Department of
Environmental Protection

Jeb Bush
Governor

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

Colleen M. Castille
Secretary

June 8, 2004

Mr. Tim Borne
Environmental Technology Solutions International
1508 S.E. 17th Avenue, Suite 5
Cape Coral, Florida 33909

Re: **Hydrogen Accelerator System**

Dear Mr. Borne:

The Bureau of Petroleum Storage Systems hereby accepts the Hydrogen Accelerator System as an innovative process for the ex situ remediation of soil contaminated by petroleum. We note that this process is capable of treating other types of contaminants that are beyond the jurisdiction of this Bureau, which is the cleanup of petroleum pursuant to Chapter 62-770, Florida Administrative Code (F.A.C.). Although this acceptance applies only to the jurisdiction of this Bureau, other bureaus within the Department of Environmental Protection, or other state agencies and local governments may choose to recognize it if their needs and regulations are similar. This Bureau, however, is not responsible for applications beyond its jurisdiction.

The Hydrogen Accelerator System is an ex situ soil treatment process that uses two oxidizers to destroy contaminants. The first oxidizer is the hydroxyl radical, which is generated onsite, using only water, via cavitation chemistry. The second oxidizer, depending on the situation, will be either hydrogen peroxide or potassium permanganate. The system can be deployed in the field as either a mechanized process of conveyors, screeners and sprays that are fed by a pay loader, or as a land farming process for contaminated soil, into which the treatment chemicals are tilled. The mechanized system, which is portable, can process up to 1,000 tons of soil per day.

A copy of this letter should be provided in the appendix of site-specific Remedial Action Plans proposing the use of the Hydrogen Accelerator System so that technical reviewers throughout the state will be informed that the Bureau has evaluated the product from a regulatory standpoint. Enclosure 1 cites some regulatory considerations that may need to be taken into account, and provides supplemental information that may be of interest.

While the Bureau does not endorse 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. Additionally, the

Department emphasizes a distinction between its regulatory “acceptance” and an approval. Products and processes are accepted but they are not approved.

It is also not a requirement that a particular remediation product or process have an official acceptance letter in order for it to be proposed in a site-specific Remedial Action Plan. The plan, however, must contain sufficient information about the product or process to show that it meets all applicable and appropriate rules and regulations.

The Bureau reserves the right to revoke its acceptance of a product or process if it has been falsely represented. Additionally, Bureau acceptance of any 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 design details must be provided in a site-specific Remedial Action Plan. You may contact me at (850) 877-1133, extension 29.

Sincerely,

Rick Ruscito, P.E.
Ecology and Environment, Inc.
Bureau of Petroleum Storage Systems
Petroleum Cleanup Section 6

Rebecca S. Lockenbach
FDEP Section Leader
Bureau of Petroleum Storage Systems
Petroleum Cleanup Section 6

c: T. Conrardy - FDEP/Tallahassee

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REGULATORY AND SUPPLEMENTAL INFORMATION

1. Applicable cleanup target regulations: The onus shall be on Environmental Technology Solutions International and users of the Hydrogen Accelerator System to comply with all applicable and appropriate rules and regulations. For Hydrogen Accelerator System soil remediation, the applicable chapters of the Florida Administrative Code (F.A.C.) include but are not necessarily limited to Chapter 62-777, for soil cleanup target levels, and 62-770, for petroleum cleanup.

2. Permits: For on-site remediation of petroleum-contaminated soil by the Hydrogen Accelerator System, pursuant to Section 62-770.700, F.A.C., under the authorization of a Department-approved site-specific Remedial Action Plan, no permit is needed.

   However, if the Hydrogen Accelerator System will be operated as a stationary, commercial soil treatment facility pursuant to Chapter 62-713, F.A.C., then a permit is needed for such a facility. And if the system will be operated as a commercial, mobile treatment facility pursuant to Chapter 62-713, F.A.C., a permit to operate as such is also needed.

3. Land farming during Source Removal phase: Treatment of excavated soil by the Hydrogen Accelerator System, in a land farming mode during the Source Removal phase of a cleanup is allowed by rule 62-770.300(2)(b), F.A.C. (August 5, 1999 issue). Conditions apply, including a requirement that the land farming be conducted on the same site as the source of contamination, and the land farming operation must be at least 200 feet from any residence. Those who contemplate use of the Hydrogen Accelerator System in the land farming mode, for source removal pursuant to Section 62-770.300, F.A.C., should refer to rule 62-770.300(2)(b), F.A.C., for the complete list of conditions that apply. Chapter 62-770, F.A.C., and other chapters of the Florida Administrative Code are currently available at web page www.dep.state.fl.us/legal/Rules/rulelistnum.htm.

