

Department of Environmental Protection

Jeb Bush
Governor

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

David B. Struhs
Secretary

June 21, 2001

Mr. Robert Leon
MCC Technology, Inc.
11445 East Via Linda, #2
Scottsdale, Arizona 85259

Re: **MCC Technology - Bio-Sparge**

Dear Mr. Leon:

The Bureau of Petroleum Storage Systems hereby accepts the MCC Technology Bio-Sparge process for the bioremediation of contaminated sites in Florida. It is the bureau's opinion that the process offers an opportunity for efficient and effective remediation of difficult to reach places, like the contaminated zones beneath underground petroleum storage tanks.

Bio-Sparge is a vapor-phase, closed-loop, recirculating/re-injection-type in situ groundwater and soil remediation system for petroleum, chlorinated solvents, and other suitable contaminants. It uses nutrients, surfactants, heat, and hydrogen peroxide to stimulate indigenous microorganisms already present at a site to bioremediate the contaminants of concern. Enclosure 1 is a proprietary chemicals voucher issued by the Bureau of Petroleum Storage Systems for the chemicals used in the Bio-Sparge process.

The system recovers vapors from one end of the underground contamination plume and partially treats them in an aboveground vessel. The aboveground vessel also amends the vapors with a mixture of nutrients, surfactants, and hydrogen peroxide. The amended vapors are then re-injected at the other end of the plume, thereby forming the closed-loop re-injection system.

The vapors from the aboveground vessel that are re-injected may contain varying amounts of the nutrients, surfactants, and hydrogen peroxide, and varying concentrations of partially treated unoxidized contaminants and their intermediate degradation products. In time, as the system continues to partially treat and re-inject the vapors, the concentrations of the contaminants gradually decrease to cleanup target levels. Eventually, all that remains in the subsurface are the ultimate products of the biodegradation, which are carbon dioxide and water, as well as chloride in the case of chlorinated solvent remediation.

For in situ vadose remediation, when the underlying groundwater will not be affected by the leaching of Bio-Sparge chemicals, there are no regulatory concerns beyond those that would normally need to be addressed in preparing a Remedial Action Plan and conducting a cleanup in accordance with the

Mr. Robert Leon
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petroleum cleanup requirements of Chapter 62-770, Florida Administrative Code (F.A.C.). However, for in situ groundwater remediation via injection into an aquifer, there are underground injection control regulations that must be observed. Since in situ aquifer remediation via injection is likely to be the most common application of this process, the bulk of the regulatory requirements discussed in enclosure 2 will be directed to that topic.

The bureau recognizes MCC Bio-Sparge as a viable process for the bioremediation of petroleum contaminated sites in Florida. There are no objections to its use provided: (a) the considerations of this letter are taken into account; (b) a Remedial Action Plan is approved by the Department, and (c) the terms of a May 2, 2001 variance granted by the Department to MCC Technologies are observed. Enclosure 2 includes a summary of the terms of the variance that allows a temporary zone of discharge for operation of Bio-Sparge at a contaminated site.

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 letter regarding regulatory acceptance (or the conditions of regulatory acceptance) be construed as certification of product or process performance.

Preparers of 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 in regard to MCC Bio-Sparge. To aid those reviewers, the Bureau of Petroleum Storage Systems provides supplemental information as enclosure 3.

The Department reserves the right to revoke acceptance of any product or process if the nature or composition of either its ingredients or performance has been falsely represented. Additionally, Department 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 site-specific design details must be provided in Remedial Action Plans prescribing the product or process. Technical questions regarding the acceptance of Bio-Sparge may be directed to Ms. Donna Cline, P.E., at telephone 850/222-6446, extension 257.

Sincerely,

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

Mr. Robert Leon
June 21, 2001
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Enclosures (4)

c: Cynthia Christen - OGC, FDEP/Tallahassee

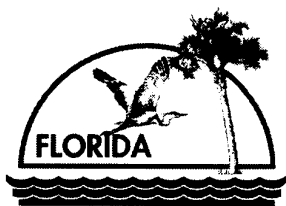
Donna Cline - PCS5/Tallahassee

George Heuler - UIC, FDEP/Tallahassee

Tom Conrardy - FDEP/Tallahassee

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BIO-SPARGE PROPRIETARY CHEMICALS VOUCHER



Department of Environmental Protection

Jeb Bush
Governor

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

David B. Struhs
Secretary

June 21, 2001

Mr. Robert Leon
MCC Technology, Inc.
11445 East Via Linda, #2
Scottsdale, Arizona 85259

Re: **MCC Technology - Bio-Sparge Proprietary Chemicals Voucher**

Dear Mr. Leon:

The Bureau of Petroleum Storage Systems hereby acknowledges receipt of a confidential disclosure dated June 1, 2000 from MCC Technology Incorporated. The disclosure is for the proprietary chemicals used in the Bio-Sparge process, including a proprietary surfactant.

