/controller and each local component to be mounted outside.

3. ICEAS Hydraulic Controller
a. Description of Controller:
1) The hydraulic controller is used to adjust the cycle time to accommodate increased flow events while maintaining treatment objectives.
2) The hydraulic controller shall automatically switch back into a normal mode of operation once the hydraulic threshold has been maintained and an additional cycle has been completed.
3) The hydraulic controller shall interface with the aeration controller to increase the settling time to minimum of 30 minutes during the high flow conditions.
4) Include an integral safety feature interlocking the aeration and mixer controllers to prevent solids carryover in the decanter.
5) Reduce energy and optimize process stability by maintaining the desired dissolved oxygen setpoint during aerobic phases of the react phase.
6) The intent of the multiple modes of operation is to protect the process operation when instrumentation has faulted or is in need of maintenance.

b. Performance Metrics:
1) Submit test data from a minimum of six (6) full-scale plants that demonstrates that the proposed hydraulic controller properly transitions to a high-flow cycle when operated continuously at the design peak flow rate, while meeting peak instantaneous NPDES permit levels for grab and composite samples, without water overflowing the basin walls.
2) For each set of test data submitted, the test shall start at minute 0 of the cycle in the normal cycle, at which time the influent flow rate shall be increased to the peak design flow rate and maintained at that level until the end of the cycle.
3) For each set of test data submitted, the control system must properly transition to the high-flow cycle, which shall be 75% of

the normal cycle periods or less, without water overflowing into the decanter before the start of the decant cycle and without the decanter being submerged at any time.

4) For each set of test data submitted, measurements of the basin water level during the test, as well as calculations of the hydraulic retention time (HRT) and weir loading rate (CFM/ft) shall be provided.

c. Instrument Specification

1) Each basin shall be equipped with a level transducer. The level transducer shall have a stainless-steel body with a head-pressure-sensing bottom Teflon faced diaphragm and an internal precision, gage pressure transducer assembly. The transducer shall be cable mounted and factory calibrated for the basin depth. The transducer shall be a 2-wire type and produce a 4-20ma signal in direct proportion to the measured level.

2) The level transducer shall be a Xylem Inc, Flygt Products LTU-40 or approved equal.

3) Each basin shall be equipped with a high-level non-mercury float switch.

4) The float shall be a Xylem Inc, Flygt Products Model ENM-10 or approved equal.

5) Level signals and level indication shall be used to control the high flow cycle time and to reduce the aeration time in case of extreme high flows.

4. Decanter Controller

a. Controller Description

1) Decanters shall be used to remove effluent from the SBR basins during the decant phase of the system cycle.

2) The decanter controller uses an algorithm to descend the decanter weir throughout the cycle at a constant vertical rate ensuring a constant discharge flow rate.

3) The decanter controller ensures proper synchronization between process decant time and weir position prior to the next phase starting to prevent solids contamination in the decanter effluent.

4) When not at design flow the decanter idle time is at the beginning of the decant cycle to maximize settling time.

5) Decanter speed will be controlled by a Variable Frequency Drive (VFD) which controls the speed of the decanter actuator motor.

b. Performance Metrics

1) Shall ensure the decanter is above the water level prior to aeration of the tank such that solids cannot carryover the decanter 100% of the time during the transition from decant to aeration phase of the cycle.

c. System Components

1) Decanter mechanism – as described in mechanical section of this specification.

2) Linear actuator – as described in mechanical section of this specification.

3) VFD

a) The VFD shall be microprocessor based, all-digital, compact style, low-noise PWM type. It shall allow programming of the torque curve, speed and voltage, over current and overload protection. It shall have protective warning and diagnosis functions. The unit shall have programmed automatic fault restarts and low power ride through. The control unit display shall be mounted in an easily accessible location. The unit shall have a NEMA 1 rating suitable for mounting in a panel, on a wall, or in an MCC. The VFD will be setup, programmed, and post commissioned supported by Sanitaire personnel. The speed is determined by the PLC in order to maintain a uniform vertical lowering of the decanter weir. The maximum decanter travel is controlled by magnetic limit switches mounted on the decanter actuator. In addition, there shall be a decanter local control station for each basin consisting of a 4-position switch enclosed in a NEMA 4X enclosure. The local station allows manual raise and lower control as well as off and automatic control. The VFD must be properly wired and programmed so that manual raise and lower control does not require any input from the PLC.

