



## COLORADO

Department of Public  
Health & Environment

Dedicated to protecting and improving the health and environment of the people of Colorado

August 3, 2015

Kraig Johnson, PhD, P.E.  
Chief Technical Officer  
Wastewater Compliance Systems, Inc.  
1500 N 3333 W  
Lehi, UT 84043

Subject: Limited Acceptance of the Bio-Domes as an Alternative Technology for Use in Domestic Wastewater Treatment Works in Colorado

Dear Mr. Johnson:

The Water Quality Control Division (Division) has received and reviewed information for the Bio-Domes in accordance with section 1.8.0 of *Design Criteria for Domestic Wastewater Treatment Works Policy WPC-DR-1* (wastewater design criteria). The Bio-Domes technology is awarded a limited acceptance for use as an alternative technology subject to the conditions and design criteria in Table 1. This limited acceptance is not intended as a third-party certification of the technology.

This limited acceptance addresses the following:

- Each Bio-Dome consisting of four concentric dome shells with packing media between shells, having external dimensions of six feet diameter and four feet height, mounted on a 12-inch tall X-shaped concrete base, and providing a combined surface area of at least 3,200 square feet.

This acceptance applies only to the Bio-Domes as described above and does not constitute construction approval for installation in domestic wastewater treatment facilities. **Review and approval for the design of any domestic wastewater facility proposing to use this technology will be further reviewed on a site-specific basis by the Division** as required by Section 22.11(1) of the *Site Location and Design Approval Regulations for Domestic Wastewater Treatment Works 5CCR 1002-22* (Regulation 22) and the Colorado Water Quality Control Act (Act), Section 25-8-702, C.R.S. which states in part that: “No person shall commence the construction of any domestic wastewater treatment works or the enlargement of the capacity of an existing domestic wastewater treatment works, unless the site location and the design for the construction or expansion have been approved by the division.”

Any modifications to the physical attributes or characteristics of this treatment technology must be submitted to this office for review and acceptance by the Division prior to sale in Colorado. This condition includes changes made to the Bio-Domes (e.g., media, area, size, piping, mechanisms). For any changes to the process or equipment following issuance of this letter, the Division will review any additional third party verification reports and issue a revised acceptance letter, or denial, as appropriate.



**Table 1. Bio-Dome Design Criteria:**

Design Criteria

1. Bio-Domes are reflective of the general lagoon environment and all lagoons are different in size, shape, configuration, and operations. Therefore, lagoon facilities will be required to implement a site-specific demonstration pilot test of the Bio-Dome technology for at least one operating year to help establish site-specific organic and/or ammonia removal capabilities. Additional pilot testing may be necessary depending on the outcome of the initial pilot data. The demonstration-scale pilot test process must include the following components at a minimum:
  - a. Division approval of a pilot test plan in accordance with section 22.8(2)(b)(vii) of Regulation 22 (see also the Regulation 22 Guidance document, page 62, line 2954) including installation configuration, sampling plan, and preliminary operations plan (see item 11 below),
  - b. conditions similar to anticipated full scale conditions (e.g., baffles, water depth, significant portion of total anticipated Bio-Domes at planned spacing, flows), and
  - c. submittal of a complete pilot test report, prior to the site location application, for review and evaluation by the Division to assess appropriate loading rates for a site.

The Division may establish additional pilot requirements based on the site-specific proposal. Pilot testing of the Bio-Dome technology does not guarantee the applicability or approval of the technology for the testing site. Pilot test results may determine a product incompatible for the site specific conditions and needs. The Division may use other site specific data as determined to be relevant and appropriate.

2. The approved facility design capacity shall be based on the maximum month average flow and loading. During the site-specific design review, calculations shall be submitted to justify the basis of design for the biological and secondary processes including, but not limited to, aeration basins/lagoons, aeration, mixing, and settling.
3. Site pretreatment processes shall be incorporated into the process train, as required, to ensure that anticipated peak loads (e.g., hydraulic, organic, nutrient) are accommodated and mitigated to maintain treatment performance.
4. Treatment must occur prior to nitrification to reduce BOD and remove oil, grease, scum, grit, and floating debris. Bio-Domes may be used for organic treatment to reduce BOD concentrations prior to domes intended for nitrification.
5. Treatment Credit. The domestic wastewater treatment plant must meet appropriate effluent discharge limits [e.g., Preliminary Effluent Limits (PELs), permitted discharge effluent limits]. Nitrification credit shall be granted within the Bio-Domes zone at the point when the BOD calculated concentration is expected to be zero. Site-specific organic and ammonia loading rates shall be determined through a Division evaluation of site-specific pilot data and any other data deemed relevant and appropriate. No denitrification credit or phosphorus removal credit is granted for the treatment technology.
6. Treatment Zone. The Bio-Dome zone shall be designed to provide uniform, focused flow across the Bio-Domes (e.g., baffle curtains, concrete walls, tanks).