Having reviewed the confidential disclosure, we hereby vouch for the ingredients associated with the Bio-Sparge chemicals. We also vouch for the correct identification of two groups of parameters for which MCC Technology Incorporated was granted a variance by the Department on May 2, 2001, for a zone of discharge for the Bio-Sparge closed-loop re-injection process.

The first group of variance parameters is associated with the chemicals added to the aboveground Bio-Sparge vessel, from which they may emerge as vapor-phase amendments for injection. They are ammonia, nitrate and nitrite. They may temporarily exceed their respective drinking water standards set forth in Chapter 62-550, F.A.C., and the minimum groundwater criteria set forth in Chapter 62-777, F.A.C., in the receiving aquifer. These are the only variance parameters associated with the chemicals brought to a remediation site for use in the Bio-Sparge vessel. The second group of variance parameters is not associated with the treatment chemicals added to the Bio-Sparge vessel, but rather a list of the petroleum and chlorinated solvent contaminants that are most likely to be remediated by the MCC Bio-Sparge closed-loop, partial treatment, vapor-phase re-injection-type process in Florida.

It is not known if the portion of vapor-phase contaminants that does not receive treatment during a given pass through the Bio-Sparge vessel meets the injection standards of Chapter 62-528, F.A.C., which assumes that the

injected fluid is a liquid. However, for the sake of thoroughness, and in deference to the intent of Chapter 62-528, F.A.C., the recirculated/re-injected vapor-phase contaminants are included as variance parameters.

Additionally, section 62-520.400, F.A.C., requires that the groundwater of the state be free from substances that are harmful to plants, animals, and organisms, and free from substances that are carcinogenic, mutagenic, teratogenic or toxic to human beings. It must be clearly understood that the obligation to comply with the minimum groundwater criteria and all other applicable rules and regulations ultimately rests with MCC Technology and users of the Bio-Sparge process, not the Bureau of Petroleum Storage Systems. No ingredients, chemical species, or byproducts formed as a result of using the Bio-Sparge system shall result in a violation of any applicable and appropriate rule or regulation.

For underground injection control purposes, remediation plans prescribing the use of Bio-Sparge must disclose the volume and composition of the fluid to be injected into an aquifer. Since some of the chemicals in the injected fluid are proprietary, and the fluid itself is a vapor of constantly changing composition, it will suffice to indicate the volumetric re-injection flow rate, say in cubic feet per minute, and to estimate the total weight of Bio-Sparge nutrients, surfactants and enzymes that will actually be injected into the subsurface over the life of the project. However, a footnote should also be provided, indicating that a one-time confidential disclosure regarding the proprietary nature of the Bio-Sparge chemicals has been submitted to the Department and accepted. Reference should be made to the original June 1, 2000 disclosure, and a copy of this voucher should be included as an appendix in the plan.

Lastly, it may be helpful for technical reviewers to know that the surfactant known as BioSolve will not be used with MCC Bio-Sparge applications in Florida, although the original plan by MCC Technology was to include a small amount of BioSolve as one of the surfactants for use in Florida. At the time, there were toxicology issues being resolved in Florida for the use of BioSolve. Those issues have since been resolved, but it was only after MCC Technology, for the sake of expediting this acceptance letter, made a decision to omit the BioSolve surfactant. MCC Technology, in the future, may want to petition for a variance that will supersede the existing May 2, 2001 variance to include the use of BioSolve surfactant.

Remediation plan reviewers for petroleum contaminated site applications involving Bio-Sparge may contact Donna M. Cline at (850) 222-6446, extension 257 or Rick Ruscito at (850) 487-3299. Questions about the remediation of sites contaminated by chlorinated organic compounds should be directed to the Bureau of Waste Cleanup at (850) 488-0190.

Sincerely,

Rick Ruscito, P.E.