5. ICEAS Aeration Controller

a. Description of the Controller

1) The aeration controller is used to reduce energy and optimize process stability by maintaining the desired dissolved oxygen setpoint during aerobic phases of the react phase.

2) The aeration controller algorithm shall switch between modes of operation and make process control adjustments and decisions based on diagnostic information that tests the integrity of the data and utilizes fault indications from the sensors.

3) The intent of the multiple modes of operation is to protect the process operation when instrumentation has faulted or is in need of maintenance.

b. Instrumentation Specifications

1) Dissolved Oxygen Probes – Each ICEAS reactor shall be equipped with a dissolved oxygen probe.

2) Communication to controller shall be digital.

3) Connection to IQ Sensor Net shall be through two wire shielded cable.

4) The sensor shall be calibration free using intelligent membrane technology.

5) Membranes shall last up to two years with replacement membranes containing calibration data chip.

6) Sensor shall use soft green fluorescent light with calibrated optics and equal path reference system.

7) Sensor shall have a measuring range of 0-20.00 mg/l.

8) Sensor shall integrated temperature measurement and compensation.
9) Temperature operating range of -5° C to + 50° C and measuring range of -5° C to + 50° C.
10) System accuracy shall be ± 0.05 mg/l < 1.00 mg/l, ± 0.1 mg/l > 1.00 mg/l.
11) Sensor shall include self-diagnostics.
12) The DO sensor shall be a YSI/WTW model FDO 700 IQ.

PART THREE – INSTALLATION AND PERFORMANCE

3.01 Certified Oxygen Transfer Performance Curve(s)

A. Submit certified oxygen transfer performance curves to demonstrate capability of the aeration equipment to meet the specified oxygen transfer requirements.

B. Base oxygen transfer curves on the following criteria:
1. A minimum of 3 tests for each specified condition in complete accordance with ASCE Clean Water Test Procedure (2006 or latest edition).
2. Tests conducted in a full-scale aeration test tank (minimum of 200 sq. ft.) at the specified submergence and water depth with a diffuser density equivalent to the specified tank configuration. Diffuser density is defined as the ratio of the total tank surface area to the total active diffuser surface area.
3. Tests conducted with air rate and mass rate of oxygen transfer directly proportional to the ratio of the shop test tank volume and the design tank volume.
4. Plot of standard condition pounds of oxygen transferred per day per 1000 cubic feet of tank volume versus standard condition cubic feet of air per minute per 1000 cubic feet of tank volume (lbs-0_2/day/1000 cubic feet-tank) vs. (SCFM/1000 cubic feet-tank).
   a. Standard conditions of oxygen transfer are defined as 68 °F, 1 atmosphere ambient pressure, clean water.
   b. Standard air is defined as 68 °F, 1 atmosphere, 36% R.H., containing 23% oxygen by weight.
5. Certify and stamp all curves by a Professional Engineer.
6. Submit curves for all specified conditions for approval by the Engineer prior to manufacturing aeration equipment**.**

3.02 Operation and Maintenance Manual

A. Electronic copies of the Operation & Maintenance Manuals shall be furnished during start-up. These manuals shall include maintenance instructions for all equipment provided.

B. Operation & Maintenance Manual shall include a Functional Design Specification (description of control software logic) and Operational Description (description of process).

3.03 Field Services, Start-Up and Training

A. The services of the field representative shall include minimum ten (10) days, exclusive of travel time, and two (2) travel trips. The Owner shall notify the manufacturer a minimum of ten working days prior to the time that the field services are desired.

B. The Owner shall notify Sanitaire when the installation of the SBR equipment has been completed. A representative of the supplier shall inspect the installation. The Owner shall be advised in writing of any corrections or adjustments that are required for the SBR equipment installation. After the SBR installation has been completed to the supplier's satisfaction, a letter of certification that all equipment is installed in accordance with its instructions and that the SBR equipment is ready for operation shall be furnished.

