REMEDIAL ACTION PLAN & SYSTEM DESIGN CHECKLIST

Bureau of Petroleum Storage Systems
Florida Department of Environmental Protection

Facility Name: _____		Preapproval Site:	[ ]
Location: _____		State Cleanup Site:	[ ]
FAC ID No: _____		Voluntary Cleanup Site:	[ ]
Reviewer: _____	Contractor:	_____	

This checklist should not be applied in blanket fashion. Technical judgment may be necessary in determining the applicability of some items. However, all information listed that is relevant to the remedial design should be provided.

☑

I. GENERAL

_____ (1) RAP signed, sealed, and dated by Florida P.E. (per Section 471.025, FS)

_____ (2) indication whether proposed plan is for preapproval program, state contracted cleanup, or voluntary cleanup

_____ (3) recap of SAR information and conclusions pertinent to RAP preparation

_____ (4) current sampling results [within nine (9) months] used for remediation system design

_____ (5) potable water considerations:

- ♦ method of potable water supply to site and surrounding area
- ♦ locations of private wells within 1/4-mile, and public wells within 1/2-mile radius of site
- ♦ indication whether FDEP district office drinking water program was notified if contaminated groundwater could be expected to reach any public or private water well. Method of notification, person notified, and date

_____ (6) identification underground utilities locations, and those which may enhance transport of contaminants

_____ (7) • cleanup time: estimated cleanup time for the groundwater, for the soil

_____ (8) fencing of treatment area required, unless public access is restricted by institutional controls

_____ (9) local, state, and federal permits to be obtained, and conditions stated

_____ (10) recap of alternatives discussed and/or alternative selected during pre-RAP conference, or cost-effectiveness analysis of alternatives and identification of recommended alternative

_____ (11) statement that signed and sealed as-built (record) drawings will be provided

_____ (12) nuisance noise and odor to neighbors avoided by careful location of equipment items and exhaust stacks or other mitigating measures

II. REQUIREMENTS OF THE PRE-APPROVAL PROGRAM REMEDIAL ACTION INITIATIVE (RAI)

For cleanup projects affected by the Pre-Approval Program Remedial Action Initiative, the requirements of this section apply. The items listed below in this section are to be taken into account for each of the operations covered by the other sections of this checklist.

_____ (1) Cleanup Goals established. End of Active Remediation goal: 70% of natural attenuation default concentrations (NADC), or 90% reduction of each contaminant group, in each key well in the source area, whichever is more

FAC ID No:_____

stringent, in the specified time frame (typically one to four years). Longer cleanup times to achieve end of active remedial action goal require special justification.

_____ (2) Pilot testing of the proposed remediation strategy is generally required. Exceptions require special justification.

_____ (3) Remediation equipment must meet the specifications contained in the Remedial Action Initiative including reasonable safety factors.

_____ (4) System designs includes adequate source area treatment wells, e.g. a safety factor of 2, and consideration of using parallel or zoned systems.

_____ (5) Ultimate cleanup target levels need to be indicated, either (CTLs) of Chapter 62-770 for unconditional NFA, or Alternative CTLs for conditional NFA. For conditional NFA, owner's acknowledgement of future institutional controls at cleanup completion should be documented

_____ (6) End of Active Remediation to be followed by Natural Attenuation Monitoring. An evaluation of "time to switch" from active remedial action to Natural Attenuation Monitoring to reach ultimate cleanup target levels may be performed to allow for the continuation of active remedial action if justified.

_____ (7) Milestones schedule must be included in RAP using the BPSS milestone model. The schedule must identify key wells, contaminants of concern, baseline contaminant concentrations, and time to reach the end of active remedial action. A linear concentration vs. time profile shall apply to each contaminant group in each key well.

_____ (8) Applicability of "difficult sites" evaluation procedures established (mandatory if post-assessment cleanup cost will likely exceed $500,000 or cleanup time will exceed 4 years). Some elements of the "difficult sites" evaluation procedures may be applicable to sites with cleanups, which will not exceed $500,000, or a 4 year cleanup time. If applicability established, FDEP PE must complete difficult sites checklist attached to May 21, 2003 Difficult Sites memorandum.

_____ (9) RAP must include a Construction Plan and a construction schedule.

_____ (10) RAP must include a Startup Test Plan, and startup testing must be conducted in accordance with manufacturer's recommendations.

_____ (11) RAP must include a Preventative and Routine Maintenance Plan and checklist, a Repair Response Plan and maintenance visit schedule. The repair response plan must address sytem monitoring, equipmant operation and replacement part availability and supply.

