*[Note from Ixom Watercare, Inc. to Specifying Authority: The Ixom Watercare, Inc. design for your project is based on high quality equipment that has a high flow rate and operates 24 hrs/day X 365 days/yr. If low flow or intermittent flow equipment is purchased to save money, in most cases a total project failure is glaringly evident to the customer and engineer within 30-60 days of placement. We encourage you to visit our manufacturing facility to learn more about our equipment if desired, contact some of our many references, review our peer-reviewed papers or case studies, and/or call us with questions.]*

#### PART 1 GENERAL

1.01 EQUIPMENT OVERVIEW

 A. These specifications provide the requirements to furnish, deliver and place into operation reservoir circulation equipment at XXXXXXXXXXXXXX.

1.02 REFERENCES

 A. Occupational Safety and Health Administration, OSHA

 B. Department of Transportation, DOT

 C. Underwriters Laboratories Inc., UL 1989

 D. Hunt Water Adsorption Test

 E. United States Food and Drug Administration, FDA title 21

##### 1.03 QUALITY ASSURANCE

1. Continuous Operation Equipment. The circulation equipment shall operate continuously, all day and all night, 365 days per year. This equipment warranty would run directly from the manufacturer of the equipment to the owner.  The equipment warranty would not be part of the contract or any required bond.
2. No Visual Defects. The circulation equipment shall have no visual defects, and shall have high quality welds and assembly, corrosion resistant finish, and site specific operational controls.

C. Qualified US Manufacturer. The manufacturer of the equipment shall have extensive experience in the production of such equipment, and the equipment shall be manufactured in the continental United States.

D. Factory Startup Services. Delivery, placement and startup services shall be included in the bid, and performed by full time factory employees experienced in the operation of this equipment and who have completed OSHA safety trainings applicable to this type of work.

E. Warranty. The circulation equipment shall be warranted to be free of defects in materials and workmanship for a period of 2 years from the date of original placement. A copy of the warranty shall be included with the submittal. This equipment warranty would run directly from the manufacturer of the equipment to the owner.  The equipment warranty would not be part of the contract or any required bond.

1.04 SUBMITTALS

 A. The awarded Bidder shall provide [5] copies of the following documents. Upon acceptance of these documents by the Engineer, the Bidder will be issued a Notice to Proceed, and may then proceed to furnish the equipment.

1. At least two independent flow studies of the Ixom Watercare, Inc. solar powered SB Series or electric powered GF Series floating mixers to be provided, with said studies conducted in working reservoirs over 3 million gallons in volume, and based on 24 hours per day operation, and using rhodamine dye or another tracer to verify the flow rate and flow pattern of the proposed equipment.

2. A statement of the quantity, model number, and flow rate of the machines that would be provided for each Cell to comply with the required flow rates shown in Section 2.02 below.

 3. A copy of the circulation equipment warranty in compliance with Section 1.03.

4. Shop drawings and specifications for the circulation equipment to be provided, in compliance with Section 2.02.

5. Manufacturer’s literature, illustrations and specification sheets.

B. Additionally, at no charge to the owner, the manufacturer is to perform water testing during, and provide, following equipment placement, additional Submittals that shall include:

1. A complete operation and maintenance manual.

2. Within 30 days of equipment placement, the manufacturers report including:

 a. Aerial photograph with labeling of pond, cell or reservoir data.

 b. Work summary.

 c. Customer contact information.

 d. Climate / weather conditions.

 e. Circulation machine information.

 f. Technician field notes.

 g. GPS location of each circulation machine and test point.

 h. Secchi depth at a minimum of two 2 locations per pond, cell or reservoir.

 i. Free water, slurry and sludge / sediment depths at a minimum of 2 locations per pond, cell or reservoir.

##### 1.05 FIELD SERVICES

A. Factory Personnel. The placement and startup shall be performed by full time factory employees trained in the operation of the circulation equipment.

B. Safety. Technicians shall have received job-specific safety training on (a) Working over Water, (b) Boating Safety, (c) Disinfecting Procedures, (d) Confined Space Entry, (e) Fall Protection, and (f) DOT Compliance.PART 2 PRODUCT SPECIFICATIONS

2.01 MANUFACTURER

 A. Specified Equipment. The circulation equipment shall be manufactured by Ixom Watercare, Inc. of Dickinson, ND, or be a pre-approved alternative.