C. A process engineer shall complete operator process training onsite, including review of the controls description, a discussion of the process control features, and recommendations for process setpoints.

End of Section

ULTRAVIOLET DISINFECTION EQUIPMENT
46 66 53

PART ONE - GENERAL

1.01 Description

A. Furnish, install, test and put into operation a horizontal stainless steel channel liner, open channel, UV disinfection system. The system shall be provided with a stainless steel liner with a built in level control weir with drain. The system shall be a gravity flow, low-pressure – high output UV lamp based system as shown on the Drawings and as specified herein.

B. The equipment supplier shall furnish all components of the system as specified herein, including:

1. One (1) stainless steel channel liner with built in level control
2. Two (2) bank of UV modules.
3. One (1) remote NEMA 4x Stainless Steel Ballast Control Center (BCC)
4. One (1) Set of spares

C. The contractor shall furnish all labor, materials, equipment and appurtenances required to install, test and place into satisfactory operation the system furnished by the equipment supplier including, but not limited to:

1. Mechanical installation of system components, anchor bolts, air piping, air piping supports, fittings, valves and appurtenances.
2. Electrical installation of system components, motor control centers, motor starters, MCC breakers, transformers (unless specified), raceways, fittings, conduits and cable trays, wires and cables (unless specified), panel boards, grounding systems, power factor correction capacitors, surge protection.

1.02 Quality Assurance

A. All system components shall be supplied to the contractor by a single equipment supplier.

B. The equipment supplier shall have at least five (5) years' experience in furnishing UV systems of similar design to the equipment specified herein. As part of their submittal package, the equipment supplier shall submit following documentation:

1. Evidence that UV systems of similar design have been in successful operation for at least ten (10) years in at least twenty-five (25) separate installations. Provide location of installation, contact person name and phone number, capacity of generation system and year installed.

C. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. American Society for Testing Materials (ASTM)

2. National Electric Code (NEC)
3. National Electrical Manufacturer's Association (NEMA)
4. Occupational Safety and Health Association (OSHA)
5. "Municipal Wastewater Disinfection" US EPA Design Manual, EPA/625/1-86/021
6. American Welders Society (AWS)
7. Underwriter's Laboratories (UL)

D. Manufacturer's Representative

1. The services of a full-time employee of the manufacturer's representative / equipment supplier shall be provided on the project site as the representative. The representative shall have complete knowledge of the system including proper installation, operation and maintenance.
2. The equipment supplier's representative shall inspect the installation and supervise any required modifications, additions, or other changes required to allow the equipment supplier to certify that the complete installation is appropriate and is expected to operate as expected.
3. The equipment supplier's representative shall instruct the owner and engineer's personnel on the operation and maintenance of the system. The instruction shall include classroom training on UV Technology and the specific installation, and field training on proper operation and maintenance procedures, along with complete demonstration of the same.
4. The equipment supplier's representative shall provide minimum services. Startup and functional training, (1) day, operator training (1/2) day.
5. The number of days indicated above shall be provided on an 8-hour day on-site basis.

1.03 Submittals

A. The Equipment Supplier shall submit, in accordance with 01 33 00, complete shop drawings to establish compliance with this section. Submittals shall include the following and all other information requested in other paragraphs of this specification section for approval:

1. Manufacturers Data - The following information shall be submitted to the engineer as required by this specification:
    a. Bioassay report.
    b. Complete description of equipment being proposed in sufficient detail to permit a thorough comparison with this specification
    c. UV system equipment layout including channel dimensions and installation requirements
    d. Electrical schematics and enclosure dimensions
    e. Documentation on cleaning and maintenance requirements of the equipment
    f. Manufacture's literature including cut sheets on all components and accessories.
2. Nominal average intensity within bank.
3. Maximum headloss through each bank at peak flow conditions.