_____ (12) RAP must indicate that equipment will be UL approved (or equivalent) and will have a warranty

_____ (13) Hour meters, flow meters, pressure gauges, and vacuum gauges specified for all critical components, including individual wells if necessary for optimization of system efficiency

_____ (14) Autodialer system specified (telemetry may be specified with justification)

_____ (16) Equipment items must be protected (covered or housed in a trailer).

_____ (17) Specifications, and an Operations Manual must be provided to FDEP/LP, and a copy must be kept at the site.

_____ (18) RAP specifies that Startup, Quarterlyand Annual Reports will be provided, and must include the information detailed in the RAI.

III. FREE PRODUCT REMOVAL

_____ (1) free product plume identification

FAC ID No:_____

_____ (2) description/design details of free product recovery system including:

♦oil/water separator sizing calculations and detention time ♦ free product storage tank of adequate size

_____ (3) automated product pump shutdown for high level in product tank

_____ (4) safety considerations: ♦ static electricity ♦ electrical & instruments per National Electrical Code

_____ (5) proper disposal and safe handling of flammable free product recovered

IV. SOIL REMEDIATION - GENERAL

_____ (1) volume of contaminated soil

_____ (2) recap of Source Removal activities and soil volume already excavated, if any

_____ (3) indication that contaminated soil will be remediated, or provide rationale for 'no action'

(4) soil cleanup target levels identified, extent of soil contamination should be delineated by use of both OVA screening results and laboratory analysis results

(5) Use of Level I Risk Management Options for soil considered, if applicable, including SPLP, TRPH fractionation, and calculation of site specific SCTLs based on soil properties

_____ (6) proper handling & treatment of excavated, contaminated soil, or proper handling & disposal of hazardous soil (e.g., ignitable, corrosive, reactive, toxic, or petroleum refining waste)

V. LAND FARMING OF SOIL

_____ (1) adequate surface area available (_____ sq ft) to spread soil 6 to 12 inches thick

_____ (2) location of land farming operation

_____ (3) land farming area is flat (less than 5% slope)

_____ (4) impermeable base provided. Type: _____

_____ (5) surface water runoff controls provided

_____ (6) groundwater monitoring plan proposed if land farm is outside of immediate contamination area

_____ (7) frequency of tilling provided

_____ (8) frequency and details of nutrient application or other enhancements provided (if proposed)

_____ (9) soil sampling frequency and sampling methods provided

_____ (10) potential for land farm causing nuisance conditions evaluated

(11) underlying soil and groundwater monitoring procedures provided and acceptable

_____ (12) land farming will be continued until the contaminants of concern meet soil cleanup target levels

_____ (13) cost-effectiveness

_____ (14) ultimate disposition of soil discussed

_____ (15) need to fence land farm area considered

VI. LANDFILLING OF SOIL

_____ (1) landfill lined and permitted by FDEP

_____ (2) name and location of landfill provided along with conditions of acceptance

_____ (3) cost-effectiveness

FAC ID No:_____

_____ (4) For out-of-state landfill disposal, evidence provided that petroleum contaminated soil disposal in the landfill complies with the landfill regulations of the other state.

VII. SOIL THERMAL TREATMENT

_____ (1) name and location of thermal treatment facility provided

_____ (2) facility is permitted for thermal treatment of petroleum contaminated soil

_____ (3) pretreatment soil sample analyses

_____ (4) cost-effectiveness

VIII. COMMERCIAL BIOREMEDIATION OF SOIL

_____ (1) name and location of bioremediation facility provided

_____ (2) facility is permitted for bioremediation of petroleum contaminated soil

_____ (3) pretreatment soil sample analyses

_____ (4) cost-effectiveness

IX. IN SITU BIOVENTING OF SOIL

_____ (1) soil cleanup criteria identification

_____ (2) estimated mass of contaminants of concern in the vadose zone

_____ (3) recap of information and data from pilot study that is pertinent full-scale system design

_____ (4) layout

- ♦ well type — vertical or horizontal
- ♦ well construction details
- ♦ location of air injection and air extraction wells with respect to contaminated soil plume location and depth
- ♦ location and depth of soil gas monitoring probes with respect to contaminated soil plume and the air injection and extraction wells