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June 21, 2001
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Bureau of Petroleum Storage Systems

ENCLOSURE 2

MCC TECHNOLOGY BIO-SPARGE: ENVIRONMENTAL AND REGULATORY INFORMATION

For Bio-Sparge, the major environmental and regulatory concerns are discussed below.

- a. Applicable rules and regulations: The onus shall be on MCC Technology and users of the Bio-Sparge process to comply with all applicable regulations, particularly those regarding underground injection control and groundwater quality. All applicable groundwater contaminant standards shall be met at the time of project completion for the contaminants of concern, any residuals associated with the ingredients of Bio-Sparge chemicals, and any byproducts produced as a result of chemical or biochemical reactions involving those ingredients. The following chapters of the Florida Administrative Code are cited as applicable but should not be construed as an exhaustive list: Chapter 62-550, F.A.C., for primary and secondary water quality standards; Chapter 62-520, F.A.C. for groundwater classes and standards; Chapter 62-522, F.A.C., for groundwater permitting and monitoring requirements; Chapter 62-528, F.A.C., for underground injection control, particularly Part V, for Class V, Group 4 aquifer remediation wells; Chapter 62-770, F.A.C., for petroleum cleanup; and Chapter 62-777, F.A.C., for contaminant cleanup target levels.

A noteworthy aspect of the minimum criteria set forth in Chapter 62-520, F.A.C., is that it requires groundwater to be free from substances that are harmful to plants, animals, and organisms, and free from substances that are carcinogenic, mutagenic, teratogenic or toxic to human beings. In effect, these "free from" requirements form a catchall. They close what would otherwise be a loophole in the regulations by preventing injection of a potentially harmful product in the event that any of its ingredients is not regulated as a specific primary or secondary drinking water contaminant.

- b. Injection well permit: The issuance of a site-specific Remedial Action Plan Approval Order, by either the Bureau of Petroleum Storage Systems or the Bureau of Waste Cleanup, for injection-type aquifer remediation constitutes the granting of a Class V injection well permit.
- c. Additional nutrients and chemicals: For in situ aquifer remediation, the composition of an injected fluid must meet the drinking water standards set forth in Chapter 62-550, F.A.C., pursuant to underground injection control Rule 62-528.600(2)(d), F.A.C., and the minimum groundwater criteria set forth in Chapter 62-520, F.A.C. If a user of Bio-Sparge makes any changes in the chemicals used in the future, then the bureau should be notified and provided with a complete chemical analysis of the new chemicals. They must meet the injection requirements set forth in these chapters of the Florida Administrative Code. An exception to the

need for a chemical analysis would be a case in which the augmenting nutrients or substances are already on the list of injection-type aquifer remediation products already accepted by the Department, for which a chemical analysis has been provided.

- d. Variance Summary: A May 2, 2001 variance granted to MCC Technology Incorporated is for an exemption from Rule 62-522.300(3), F.A.C., in order to create a 100-foot zone of discharge in the aquifer around each injection point. Within this zone of discharge, for a period of time not to exceed 2 years, a temporary departure from the drinking water standards set forth in Chapter 62-550, F.A.C., and the minimum groundwater criteria set forth in Chapter 62-520, F.A.C.

The parameters for which the variance was granted can be divided into two groups. The first group includes parameters associated with the chemicals brought to the remediation site for use in the Bio-Sparge process: ammonia, nitrate and nitrite.

The second group of variance parameters is not associated with the chemicals used in the Bio-Sparge process but rather a list of the petroleum and chlorinated solvent contaminants that are most likely to be remediated by the Bio-Sparge process in Florida. As the Bio-Sparge re-circulating closed-loop system operates, these contaminants may emerge from the aboveground vessel, in the gaseous state or entrained, and only partially treated, for re-injection. They include but are not limited to the following: benzene; toluene; ethylbenzene; xylenes; methyl tertiary butyl ethyl; naphthalene; 1-methylnaphthalene; 2-methylnaphthalene; chloride; perchloroethylene; trichloroethylene; trans 1,2-dichloroethylene; vinyl chloride; and 1,1,1-trichloroethane.

It is not known if the portion of vapor-phase contaminants that does not receive treatment during a given pass through the Bio-Sparge vessel meets the injection standards of Chapter 62-528, F.A.C., which assumes that the injected fluid is a liquid. However, for the sake of thoroughness, and in deference to the intent of Chapter 62-528, F.A.C., the recirculated/re-injected vapor-phase contaminants are included as variance parameters.