4. Active Remediation phase: For onsite remediation of excavated soil by the Hydrogen Accelerator System during the Active Remediation phase, Section 62-770.700, F.A.C., applies. An approved site-specific Remedial Action Plan is required, and the soil cleanup goals of Chapter 62-777, F.A.C., as referenced by Chapter 62-770, F.A.C., apply. Most often, the cleanup target levels for the treated soil will be the lower of the direct exposure residential cleanup target levels and the leachability based on groundwater criteria cleanup target levels specified in Chapter 62-777, F.A.C., Table II. Treated soil that meets these cleanup target levels can be disposed either onsite or offsite, but responsible parties are advised that federal and local requirements may apply. Although there is an option for either onsite or offsite disposal of treated soil meeting these cleanup levels, the prudent course of action in most cases, from a liability standpoint, may be to return the treated soil to the same excavation pit from where it originated at the site.

5. First oxidizer: The first oxidizer used in the Hydrogen Accelerator System process is the hydroxyl radical, which is produced at the remediation site, in a reactor that subjects water to cavitation, ultra violet light, and an aluminum oxide catalyst in order to produce the hydroxyls. The reactor is an equipment item that is brought to the site. It can produce “reactor” water at approximately 50 to 75 gallons per minute. The Bureau of Petroleum Storage Systems would like to pass along

to readers, as a rule-of-thumb, that approximately 1,500 gallons of hydroxyl-laden reactor water is used per each 400 tons of soil processed. The Bureau notes that this represents only a 1.56-percent increase in moisture on the weight of the soil.

6. Second oxidizer options: The second oxidizer used in the Hydrogen Accelerator System will either be hydrogen peroxide or potassium permanganate, depending on the conditions. In the case of treating soils with a high clay content, lime may also be added.

   a. Hydrogen peroxide as the second oxidizer: The hydrogen peroxide used by the Hydrogen Accelerator System is produced at the site, just prior to application. It is produced by the mixing of sodium percarbonate ($2NaCO_3 \cdot 3H_2O_2$) and an acidic activator. The result of the mixing is a reaction that releases hydrogen peroxide, and a byproduct, $NaCO_3$. As a rule-of-thumb, approximately 50 pounds of sodium percarbonate is used per 400 tons of soil, per 5000 parts per million of contamination. For the sodium, the Bureau notes that this represents an addition of only .00625 percent sodium on the weight of the soil. The activator, a proprietary formulation, is applied at a rate of approximately 1 pound per 400 tons per soil, which is equivalent to .000125 percent (1.25 parts per million) on the weight of the soil, and the byproducts of the spent activator include amides and ammonium salts.

      The chemical species associated with the byproducts of sodium percarbonate and activator are sodium (as sodium carbonate) some amides, and some ammonium salts. At the typical application rates cited for the treatment chemicals, these byproducts should not be an environmental problem with respect to the disposition of treated soil, and the Bureau believes that monitoring of them should not be necessary, either in the treated soil, or in the underlying groundwater of an excavation pit to which treated soil has been returned. If, however, for some reason a much higher concentration of sodium percarbonate and activator is used at a particular remediation site, then it may be prudent to first determine, and evaluate from an environmental standpoint, the residual amounts of sodium, amides and ammonium salts that may be present. For groundwater that may come into contact with the treated soil, either directly or by way of leachate, the byproducts of the treatment chemicals in the treated soil must not cause an exceedance of the following groundwater standards: pH, range 6.5 to 8.5; sodium, 160 milligrams per liter (mg/L); and ammonia nitrogen, 2.8 mg/L.

      Information about the amount of lime (CaO) used during the processing of soils with a high content of clay was not given. With exception of the effect on soil pH, the Bureau believes that the byproducts of lime that has reacted with water and any carbon dioxide that may be present are in themselves chemical species that do not warrant a high degree of concern from an environmental standpoint. It is common knowledge that the main byproducts are calcium hydroxide and calcium carbonate.

   b. Potassium permanganate as the second oxidizer: Ten (10) pounds of potassium permanganate ($KMnO_4$) is applied to every 800 tons of soil processed. This equates to 6.25 milligrams per kilogram (mg/Kg). This small concentration obviously does not exceed the 1,600 mg/Kg direct residential exposure limit for manganese in Table II of Chapter 62-777, F.A.C. However, it also must not exceed a leachability value based on groundwater criteria per that same Table II. This

leachability value is obtained by EPA test method 1312, Synthetic Precipitation Leaching Procedure (SPLC), as described in EPA Document SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. A description of this method can be found on the Internet at www.epa.gov/epaoswer/hazwaste/test/main.htm.

In the interest of protecting the groundwaters of the state, the concentration of $KMnO_4$ added to soil during the treatment process shall not be so high as to cause a leachability risk with respect to manganese upon final disposition of the treated soil, especially if it is used as fill. The SPLC test cited in the preceding paragraph can be used to determine whether or not excessive leaching of manganese into underlying groundwater will occur. The current secondary maximum contaminant level for manganese per the drinking water standards of Chapter 62-550, F.A.C., is 50 micrograms per liter (equivalent to 50 parts per billion). In regard to potassium, there is neither a primary nor a secondary standard.

7. Safety: As in any remediation project, the user is expected to pay attention to safety in both the design and operation of a Hydrogen Accelerator System remediation system. This includes, but is not necessarily limited to, safety considerations in the following categories: fire, electrical, mechanical, personnel, the handling and compatibility of chemicals, air emissions, and passersby.