_____ (5) design and operating parameters, equipment sizing calculations, mechanical details

_____ (6) instruments, controls, gauges, and valves

_____ (7) monitoring plan: CO_2; pertinent bioremediation parameters; contaminants of concern

_____ (8) air emissions

- ♦ demonstration that primary mechanism of remediation will be bioremediation and not volatilization. Air flow rates will be limited based on oxygen demand for bioremediation as demonstrated by pilot study results
- ♦ evaluation of methods for off-gas treatment if pilot test indicated that a significant amount of hydrocarbon volatilization will occur

X. SOIL VAPOR EXTRACTION

_____ (1) prerequisites: ♦ relatively permeable soil ♦ depth to groundwater > 3 ft ♦ relatively volatile contaminants

_____ (2) recap of information and data from pilot study that is pertinent to full-scale system design:

(3) full-scale design

FAC ID No:_____

_____ (a) layout and spacing of SVE wells (consideration given to radius of influence and overlapping of radii)

_____ (b) vapor extraction well(s)

- ♦ no. of wells ♦ cfm each well ♦ total cfm ♦ well type (vertical or horizontal) ♦ well construction details

_____ (c) pneumatic design

- ♦ operating vacuum @ wellhead(s) (inches of water)
- ♦ piping system friction losses
- ♦ pump motor (hp) based on system losses plus required vacuum at wellhead

_____ (d) vacuum source type: regenerative blower; positive displacement vacuum pump; other

- ♦ design specifications: cfm @ inches of water; operating cfm @ inches of water
- ♦ mfr; model; motor hp; rpm; performance curves
- ♦ nonferrous materials of construction and/or assembly to minimize potential for sparking and friction
- ♦ explosion-proof motor

_____ (e) moisture separator/condensation trap ("knock out pot") prior to inlet of vacuum pump

_____ (f) surface sealing provided for vacuum extraction, or existing concrete or asphalt adequate

_____ (g) safety

- ♦ system operation at approximately 25% of Lower Explosive Limit (LEL)
- ♦ bleed valve provided to control flammable vapor concentrations

_____ (h) instrumentation, gauges, and appurtenances

_____ (i) air emissions control (general)

- ♦ method of off-gas treatment to be provided during first month of system operation (provide details in Section X or XI for carbon adsorption or thermal oxidation of off-gas, or provide details of an alternative method)

_____ (j) system monitoring

- ♦ sample and analyze air emissions for total petroleum hydrocarbons, weekly for first month, monthly for next two months, quarterly thereafter
- ♦ vacuum measurement locations (suggestion: use monitor wells at various radial distances from extraction wells)
- ♦ acknowledge that air emission controls must be provided for at least first 30 days, but may have to be continued longer until petroleum hydrocarbon emissions to the atmosphere are less than 13.7 lbs/day

XI. VAPOR-PHASE CARBON ADSORPTION (for control of air emissions)

_____ (1) recap of information and data from pilot study that is pertinent to full-scale system design, if a pilot was conducted

_____ (2) cost-effectiveness evaluation in comparison to other alternatives for control of air emissions

_____ (3) mechanical details, sizing calculations, and operating parameters

_____ (4) instrumentation, controls, gauges, sampling and valves

_____ (5) safety

- ♦ operation of system below Lower Explosive Limit (LEL) for type of vapors being handled

FAC ID No:_____

- ♦ observance of appropriate requirements in Series 500 articles of the National Electrical Code — equipment shall meet either Class I, Group D, Division 1 or Class I, Group D, Division 2 hazardous area requirements, whichever is applicable, when an equipment item is located in a hazardous area as defined by the code

XII. THERMAL/CATALYTIC OXIDATION (for control of air emissions)

_____ (1) cost-effectiveness evaluation in comparison to other alternatives for control of air emissions

_____ (2) mechanical details, equipment sizing calculations, and operating parameters

_____ (3) instrumentation, controls, gauges, and valves. [schematic or mobile unit manufacturer's drawings indicating instrumentation, controls, gauges, and valves for all process streams (contaminant-laden influent, fuel gas, and combustion air)]

_____ (4) safety considerations include, but are not limited to:

- ♦ bleed valve or dilution control valve to maintain influent flammable vapor concentration at 25% of the Lower Explosive Limit (LEL)
- ♦ air purge prior to re-ignition
- ♦ observance of appropriate requirements in Series 500 articles of the National Electrical Code — equipment shall meet either Class I, Group D, Division 1 or Class I, Group D, Division 2 hazardous area requirements, whichever is applicable, when located in a hazardous area as defined by the code
- ♦ use of thermal or catalytic oxidizers which meet appropriate fire codes for handling natural or propane gas and prevention of furnace explosions — National Fire Protection Association, Industrial Risk Insurer's, Factory Mutual, etc. Some of the most important safety shutdowns for gas-fired burners occur upon: high gas pressure; low gas pressure; loss of combustion supply air; loss or failure to establish flame; loss of control system actuating energy; power failure