By the end of the 2-year variance period, the variance parameters listed above must meet their respective groundwater concentration standards set forth in the Florida Administrative Code, or the natural-occurring background concentration at a given remediation site, whichever is less stringent.

- e. Bureau advice on the variance: Depending on site-specific conditions, there may be either a greater or lesser number of contaminants that are re-injected in comparison to those listed in the variance. Since it is not possible for a variance for a recirculation process like Bio-Sparge to cite every possible contaminant that it will ever be re-injected, it is recommended that the state's technical reviewers use common sense and judgment to carry out the intent of the variance that was granted. It may not be practical to require a new variance each time a re-injection

contaminant not listed in the variance is encountered. However, if a contaminant is encountered that represents a significant and serious departure from list, then the need for an additional or superseding variance should be considered.

- f. Groundwater standards: The current groundwater standards for the parameters listed in the May 2, 2001 Bio-Sparge variance are as follows: ammonia, 2.8 mg/L; chloride, 250 mg/L; nitrate, 10 mg/L; nitrite, 1 mg/L; benzene, 0.001 mg/L; toluene, 0.04 mg/L; ethylbenzene, 0.03 mg/L; xylenes, 0.02 mg/L; methyl tertiary butyl ether, 0.05 mg/L; naphthalene, 0.02 mg/L; 1-methylnaphthalene, 0.02 mg/L; 2-methylnaphthalene, 0.02 mg/L; perchloroethylene, 0.003 mg/L; trichloroethylene, 0.003 mg/L; trans 1,2-dichloroethylene, 0.1 mg/L; vinyl chloride, 0.001 mg/L; and 1,1,1-trichloroethane, 0.2 mg/L.

No other chemical species in the Bio-Sparge process are expected to exceed a drinking water standard or minimum groundwater criteria. The variance granted by the Department is a general variance, which may be applied to each site-specific Bio-Sparge Remedial Action Plan submitted hereafter. MCC Technology Incorporated does not have to petition for a new variance each time Bio-Sparge is proposed for the remediation of a site.

- g. 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 the application of Bio-Sparge. However, no "designated" monitoring well, dedicated to the tracking of remediation progress (by sampling) shall be used to apply Bio-Sparge chemicals. This will avoid premature conclusions that the entire site meets cleanup goals. By making sure that designated tracking wells are not used for treatment, there will be more assurance that the treatment process has permeated the entire site and that it did not remain localized to the area immediately surrounding each injection well.

- h. Groundwater monitoring:

1. Active remediation petroleum monitoring: During the period of active remediation, groundwater shall be monitored for petroleum contaminants of concern in accordance with the requirements set forth in Section 62-770.700, F.A.C. Two noteworthy rules within that section are 62-770.700(3)(i), F.A.C., for frequency of sampling, and 62-770.700(5)(f), F.A.C., which requires a sampling schedule for bioremediation. If Bio-Sparge will be used for the cleanup of non-petroleum hydrocarbons, then the monitoring should be conducted in accordance with the provisions of an approved Remedial Action Plan.
2. Post remediation petroleum monitoring: At least one (1) year of quarterly post remediation groundwater monitoring for petroleum contaminants of concern shall be conducted at a minimum of two (2) wells, one located in the area of maximum

petroleum contamination, the other downgradient of the area of maximum petroleum contamination, pursuant to Chapter 62-770.750, F.A.C. If Bio-Sparge will be used for the cleanup of non-petroleum hydrocarbons, then the monitoring should be conducted in accordance with the provisions of an approved Remedial Action Plan.

3. Underground injection control monitoring: The Department, pursuant to Rules 62-528.615(1)(b)1 and (2), F.A.C., has determined that users of Bio-Sparge must monitor groundwater for ammonia, nitrate, and nitrite. And depending on the contaminants of concern present at a site, those that are applicable from the following list (and even some that may not be on the list, if applicable) should be monitored: benzene, toluene, ethylbenzene, xylenes, methyl tertiary butyl ethyl, naphthalene, 1-methylnaphthalene, 2-methylnaphthalene, chloride, perchloroethylene, trichloroethylene, trans 1,2-Dichloroethylene, vinyl chloride, and 1,1,1-trichloroethane. They should be monitored in the groundwater downgradient from Bio-Sparge injection points for two (2) years, according to the terms of the May 2, 2001 variance granted to MCC Technology Incorporated.

i. Operation:

1. Avoidance of migration: For in situ injection-type aquifer remediation projects, injection of Bio-Sparge chemicals shall be performed in such a way, and at such a rate and volume, that no undesirable migration of either the chemicals or the contaminants of concern in the aquifer results, pursuant to Rule 62-528.630(3), F.A.C.
2. Underground injection control operating permit: Although an operating permit is not required for aquifer remediation wells pursuant to Rule 62-528.640(1)(b), and 62-528.640(1)(c), F.A.C., since no movement of the petroleum contamination plume is expected to accompany the Bio-Sparge product treatment process, the Department requests that the information items listed in Rule 62-528.640(1)(b), F.A.C., be considered and included in Remedial Action Plan proposals as a matter of good and thorough design practice. Briefly summarized, they are: quality of water in the aquifer; quality of the injected fluid; existing and potential uses of the affected aquifer; and well construction details. Additionally, each Remedial Action Plan should provide an estimate of the total weight of Bio-Sparge nutrients, surfactants and enzymes that will actually be injected into the subsurface over the life of the project.
3. Operating parameter measurements: Petroleum cleanup Rule 62-770.700(9)(h), F.A.C., sets forth frequency requirements for the measurement of bioremediation operating parameters such as dissolved oxygen levels, rates of nutrient addition, temperature, etc. It also includes an option for reduction in

the frequency or discontinuation of some measurements in situations when appropriate.

- j. Abandonment of wells: Upon issuance of a petroleum Site Rehabilitation Completion Order, or a declaration of "No Further Action", injection wells shall be abandoned pursuant to Section 62-528.645, F.A.C. The Underground Injection Control Section of the Department shall be notified so that the injection wells can be removed from the inventory-tracking list.

ENCLOSURE 3

MCC TECHNOLOGY BIO-SPARGE: SUPPLEMENTAL INFORMATION

The information below, compiled from several sources, may be helpful to reviewers of Remedial Action Plans proposing the Bio-Sparge process.

- a. Nature of the process: The Bio-Sparge process uses nutrients, hydrogen peroxide, surfactants, and heat to augment the bioremediation of contaminants. For applications in Florida, five (5) chemicals will be used. They will not be directly injected into the subsurface but rather poured into the aboveground vessel of the closed-loop system, from which vapors will emerge for re-injection. The five chemical additives are described below.
 - Meta-Boost: A stimulator that is a proprietary liquid blend of enzymes, nutrients, and a suspension agent.
 - Desorb-A: A biosurfactant of proprietary formulation that performs emulsification and acts as a vapor suppressant during removal of free product.
 - Nitro-Boost: A proprietary formulation of ammonium nitrate and trace micronutrients. This amendment, in a liquid form, is used to provide nitrogen, phosphorous and other bulk nutrients.
 - Deep Treat: A hydrogen peroxide based blend with micronutrients. It provides the enzymes and saturated oxygen to ensure that the remediation process will continue in an aerobic state.
 - Surfactant 1: A proprietary surfactant that can be used in the process.
- b. Instructions for state technical reviewers: Department of Environmental Protection reviewers of in situ injection-type aquifer remediation plans, regardless of whether in Tallahassee or district offices, must fill in the blanks on the enclosure 4 memorandum, whose subject is "Proposed Injection Well(s) for In Situ Aquifer Remediation at a Petroleum Remedial Action Site". The completed form must be submitted to the Underground Injection Control Section at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400. A similar form is available through the Bureau of Waste Cleanup for notification of injection at a non-petroleum remediation site.

Only reviewers within the Department and its district offices may approve in situ injection-type remediation plans in which the approval constitutes the issuance of a Class V injection permit; local programs are not authorized to grant such approvals.

Reason: Although an arrangement between the US Environmental Protection Agency and the Department delegates underground

injection control authority to the Department, it does not allow the Department to delegate that authority any further. This includes delegation to the Department's contracted remediation review agencies such as those operated by the counties and other local governments. Injection approval instructions to the local programs can be found in the Bureau of Petroleum Storage Systems guidance document BPSS-10 titled "In Situ Chemical Additives" at web page /www.dep.state.fl.us/dwm/programs/pcp/geninfo/active.htm.