 B. Pre-approved Alternative(s). Alternatives to the specified equipment will be considered on the following basis only.

 1. Ten (10) Days Before Bid. To offer equipment as a pre-approved alternative, written application from the alternative supplier shall be made to the Engineer at least 10 days in advance of the bid opening.

 2. No Material Difference in Quality of Equipment or in Vendor Support. The application should include:

 a. A brief description of how the offered alternative does or does not meet each of the specifications in this document.

 b. An analysis of how acceptance of the alternative equipment would likely affect the overall water quality goals of the project.

 c. A statement of the science and support background of the supplier of the alternative equipment, so that the benefits and costs of the alternative equipment to the Owner can be estimated by the Engineer.

 3. Five (5) Days Notice to Bidders. If the alternative equipment is accepted by the Engineer, an informational addendum to these specifications shall be distributed by the Engineer to plan holders at least 5 days in advance of the bid opening.

2.02 PERFORMANCE AND FEATURES

 A. Flow Rate Required For Each Body of Water. To meet the project flow rate requirements, the following total flow rate shall be provided for each body of water, 24 hours per day X 365 days/year, involved in this project. "Total flow rate" is defined to be the total flow, in gallons per minute (gpm), through the impeller(s) of the machines in that cell. The total flow rate may be achieved with a fewer number of high gpm machines, or else a larger number of low gpm machine, at the bidders option, as long as the total gpm shown below is met for each reservoir or cell on a continuous basis for 24 hours per day.

|  |  |
| --- | --- |
| Cell # | Total flow rate through the impeller(s), gallons per minute (gpm) |
| Reservoir or cell #1111111 |  |
| Reservoir or cell #2222222 |  |
| Reservoir or cell #3333333 |  |
| Reservoir or cell #4444444 |  |
| Reservoir or cell #5555555 |  |
| Reservoir or cell #6666666 |  |

 B. Stainless Steel Construction. The circulation equipment shall be constructed primarily of Type 316 stainless steel metal for corrosion resistance.

 C. Motor. The circulation equipment shall be mechanically operated by a motor that meets the following criteria.

1. Brushless, and using hall effect commutation, to avoid brush replacement.

2. Direct Drive, with no gearbox, to avoid lubrication maintenance.

3. Stainless Steel Bearings, requiring no scheduled lubrication, rated bearing life expectancy greater than 100,000 hours continuous operation.

4. Designed for marine, outdoor environment by having a sealed housing with polymeric encapsulated internal windings for superior corrosion resistance. Capable of withstanding the following environment conditions:

 a. -40oF to 140oF (-40oC to 60oC) ambient temperature range, freeze resistant

 b. 100% humidity

 c. Condensation resistant

 d. Splash resistant

5. Designed for Continuous Operation without overheating or compromising motor life expectancy.

6. Less Than 48 volts DC power requirement, to avoid risk of electrocution.

 D. Controller. The circulation equipment shall be supplied with a motor controller and power management with the following features.

 1. Digital Electronic Control System, with firmware and software that is easily re-programmable to optimize the level of water quality achieved in the reservoir.

 2. Anti-Jam Reverse, automated self-clearing for locked rotor triggered by high current occurrences caused from jammed impeller.

 3. Operation Schedule, with daily and seasonal scheduling for motor speed and direction.

 4. Scheduled Reverse Cycles, with daily reverse impeller cycling for self-clearing of impeller to minimize fouling.

 5. Motor Health Status Monitoring and Recording, including scheduled speed, commanded speed, actual speed, motor current, motor voltage, and motor controller errors.

 6. Fully Potted And Encapsulated Motor Control Circuit, for superior corrosion resistance in marine environment.

 7. SD (Secured Digital) Card Reprogrammable features, so digital controller is capable of being field programmable using an SD card for uploading new firmware and changing programmed operations.

 8. Manual On/Off Switch, to shut power off to the motor. On/Off switch shall be rated for marine environment and have yellow and red color markings for indicating emergency shut off.

 9. Fused Main Power Line, for added protection against power surge through motor controller and motor.

 10. Temperature Compensated Charging, so that battery charging parameters are automatically adjusted based on battery temperature.

 11. Maximum Power Point Tracking (MPPT), so the charging algorithm is automatically adjusted for optimum results based on solar power input and battery capacity.

 12. Power Conservation & Continued Operation Mode, a programmed algorithm for reducing motor load and continuing operation by incremental speed reduction. This feature to be automatically enabled when extended low sunlight conditions occur or battery reserve power is reduced.