XIII. GROUNDWATER EXTRACTION

_____ (1) feasibility of using existing on-site wells for groundwater extraction considered

_____ (2) recovery well summary

- ♦ recovery well or trench location(s) and construction details included (diameter, screen length, grout, etc.)
- ♦ recovery well depth and screen length appropriate for depth of contamination

_____ (3) predicted horizontal and vertical area of influence provided

_____ (4) expected drawdown in recovery well or trench

_____ (5) consideration of multiple well configuration to minimize drawdown

_____ (6) groundwater pump performance requirements, sizing, and description

- ♦ hydraulic design considerations (friction losses and suction lift)
- ♦ pump performance curve or information provided (flow rate vs. pressure)
- ♦ pump manufacturer, model; hp, rpm

_____ (7) automated well level controls provided for stopping/starting groundwater pump(s)

_____ (8) totalizing flowmeter installed on influent line from each groundwater recovery pump

_____ (9) check valve provided on pump discharge piping if not integral to pump

FAC ID No:_____

_____ (10) shutoff/throttling valve provided on pump discharge piping

XIV. GROUNDWATER TREATMENT SYSTEM - GENERAL

_____ (1) influent concentrations for each contaminant of concern, for design of treatment system, based on either actual dynamic pump test sample, weighted averaging procedure, or other reasonable assumption

_____ (2) feasibility & cost-effectiveness of direct discharge of recovered contaminated groundwater to sewer treatment plant, instead of onsite treatment

_____ (3) site piping summary

- ♦ schematics of all treatment components, piping, valves, controls and appurtenances provided
- ♦ influent and effluent sampling ports provided
- ♦ piping type and size provided

_____ (4) fouling & scaling considerations

- ♦ whether control of iron fouling is necessary, either by filtration of influent to remove particulately-bound iron, and/or by removal or sequestering of dissolved iron to prevent precipitation in process equipment items
- ♦ whether pretreatment or other measures necessary to prevent precipitation of calcium carbonate (Langelier Index)
- ♦ whether pretreatment or scheduled O&M measures will be needed for control of biofouling

XV. AIR STRIPPING TREATMENT PROCESS

_____ (1) packed tower

- ♦ type, size, and surface area of packing
- ♦ design and operating parameters, sizing calculations, mechanical details (tower height; packing type, height, surface area; air/water ratio; pressure drop; blower type, model, hp; mist eliminator; etc.)

_____ (2) diffused aerator (tank type)

- ♦ design and operating parameters, sizing calculations, mechanical details (tank volume; contact time; air flow rate; pressure drop; removal efficiency of contaminants of concern; blower type, model, hp; etc.)

_____ (3) low profile air stripper

- ♦ design and operating parameters, sizing calculations, mechanical details (number of trays; water flow rate; air flow rate; air/water ratio; pressure drop; blower type, model, hp; mist eliminator)

_____ (4) general

- ♦ instrumentation, controls, gauges and valves
- ♦ air emissions calculations; emissions stack height
- ♦ equipment description if emissions treatment necessary
- ♦ automated recovery well shutdown when blower failure occurs
- ♦ sampling of effluent, daily for first three days, monthly for next two months, quarterly thereafter

XVI. LIQUID-PHASE CARBON ADSORPTION

_____ (1) recap of information and data from pilot study that is pertinent to full-scale system design, if a pilot was conducted

_____ (2) indication whether adsorption is for primary treatment of groundwater or polishing of effluent

FAC ID No:_____

_____ (3) carbon specifications

_____ (4) carbon unit(s) sizing calculations (carbon usage rate, contact time, pressure losses) design assumptions

_____ (5) TOC in groundwater determined and effect on carbon usage considered

_____ (6) need for sand filter or cartridge unit prior to carbon unit considered

_____ (7) pressure gauge and pressure relief valve provided on carbon (and sand) filter

_____ (8) carbon disposal and replacement method

_____ (9) series configuration of carbon units considered to allow for maximum carbon utilization and prevention of contaminant breakthrough to system effluent