- c. Patent: United States patent number 5,246,309, titled "System and Method for the Decontamination of Contaminated Ground" was issued in 1993. The inventor is identified as Michael M. Hobby of Bennion, Utah.
- d. Pilot study: For innovative technologies and bioremediation, per rule 62-770.700(2), F.A.C., a pilot study proposal shall be submitted for review, and a pilot test shall be performed prior to designing a treatment system. If conditions or the situation at a site do not warrant a pilot study, then a proposal explaining the rationale for the decision not to perform a pilot study shall be submitted for review. The state's technical reviewers are encouraged to use judgment in balancing cost and the need for technical information to be obtained from a pilot study. In some cases, only a treatability test may suffice. In other cases, perhaps only a sampling of the site for parameters indicative of bioremediation could serve in lieu of a pilot test, to show that some bioremediation is already occurring naturally and that the site may be conducive to enhancements.
- e. Bioremediation indicator samples: Prior to preparation of a remedial action plan for full-scale in situ injection-type aquifer remediation of a site, the bureau recommends the sampling of monitoring wells that are upgradient, within, and downgradient of the groundwater contamination plume for bioremediation parameters, and then comparing the results in order to determine whether intrinsic bioremediation is already occurring across the plume. Paragraph *h* below lists some of the bioremediation parameters that may be sampled. This sampling suggestion is for technical, not regulatory purposes. It is not mandatory but is recommended as a matter of good practice.
- f. Underground injection control inventory: Remedial Action Plans prescribing in situ injection-type aquifer remediation shall include information pursuant to Rule 62-528.630(2)(c)1 through 6, F.A.C., for the inventory purposes of underground injection control. Per Rule 62-528.630(2)(c), F.A.C., aquifer remediation projects involving injection wells may be authorized under the provisions of a Remedial Action Plan, provided the construction, operation, and monitoring requirements of Chapter 62-528, F.A.C., are met. A memorandum outlining the inventory information about injection-type aquifer remediation plans to be transmitted by Department reviewers to the Underground Injection Control Section is provided as enclosure 4.

- g. Degradation products: Carbon dioxide and water are the ultimate products of aerobic biodegradations of hydrocarbons. The intermediate products of aerobic degradation may include simple acids, alcohols, and fatty acids. Aerobic processes use oxygen as an electron acceptor to produce carbon dioxide and water. When chlorinated organic compounds are biodegraded, the degradation products will include chloride.
- h. Parameters: The following parameters may be useful in determining the potential for bioremediation at a site, or whether bioremediation is already occurring. They were selected from a list that appears in the publication "In Situ Treatment Technology" by E. Nyer et al., Lewis Publishers, 1996. The parameters are: dissolved oxygen; redox potential; pH; temperature; specific conductance; volatile organic compounds; nitrate; nitrite; ammonia nitrogen; manganese (total and dissolved); iron (total, dissolved, and ferrous); sulfate; sulfide; and total organic carbon. Gaseous parameters include carbon dioxide, oxygen, nitrogen, and methane. Other parameters that may be helpful are chemical oxygen demand, biochemical oxygen demand, and total organic carbon. Preparers of bioremediation plans and their reviewers should determine which parameters, if any, should be investigated on a site-specific basis.
- i. Configuration: The Bio-Sparge system is a mobile unit primarily consisting of a vacuum compressor, the Absorption Bioreactor (ABS), and an oxygen generator. Components are upgraded, added, or deleted, depending upon the specific-site requirements. In some instances, an ozone generator or in-line air heater is utilized.
- j. How Bio-Sparge works: The Bio-Sparge Absorption System (ABS) is a liquid-filled bioreactor that the soil gas effluent is sparged into. One-half the volume of the ABS is filled with bioballs. The bioballs are coated with a product called Gilsonite that encourages the growth of bacteria. Gilsonite is a naturally occurring carbon compound that is 100% insoluble in water and high in nitrogen. Within the ABS bioreactor volatile contaminants are scrubbed from the air stream as rising bubbles fragment and recombine, and are destroyed by the bacteria that are growing on the bioballs. From an operations and maintenance perspective, no activated carbon is required. A pressure of 12-20 psi is maintained in the bioreactor. The soil gas leaves the top of the Absorption Bioreactor and is recirculated to the vapor return wells.
- k. Oxygen: An oxygen generator oxygenates the liquid within the ABS bioreactor to ensure the continued growth of the bacteria.
- l. Design and operating parameters: Vacuum-pressure tests, if appropriate, are used to determine the necessary interval between wells screened across the vadose zone. A pump or slug test is utilized to calculate site-specific porosity and permeability to determine the configuration, number, and spacing of wells screened within the groundwater interval. For maximum effectiveness, the

Bureau of Petroleum Storage Systems believes that designers of remediation systems should make sure Bio-Sparge is used in such a way that adequate vertical and horizontal coverage throughout the volume of soil and/or groundwater to be remediated is achieved.