 13. Low Voltage Shut Off, a programmed shut off switch to disconnect motor load before reaching damaging depth of battery discharge. The motor load automatically re-connects when battery capacity is restored.

 14. NEMA 4 Enclosure, for protection against condensation and moisture in a marine environment. The internal circuit boards shall be conformal coated for added protection against moisture.

 • See end of specifications for 120VAC supplemental power options and insert here if required.

 E Battery. The battery power storage shall meet the following criteria.

 1. Single Battery, multiple batteries are not allowed unless connected in series, to avoid charging problems leading to failed batteries.

 2. Battery Capacity Rating, at a 24 hour discharge rate, in watt hours, shall be at least 50 times the motor load in watts during normal operation (full speed, peak load).

 3. Battery shall be Submerged, to avoid extremes in temperature and extend battery life.

 4. Battery shall comply with DOT HMR49, non-spillable battery, for transport.

 5. Battery shall be UL Listed, compliant to UL 1989.

 6. Battery shall have a pressure relief Safety Valves for each cell that incorporates a flame-arrester for safety, and rated as Explosion Resistant.

 7. Battery shall be Maintenance Free and not require re-watering.

 8. Battery shall contain power conductors constructed of multi strand power wire having a flexible outer jacket, all contained inside stainless steel sheathing for protection from the elements and from rodents.

 9. Battery shall be Freeze Tolerant for frigid conditions.

 10. Battery shall have a Self-Discharge Rate of 1% to 3% per month.

 11. Battery shall have a Temperature Sensor monitoring battery housing temperature, not ambient temperature, to optimize charging cycles and extend battery life.

 12. Battery shall be encased in Double Wall Plastic, and mounted in a Stainless Steel Cage, for safety and battery protection purposes.

 F. Photovoltaic Modules (PV modules, Solar Panels). The PV modules shall meet the following criteria.

 1. To ensure continuous operation of the motor and impeller in all seasons, the total Nominal Wattage Rating of the PV modules shall be a minimum of 5 times the normal operating wattage of the motor.

 2. To ensure adequate power collection during low sunlight conditions, photovoltaic modules shall be Mono-Crystalline, not multi-crystalline.

 3. Photovoltaic modules shall contain power conductors constructed of multi strand power wire having a flexible outer jacket, and shall be contained inside stainless steel sheathing for protection from the elements and from rodents.

 G. System Operation Monitoring. The digital controller shall have the following monitoring features.

 1. LED (Light Emitting Diode) Flash Code, flashing LEDs in the control box readily accessible by service personnel shall provide continuous electrical diagnostics so the state of the power system can easily be determined.

 2. SCADA (Supervisory Control and Data Acquisition), the digital controller shall output system state of health and operation monitoring using RS-232 serial communication (Modbus RTU), DB9 male connection point. A protocol document shall be provided for local network (PLC or RTU) programming assistance.

 3. Operation Back Log, the digital controller shall store within controller memory a 30 day rolling log of all primary machine operation parameters.

 H. Adjustable Horizontal Water Intake. The circulation equipment shall be supplied with an intake capable of being field adjusted to a set level below the water surface without requiring machine removal and redeployment. The intake shall bring a 1 ft (30 cm) thick horizontal layer of water into the machine. The intake shall include a singular hose of adequate length to reach the required intake depth setting. The flow through the hose and intake shall not exceed 1 foot per second (0.3 meter per second).

 • See end of specifications for Dual Mix Intake options for applications benefiting from dual intake levels and insert here if required.

 I. Maintenance Requirements. The circulation equipment shall operate normally with the following maintenance features.

 1. No scheduled lubrication is required of any system components including motor and motor bearing.

 2. No brush replacement, gearbox replacement, or motor replacement shall be expected or required during the expected life of the circulation equipment.

 3. No spare parts shall be required to be kept on hand.

 4. No tools beyond normal cleaning supplies and a few common hand tools shall be required for scheduled maintenance.

 5. Circulator shall be equipped with swinging latched gates for easy access to digital controller, motor, and impeller assembly for inspection.

 6. Impeller assembly shall be removable without requiring any tools and shall be easily accomplished out on the water where circulation equipment is deployed.

 7. Circulator shall be equipped with a bird deterrent system to minimize bird roosting, droppings on photovoltaic modules.

 J. Solids Handling: The circulation equipment shall be capable of passing up to 4 inch (10 cm) spherical solids through the intake and impeller.

