# Department of
# Environmental Protection

Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Jeb Bush
Governor

David B. Struhs
Secretary


September 25, 2001

Mr. Walter S. Mulica
Global Technologies, Inc.
4808 Westridge Drive
Fort Collins, Colorado 80526

Re: **in situ Submerged Oxygen Curtain (iSOC)**

Dear Mr. Mulica:

The Bureau of Petroleum Storage Systems hereby accepts the in situ Submerged Oxygen Curtain (iSOC) as an innovative device that produces dissolved oxygen for in situ biodegradation of petroleum and other aerobically degradable contaminants in groundwater. As indicated by the information you submitted, this "in-the-well" device produces dissolved oxygen concentrations in groundwater in the 50 to 70 parts per million (ppm) range, and greater, without creating bubbles, and is manufactured by inVentures Technology Incorporated, Oakville, Ontario, Canada. It can be used in several ways at contaminated sites, either to create an oxygen barrier curtain, or to treat a source area, or as an enhancement to natural attenuation. Additional information is provided as enclosure 1.

The bureau recognizes the iSOC as a viable product for the bioremediation of petroleum contaminated sites in Florida. There are no objections to its use provided a Remedial Action Plan for the cleanup of petroleum contamination, pursuant to Chapter 62-770, F.A.C., is approved by the Department.

While the Department of Environmental Protection does not provide endorsement of specific or brand name remediation products or processes, it does recognize the need to determine their acceptability from an environmental standpoint with respect to applicable rules and regulations, and the interests of public health, safety, and welfare. Vendors must then market the products and processes on their own merits regarding performance, cost, and safety in comparison to competing alternatives in the marketplace. In no way, however, shall this regulatory acceptance letter be construed as certification of product performance.

Those who prepare Remedial Action Plans are advised to include a copy of this letter in the appendix of plans they submit, and call attention to it in the text of their document. In this way, technical reviewers throughout the state will be informed that you have contacted the

Department of Environmental Protection to inquire about the environmental acceptability of this product.

The Department reserves the right to revoke its acceptance of any product or process it has accepted if its nature, performance, or any other aspect has been falsely represented. Additionally, Department acceptance of a product or process does not imply it has been deemed applicable for all cleanup situations, or that it is preferred over other treatment or cleanup techniques in any particular case. A site specific evaluation of applicability and cost-effectiveness must be considered for any product or process, whether conventional or innovative, and adequate site-specific design details must be provided in a Remedial Action Plan. You may contact me at 850/487-3299 if there are any questions.

Sincerely,

Rick Ruscito, P.E.
Bureau of Petroleum Storage Systems

c: John Archibald
inVentures Technology, Inc.
2177 Oakmead Boulevard
Oakville, Ontario L6H 5N4, Canada

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# ADDITIONAL INFORMATION ABOUT iSOC

1. Equipment: Very little equipment is associated with the iSOC. The device itself is made of stainless steel and is 1-3/4 inches in diameter and 15 inches long. It is designed to fit into wells as small as 2 inches in diameter. The only other items needed for its installation are an oxygen cylinder, pressure regulator, valves, rotameter, ¼-inch oxygen tubing, and a suspension line that connects to a lifting eye on the iSOC.

2. Nature of the device: The iSOC contains hydrophobic microporous hollow fibers that provide approximately 7,000 square meters of interface area per cubic meter of fiber for mass transfer of oxygen into the surrounding groundwater. It is an efficient method for the dissolution of oxygen into the groundwater because it does not create bubbles. In comparison, conventional bubble-type systems waste most of the oxygen that is injected, because the bubbles rise to the top of the groundwater table and escape before they have a chance to dissolve.

   The iSOC is capable of producing dissolved oxygen concentrations in groundwater in the range of 50 to 70 parts per million, or greater depending on the atmospheric pressure and the depth at which the device is located below the water table. In comparison, conventional air bubble systems only achieve 6 to 8 ppm of dissolved oxygen in groundwater at ambient temperatures.

   The underlying underlying scientific principle for the iSOC is the equilibrium that exists between the dissolved concentration of a gas in a liquid and the partial pressure of that gas above the liquid. The proportionality constant that relates the partial pressure to the concentration in the dissolved phase is the Henry’s Constant, for which additional information is readily available in textbooks.

3. Safety: For iSOC, like any other equipment item used for the remediation of petroleum contaminated sites, the Department expects appropriate safety practices for the handling and use of oxygen cylinders to be observed.

4. Utilization of wells: If a remediation site happens to have an abundance of monitoring wells, then the Department has no objection to the use of some wells for iSOC purposes. However, no “designated” monitoring well, dedicated to the tracking of remediation progress (by sampling) shall be used as an iSOC well. This will avoid premature conclusions that the entire site meets cleanup goals. By making sure that designated tracking wells are not used for the introduction of oxygen, there will be more assurance that dissolved oxygen has permeated the entire site and that it did not remain localized to the area immediately surrounding each iSOC well.

5. Design considerations: As is the case with most in situ remediation strategies, the spacing of injection wells will be depend on site-specific conditions. An example of a barrier curtain contained in one of the iSOC brochures shows three wells, in a line, spaced 16 feet on center, which is equivalent to a radius of influence of 8 feet. For situations where site-specific pilot test information about a radius of influence is not available, the Bureau of Petroleum Storage Systems believes that a 16-foot spacing would be a reasonable spacing for most Florida sites. The extent to which the dissolved oxygen extends downgradient from each iSOC well will depend on the velocity of the groundwater and the oxygen demand.

6. Oxygen usage: Because the iSOC system does not create bubbles that waste oxygen, it can operate at oxygen flow rates of less than 10 cc/min. One case study presented by the vendor for a 3-well system used three 20-pound oxygen cylinders or approximately 64 pounds of oxygen in a 5-month period. A second case study for a 2-well system use two 20-pound cylinders or approximately 32 pounds of oxygen in a 3-month period.

7. Dissolved oxygen meters: The use of a high-range dissolved oxygen meter, capable of measuring concentrations greater than 15 ppm is recommended. One such meter is the Oxyguard Alpha High Range Oxygen Meter, from Point Four Systems Incorporated, Port Moody, British Columbia, Canada, telephone 604-936-9937.

8. BTEX pilot site results: For one pilot site, during a 6-month period, the average BTEX reduction using iSOC was 60%, with results at individual measuring points ranging from 33% to 96%. For another pilot site, during a 6-month period, the average BTEX reduction using iSOC was 44%, with results at individual measuring points ranging from 0% to 100%.