- m. Dosage and application rate: The Bio-Sparge biotreatment mixture is based on the site-specific contaminants that are present, their concentration in the soil, the soil permeability, and the total soil and/or groundwater volume requiring remediation.

Memorandum**Florida Department of
Environmental Protection**

TO: Richard Deuerling, Mail Station 3530
 Division of Water Facilities
 Underground Injection Control Section
 Florida Department of Environmental Protection
 2600 Blair Stone Road, Tallahassee, FL 32399-2400

FROM: _____ (Note 1.)

DATE: _____

SUBJ: **Proposed Injection Well(s) for In Situ Aquifer
 Remediation at a Petroleum Remedial Action Site**

Pursuant to Rule 62-528.630(2)(c), F.A.C, inventory information is hereby provided regarding the proposed construction of temporary injection well(s) for the purpose of in situ aquifer remediation at a petroleum-contaminated site.

Site name: _____

Site address: _____

City/County: _____

Latitude/Longitude: _____

FDEP Facility Number: _____

Site owner's name: _____

Site owner's address: _____

Well contractor's name: _____ (Note 2.)

Well contractor's address: _____

Brief description of the in situ injection-type aquifer remediation project:

Summary of major design considerations and features of the project:

Areal extent of contamination (square feet): _____

Number of injection wells: _____

Composition of injected fluid (Note 3)
 (ingredient, wt. %): _____

Injection volume per well (gallons): _____

Single or multiple injection events: _____

Injection volume total (all wells, all
 events): _____

Richard Deuerling

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Site name: _____

FDEP facility no.: _____

Date: _____

A site map showing the areal extent of the groundwater contamination plume, and the location and spacing of injection wells and associated monitoring wells is attached.

The following is a summary description of the affected aquifer:

Name of aquifer: _____
Depth to groundwater (feet): _____
Aquifer thickness (feet): _____

The injection well(s) features are summarized below, and/or a schematic of the injection well(s) is attached.

Direct-push or Conventional (*circle the appropriate well type*)
Diameter of well(s) (i.e., riser pipe & screen)(inches): ____
Total depth of well(s) (feet): _____
Screened interval: _____ to _____ feet below surface
Grouted interval: _____ to _____ feet below surface
Casing diameter, if applicable (inches): _____
Cased depth, if applic.: _____ to _____ feet below surface
Casing material, if applic.: _____

The in situ injection-type aquifer remediation plan for this petroleum contaminated site is intended to meet the groundwater petroleum cleanup criteria set forth in Chapter 62-770, F.A.C. Additionally, all other groundwater standards will be met at the time of project completion for any residuals associated with the ingredients of the injected remediation products, and any by-products or intermediates produced as a result of the chemical or biochemical transformation of those ingredients or the contaminating petroleum during their use. Applicable primary and secondary drinking water standards are set forth in Chapter 62-550, F.A.C., and additional groundwater quality criteria are set forth in Chapter 62-520, F.A.C.

The remediation plan estimates that site remediation will take _____ months. We will notify you if there are any modifications to the remediation strategy that will affect the injection well design or the chemical composition and volume of the injected remediation product(s).

The proposed remediation plan was approved on _____ by an enforceable approval order. A copy is attached. The remediation system installation is expected to commence within 60 days. Please call me at _____ if you require additional information.

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- Note 1. Local programs are not authorized to approve underground injections into aquifers. Reason: Per agreement with EPA, the FDEP cannot delegate this authority. Local programs, after reviewing a Remedial Action Plan or an injection proposal document, should follow the instructions in a March 16, 2000 memorandum to arrange for Department headquarters' execution of an approval order, and then complete this form. This form is primarily for use by state and local program technical reviewers, but petroleum remediation contractors may fill in all blanks except those labeled "FROM", "DATE", and "approval date", and "telephone number" blanks in the last paragraph. Only a state or local program reviewer should complete those blanks.
- Note 2. If an injection well installation contractor has not yet been selected, then indicate the name and address of the project's general remediation contractor/consultant.
- Note 3. Chapter 62-528, Florida Administrative Code, requires complete chemical analysis of injected fluid. Proprietary formulations shall make confidential disclosure. Injected fluids must meet drinking water standards of Chapter 62-550, F.A.C., unless an exemption or variance has been granted.