7. Aeration Equipment. The Bio-Domes require adequate air capacity to facilitate treatment and purge lines for maintenance. Blower or compressor capacity shall be able to provide a minimum operating capacity of 1 scfm per Bio-Dome at 3-5 psi at the Bio-Dome and capacity to provide a periodic (e.g., weekly) "blast" purge of air lines and orifices at a rate of 2 scfm per Bio-Dome for five minutes at 3-5 psi at the Bio-Dome. Variable frequency drives are recommended. Blowers or compressors shall provide full capacity with largest unit out of service. The design must demonstrate adequate compressor size and capacity based on site-specific conditions and treatment requirements including, but not limited to, elevation, temperature (e.g., seasonal, air, wastewater), pipe sizes, bends, etc. Separate equipment shall be provided for the lagoon operation such as aeration, mixing, and pumps consistent with the wastewater design criteria. The lagoon and Bio-Dome aeration systems designs shall provide sufficient air transfer using an appropriate  $\alpha$ -factor and provide sufficient oxygen for carbonaceous and nitrification oxygen demand.
8. Alkalinity. Nitrification requires alkalinity, 7.14 pounds as CaCO<sub>3</sub> per pound ammonia oxidized. The wastewater must be shown to have sufficient alkalinity (i.e., 50 mg/L excess) or chemical treatment must be included to provide adequate alkalinity.
9. A solids separation unit process is required following the Bio-Domes zone (e.g., final lagoon cell).
10. Design Redundancy. At least two equal trains of Bio-Domes (i.e., separate functionality for controls, air, independent lagoons) shall be installed, each with a design flow of at least 50 percent of the total design capacity. Fixed capacity (i.e., all units operating) for aeration, mixing, and pump capacity shall be capable of providing design requirements (e.g., enable the design oxygen transfer). Firm capacity (i.e., largest unit out of service) for aeration capacity shall be available at the site to provide design requirements (e.g., enable the design oxygen transfer). It is permissible for the backup unit to be an uninstalled unit, provided the installed unit can be easily removed and replaced. The aeration system for a basin shall be designed such that the largest section of air lines can be isolated without significantly impairing the oxygen transfer capability of the system.
11. Operations Plan. The design shall include an operations plan that identifies operational changes, such as lagoon bypasses, to maintain effective biofilm and wastewater conditions under various operating scenarios such as seasonal variations, loading at partial capacity, etc.
12. Adequate flow splitting devices must be provided to ensure appropriate flow to each unit.
13. Other Processes Required. Although the Bio-Domes act as major unit process components of a treatment plant, the Bio-Domes do not constitute a complete package treatment plant and the particular site-specific design must include other unit processes (e.g., influent and effluent flow metering, chemical addition, disinfection, phosphorus removal) to be a fully functioning wastewater treatment plant and meet effluent discharge limits. In addition to the Bio-Domes, these other supporting unit processes will be evaluated during the site location and design reviews.
14. Startup Considerations. Bio-Domes must be installed in an area where existing sludge has been removed to less than 6 inches provided the concrete bases can be set on a non-degradable, stable base. Project scheduling must include provisions to install Bio-Domes during a period that provides adequate time for growth of adequate biofilm before meeting effluent limits at the discharge.
15. For facilities where ambient temperatures can be below freezing, the design shall include adequate cold weather provisions (e.g., heat trace lines, insulated covers, installation in a temperature-controlled enclosure for above ground wet components).

16. Alarm. A blower or compressor malfunction alarm must be provided. The design must identify how the alarm signal will notify operators of alarm activations, when the facility is attended and unattended.
17. Maintenance Access. Design shall include provisions that allow the operator to access, operate, and maintain the treatment technology (e.g., blowers, compressors, airlines, baffle curtains, access roads, bypass lines if lagoon drained).
18. Manufacturer Review. A review letter issued by the manufacturer indicating the installation was designed in accordance with manufacturer recommendations must be included with the site-specific design submittal. The manufacturer's review may not supersede criteria in this acceptance. The manufacturer's review may not be substituted for all required engineering documentation and calculations stamped and signed by a Colorado licensed Professional Engineer.

#### Additional Operations and Maintenance Criteria

1. Design must include discussion of residuals management considerations, including the expected solids generation quantities and quality, and a discussion of the method of final sludge disposal.
2. Design shall include provision for operator training. An Operations and Maintenance (O&M) Manual shall be provided for all installations. Individual operations plans shall include scheduled inspections, assessments, and maintenance of the air lines and Bio-Dome biofilm growth condition as an operational safeguard. The document should be available for review by the Division during compliance inspections.
3. Facility Classification. This technology has a Class C or Class B Domestic Wastewater Treatment Facility Classification, depending upon the system complexity and sensitivity of the receiving water, in accordance with Regulation 100 Water and Wastewater Facility Operators Certification Requirements.

The owner of the domestic wastewater treatment works is responsible for proper design, operation, and maintenance of the facility to meet permit effluent requirements.

Please be aware that any point source discharges of water from treatment facilities are potentially subject to a discharge permit under Colorado's State Discharge Permit System. Any point source discharges to state waters without a permit are subject to civil or criminal enforcement action.

As part of this review, the Division has evaluated the following documents:

- March 27, 2015 Submittal from RG and Associates, LLC requesting alternative technology acceptance for Bio-Domes.
- June 5, 2015 Submittal from RG and Associates, LLC providing additional information for the alternative technology review for Bio-Domes.

Please direct any further correspondence regarding this acceptance to:

David Kurz, P.E.  
Colorado Department of Public Health and Environment  
Water Quality Control Division  
4300 Cherry Creek Drive South  
Denver, CO 80246

If you have any questions or comments, please contact David Kurz at [david.kurz@state.co.us](mailto:david.kurz@state.co.us) or 303-692-3552.

Sincerely,

David Kurz, P.E.  
Lead Wastewater Engineer  
Engineering Section  
Water Quality Control Division  
Colorado Department of Public Health and Environment