 K. Flotation: The circulation equipment shall contain a flotation system meeting the following criteria.

 1. Adjustable Float Arms shall have a 1” (2.5 cm) diameter shaft and turnbuckle to achieve the optimal performance setting. The float arms shall be a closed frame to minimize torsion forces on the circulation equipment and provide balanced flotation.

 2. Flotation Buoyancy shall be 1,350 pounds (620 kg) or more to support the weight of the assembled circulation equipment with a safety factor greater than 1.5. Each circulation machine shall weigh approximately 850 pounds (380 kg).

 3. For Flotation Longevity, flotation shall contain Expanded Polystyrene Foam (EPS) beads that are steamed together to minimize water adsorption and provide a solid float core for structural strength. The EPS contents shall have a 0.9-1.2 pounds per cubic foot density with water adsorption not to exceed three pounds per cubic foot in accordance with the Hunt Water Adsorption Test. The flotation shall not sink should the float encasement be punctured.

 4. Each Flotation Encasement shall be constructed of a linear polyethylene resin containing ultraviolet (UV) inhibitors to prevent accelerated deterioration in this marine environment. The float encasement shall offer a balance of toughness, rigidity, environmental stress-crack resistance and low temperature impact performance. Resin shall also be in compliance with FDA title 21. Resin shall be made of a food grade material that will not contaminate the waterways and is recyclable. Encasements shall be rotationally molded for seamless, one-piece construction and shall have a nominal minimum wall thickness of 0.15 inches (4 mm). Encasements shall be resistant to damage by animals, ice, bumps by watercraft, contact deterioration from petroleum products and suitable for marine use.

 L. Anchoring. At the manufacturers recommendation, the circulation equipment shall be held in position by either (a) attachment to mooring blocks at the bottom of the reservoir, or (b) tethering the circulation equipment to shore.

#### PART 3 EXECUTION

 3.01 PLACEMENT

 A. The circulation equipment manufacturer shall provide Placement, Startup, and On-Site Water Testing Services to insure (a) proper machine spatial placement in the reservoir, and (b) proper intake depth setting.

B. The field services shall be performed by full time factory employees experienced in the operation of this equipment, and who have completed safety trainings required for this type of work in compliance with OSHA regulations including (a) Working over Water, (b) Boating Safety, (c) Disinfecting Procedures, (d) Confined Space Entry, (e) Fall Protection, and (f) DOT Compliance.

C. Within 30 days following equipment placement, the manufacturer shall provide a report detailing as described in submittal section.

 D. The circulation equipment manufacturer shall have the following support team available for full service if ever needed following the equipment placement.

 1. A minimum of (10) x (2)-member factory crews.

 2. A full customer service staff including engineers and science personnel that are trained for assistance in this application.

#### PART 4 OPTIONAL ACCESSORIES (Delete PART 4 when finished)

 **Supplemental AC Power (Insert into Section 2.02 D when required)**

 16. Circulation equipment shall be supplied with supplemental AC power as a secondary power source. Solar power shall remain primary power source. This accessory requires that tethering be applicable and used across pond or cell to secure circulation equipment in place. This accessory requires a 120 VAC power source, 15 Amp rated outlet located at the edge of the pond or cell near one of the two tether anchor points. 120 VAC power source shall be supplied by others and not the circulation equipment manufacturer.

 **Dual Mix Intake (Insert into Section 2.02 H when required)**

 The circulation equipment shall be supplied with a dual mix intake that consists of the following.

1. The Upper Mixed Zone fluid intake shall be flanged and bolted to the bottom of the circulation equipment. The intake shall be a fixed horizontal 48-inch (1.2 m) diameter stainless steel intake plate. Horizontal flow into the intake shall be through 12-inch (30 cm) openings above the intake plate.

 2. The Lower Mixed Zone fluid intake shall be flanged, fit through an opening in the fixed horizontal plate and bolted to the bottom of the circulation equipment. The intake hose shall be 12-inch (30 cm) diameter for SB10000 v18 and 8-inch (20 cm) diameter for SB5000 v18 by 20 feet (6.1 m) length and constructed of thermoplastic rubber. The inlet end of the hose shall include an inverted bell-shaped strainer with 3-inch (7.6 cm) holes. The strainer shall have built-in flotation and the inlet end of the hose shall have a built-in weight, so that the strainer is always held up 2 feet (60 cm) above the bottom of the pond or reservoir.