B. Design Data

1. Supporting documentation from manufacturers' bioassay demonstrating that the dose required in the performance section is being met or exceeded. Only bioassay results using MS2 phage or similar bacteria shall be acceptable as a means of determining dosage and validating the calculations.

C. The equipment supplier shall submit three (3) copies of complete Instructions Manuals with detailed operation and maintenance data for each component of the system. The instructions manual shall include:

1. Safety Precautions
2. Protective Equipment and Clothing
3. Technical Data, including detailed descriptions of SYSTEM operation, and each component.
4. Installation data, procedures and recommendations
5. Operation instructions, including startup and shutdown procedures and sequence.
6. Service and Maintenance data, include all information and instructions required by plant personnel to keep equipment properly cleaned, lubricated and adjusted so that it functions economically throughout its full design lift
7. Illustrations
8. Project Parts List
9. Name, address and phone number of manufacturer and manufacturer's local service representative.

1.04 Spare Parts and Special Tools

A. Included in the proposal, the equipment supplier shall furnish spare parts required to ensure adequate operation of the system. Spare parts shall include as a minimum:

1. Two (2) spare lamps
2. Two (2) quartz sleeves
3. Eight (8) orings
4. Eight (8) wiper rings

B. One (1) Operators Kit including one (1) UV face shield, one (1) set of gloves and one (1) Lime-A-Way cleaning solution

C. The equipment supplier shall furnish all special tools required for the proper installation, operation and maintenance of any component of the system.

D. Spare parts shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the contractor at the completion of the contract.

1.05 Description of System

A. The equipment specified herein shall be low pressure UV light disinfection equipment designed to reduce the fecal coliform microorganisms of a domestic, wastewater with UV influent characteristics as specified in Paragraph 1.05C so that the final effluent shall meet

the final effluent discharge conditions as specified in Paragraph 1.05E. The UV system shall be hydraulically rated for 775,000 GPD peak flow and shall provide a minimum dose of 30,000 uWs/cm^2 at this peak rate.

B. The lamp array configuration shall be horizontal, with all lamps parallel to each other and parallel to the flow. The lamps shall be spaced with 3" centerline spacing that will ensure effective disinfection while maintaining practical system headloss.

C. Influent Characteristics to Disinfection

1. The UV disinfection system shall be designed to disinfect at the flow rates and with the characteristics shown below:

   a. Peak Flow: 775,000 GPD
   b. Minimum Flow (MGD) 0
   c. Total Suspended Solids (mg/L) <30
   d. BOD (mg/L) <30
   e. UV Transmittance @ 253.7-nm 65%
   f. Wastewater Temperature (°F) 45-80
   g. E-Coli Concentration (MPN/100 mL) <126MPN/100mL

D. UV Channel Configuration

1. Stainless steel channel liner with built in level control.
2. Hand UV bulb cleaning, no automatic wiper cleaning required.
3. The minimum design requirements of the UV system supplied shall be as follows:
   a. Number of UV Channel Liners: 1
   b. Number of UV Banks per Channel: 2 (duplicity is required)
   c. Number of UV Lamp Modules per Bank: *
   d. Number of Lamps in Each UV Lamp Module: *
   e. Number of Lamps in bank: *
   f. Total lamps in system: *
   g. Water level : *
   h. Number of UV Intensity Sensors per bank: 1
   i. *Number of UV lamp modules per bank, number of lamps in each module, number of lamps and final water level shall be determined by UV manufacturer to meet compliance limits based on 1.05C above.

E. Bacteriological Inactivation Requirements

1. E Coli Testing Criteria
   a. 30 Day Geometric Mean of Daily Samples <126 MPN/100 mL

F. System Performance

1. The end of lamp life UV dose produced by the system shall not be less than 30,000 uWs/cm^2 in an effluent with 65% UV transmittance @ 253.7-nm. Lamp output must be at least 80% of initial level after 12,000 hrs of operation and with no fouling on the quartz sleeves.

2. The system design shall be based on bioassay calculations with the following criteria:
    a. UV transmission (T10) 65%
    b. UV Lamp End of Life Factor 90%
    c. Quartz Sleeve Fouling Factor 0.90 (based on clean sleeves)

PART TWO - PRODUCTS

2.01 Manufacturer

A. Acceptable manufacturers for the UV Disinfection equipment include:
    a. Glasco UV
    b. Calgon Carbon UV
    c. Trojan Technologies
    d. Or approved equal

2.02 Materials and Equipment

A. General

1. The UV system shall be installed in pre-fabricated stainless steel channel liner with built in weir. UV manufacturer shall provide the UV modules, ballast control center and UV intensity monitoring system.
2. All metal components exposed to or in contact with plant effluent, including all anchoring hardware, shall be Type 304L or 316L SS. All materials exposed to UV light shall be unaffected by prolonged exposed to same and shall be Type 304L or 316L SS, Type 214 quartz, Viton, EPDM or Teflon.
3. All metal components not in contact with plant effluent and/or UV light shall be Type 304L SS.

2.03 UV Disinfection Channel

A. Stainless steel liner channel system shall be provided by the UV manufacturer. This shall be embedded into concrete by others.

2.04 Ultraviolet Lamps

A. The UV lamps shall be low-pressure UV lamps.

B. UV Lamps shall have the following characteristics:

1. Lamp shall be low pressure high output type (non amalgam) .
2. Lamps shall be low pressure high output style mercury slim line type of the pre-heat design with a 4-pin connection at one end.
3. Lamps shall be equal to or exceed the performance of type GHO64T5L.

C. Lamps shall have electrical connections at one end with four pins per connection and shall be dielectrically tested for 2,500 volts. Lamp bases shall be of ceramic construction resistant to UV and ozone. Lamp socket should also be of ceramic construction resistant to

UV and ozone and should be of a multi-level (step) design to prevent arcing. Lamp tubes shall be of a material capable of transmitting 94 percent of the radiation produced therein.

D. Changing lamps will not require removal of the quartz sleeves from the UV lamp module. Lamps shall be capable of being replaced by plant operating personnel.

E. The UV system manufacturer shall guarantee operating life of lamps for a period of 12,000 hours.

F. Lamps shall be non-ozone producing type.

2.05 Quartz Sleeves

A. Lamp sleeves shall be type GE TYPE 214 clear fused quartz circular tubing. Sleeves shall be rated for transmission of 94% or more and sleeves shall not be subject to solarization over the length of their life. The nominal wall thickness shall be between 1.0 and 2.0 mm.

B. One end of each sleeve shall be closed and the other end sealed by a lamp end seal and compressed O-ring. The closed end of the quartz sleeve shall not come in contact with any metal in the frame.

2.06 UV Lamp Module

A. The UV module shall be fitted in a horizontal position within the stainless effluent flow channel. The UV lamps shall be symmetrically centered on 3" centerline spacing to maximize the dosage of UV radiation seen by the wastewater effluent.

B. Each UV module shall consist lamps with each lamp placed in their individual quartz sleeve. In the event that a quartz sleeve breaks no other lamps shall be exposed to the effluent.

C. Each module shall be constructed from Type 304L or 316L stainless steel.

D. Modules shall be constructed in a manner not to allow UV light to radiate above the channel when the lamp modules are energized and fully immersed in the effluent.

E. The modules shall be directly wired to the Ballast Control Center (BCC) in a UL watertight flexible conduit.

F. The modules shall be able to be removed by lifting out of channel by hand.

G. The open end of the lamp sleeve shall be sealed by means of a UV resistant polymer, which shall thread onto a sleeve cup and shall compress the external O-ring sleeve seal.

H. The sleeve nut shall not require special tools for removal.

2.07 UV Intensity Sensor

A. Each bank shall have one (1) UV intensity sensor.

B. The sensor shall be cleaned as part of the automatic quartz cleaning process.

C. The sensor shall be solar blind and shall measure only the germicidal spectrum wavelength (254 nm).

D. The UV intensity shall be displayed in the UV module window kit through a digital meter with a 0 to 100% output reading.

2.08 Electrical

A. The system shall be provided with a remote wall mounted modified NEMA 4x fan cooled stainless steel Ballast Control Center (BCC). This enclosure shall be twelve (12) feet away from the disinfection channel and shall be installed by the contractor. The purpose of this enclosure is to provide power to the UV lamps.

B. BCC shall be protected from the environment with a shield to provide for optimum performance. The structure/shield shall be designed to provide protection from heat load.

C. The BCC shall be supplied with an external H-O-A switch mounted on the enclosure. Electrician is responsible for punching and wiring to Ballast Control Center (BCC). Since the treatment system is a intermittent discharge system, controls shall be able to receive communication to turn on/off from the Sanitare Process control panel. See specification section 46 53 53 Continuous Flow Batch Reactor System for more details.

D. Ballast Control Center

1. The plant electrician or contractor shall bring protected power to the BCC, providing necessary conduit and field terminations.
2. BCC shall require the following:
    a. 120 volt 50/60 Hz
    b. 2.7 max kW/hr
3. Displays
    a. Lamp Status. The status of each lamp (on/off) shall be displayed via a dedicated LED. An energized LED will indicate proper functioning of the UV lamp. The LED shall indicate lamp off status when extinguished.
    b. Run Time. A non-resettable five (5) digit time meter shall be integrated to track lifetime hours.
4. Wiring
    a. All wiring, which may be exposed to ultraviolet light, shall be Teflon coated or sheathed and shall be rated for 600 volts service. All other wiring and electrical connections shall be protected against moisture to prevent electrical shorts or failure. All connections must be landed on a terminal; "butt" connections are not allowed anywhere in the system.
5. Ballasts
    a. Electronic ballast shall be provided to control, operate and display information for the low pressure lamps. Ballasts shall be wired in a manner, which allows them to be readily removed from the electrical enclosure. Ballast shall be on removable trays.
6. Module Interconnect Cables
    a. Multiconductor cable shall be suitable for outdoor installation.

b. Insulation shall be thermoplastic rubber with operating range of minus 60 to 125 degrees C minus 76 to 52 degrees F with low temperature flexibility and flame retardants.
c. The UV stabilized jacketing shall be resistant to oils, chemicals, fuels, solvents, and to mechanical abuse and abrasion.
d. Cable shall be supplied by the equipment manufacturer and shall be of sufficient length and number for a complete system.
e. Cable shall be of a modular repairable type and shall allow for field replacement and repair of its components by plant operators.

PART THREE - EXECUTION

3.01 Shipping and Equipment Delivery

A. All equipment and materials shall be inspected against approved Shop Drawings at time of delivery. Equipment and materials damaged or not meeting requirements of the approved Shop Drawings shall be immediately returned to the equipment supplier for replacement or repair.

B. The Contractor shall handle and store the equipment and materials in a dry location and protect them from the elements according to the manufacturer's instructions.

3.02 Commissioning and Start-Up

A. The equipment supplier / manufacturer's representative shall inspect equipment installation, piping and wiring to ensure proper installation of each component in accordance with approved submittals. Contractor shall make at its own cost any modifications required to meet equipment supplier installation recommendations. A written statement certifying that the equipment has been properly installed and interconnected shall be provided by the equipment supplier.

B. The equipment supplier shall coordinate commissioning of the system and verify that each component of the system is ready for operation. System commissioning shall include testing and calibration of each component of the system. A written statement certifying that the system has been commissioned and is ready for operation shall be provided.

C. The equipment supplier shall coordinate initial system start-up to ensure operating procedures are followed in accordance with approved submittal's instructions manuals. This shall be for ½ day and combined with the ½ day training.

3.03 Training

A. The equipment supplier/ manufacturer's representative shall provide operator training at the site for a period no less than ½ - 8-hr day. Training shall include operation, maintenance and troubleshooting for each component of the system.

3.04 Warranty

A. The system shall be free from defects in materials and workmanship for a period of 12 months from Final Acceptance of the system, or 18 months from shipment, whichever occurs first.

B. Lamps shall be warranted for a period of 12,000 hours operating time under normal operating conditions.

End of section.