_____ (10) automated recovery well shutdown if primary carbon unit pressure too high

_____ (11) schedule for sampling between and after carbon adsorption units

XVII. IN SITU AIR SPARGING OF GROUNDWATER

_____ (1) prerequisites

- ♦ no or little free product which could spread via sparge turbulence, or prolong sparging
- ♦ volatile (C_3-C_{10}) petroleum fractions with Henry's Constant ≥ 0.00001 atm∗m^3/mol (approx. rule of thumb, unless biosparging is proposed)
- ♦ no high concentrations of metals (iron, magnesium) to form oxides which plug aquifer or well screens, or high concentrations of dissolved calcium, which could react with CO_2 in air to clog aquifer w/calcium carbonate

_____ (2) recap of information and data from pilot study that is pertinent to full-scale system design

(3) full-scale design

_____ (a) groundwater contamination plume coverage

- ♦ location(s) and radius of influence for full-scale air injection well(s)
- ♦ adequate coverage by overlapping radii of influence if multiple well system

_____ (b) air injection well(s): no. of wells; well design; operating air pressure at wellheads; cfm each well; total cfm _____

_____ (c) avoidance of long screen allowing air to diffuse at top portion only, where air flow resistance is least (typ screen is 1 to 3 ft long)

_____ (d) well depth and screened interval (or depth of sparge tip) appropriate w/respect to depth of contamination

_____ (e) vapor extraction well(s) in conjunction w/sparging situated properly to recover volatiles and prevent their release to atmosphere

- ♦ injection cfm of air typically 20 to 80% of vapor extraction cfm (0.2 to 0.8)
- ♦ automatic shutdown of air injection upon loss of, or low, vapor extraction system vacuum, or failure of vacuum pump motor, in order to prevent air emissions
- ♦ adequate and cost-effective treatment of vapor extraction system off-gas proposed to prevent air emissions

_____ (f) compressor

- ♦ design: cfm @ psig; operating cfm @ psig

FAC ID No:_____

- ♦ type; mfr; model; motor hp; rpm; performance curves; air filter at compressor inlet; oil trap or oil-free compressor to avoid introducing more contamination to aquifer

_____ (g) safety: pressure relief valve at discharge of compressor and/or high pressure switch for automatic shutdown

_____ (h) instrumentation and gauges: pressure indicating gauges at each sparging well

_____ (i) air flow control: shutoff/throttling valve at each well; other flow control device or method

XVIII. IN SITU BIOREMEDIATION

_____ (1) general:

- ♦ media to be remediated: groundwater; soil
- ♦ application method: direct-injection; recirculating/re-injection type system; addition to excavation pit
- ♦ aerobic or anaerobic
- ♦ stimulation of indigenous microorganisms or addition of microorganisms

_____ (2) recap of information and data from pilot study that is pertinent to full-scale system design

_____ (3) design and operating parameters (e.g.: injection well construction details; layout and spacing of wells commensurate with injection radius of influence for adequate horizontal coverage; screened interval of injection wells commensurate with vertical extent of contamination for adequate vertical coverage; injection pump develops adequate pressure and flow rate for injection , for the site-specific conditions.)

_____ (4) dosage (of nutrients and/or microorganisms, per pound of hydrocarbon contaminants to be biodegraded) (Some bioremediation products may express dosage as a required amount per cubic yard of contaminated media.)

_____ (5) RAP (or RAP Mod) must contain the necessary underground injection control information required by Chapter 62-528 FAC. [That is, the RAP must contain enough information for a state or local program reviewer to fill out the 2-page UIC notification memorandum titled "Proposed Injection Well(s) for In Situ Aquifer Remediation at a Petroleum Remedial Action Site".] This includes the following information:

- ♦ chemical analysis (composition) of the fluid to be injected. Note: The injected fluid must meet primary and secondary drinking water standards of Chapter 62-550, FAC, and the minimum groundwater criteria of Chapters 62-520 and 62-777 FAC, otherwise Rule 62-522.300(2)(c) may apply and/or a zone of discharge variance may be necessary.
- ♦ no. of injection wells ♦ no. of injection events ♦ injection volume per well per injection event
- ♦ total injection volume (i.e. the total for all injection wells, all injection events)

_____ (7) anticipated schedule of injection events for nutrients and/or microorganisms (i.e. the timing and frequency of injections over the life of the project)

_____ (7) provide additional oxygen, if necessary, if the bioremediation is aerobic and site's groundwater is lacking in dissolved oxygen. (method by which additional oxygen will be delivered.; provide design details if method of delivery is mechanical, e.g. air sparge, O_2 injection, iSOC, etc.; provide chemical information if oxygen is supplied chemically: e.g. magnesium peroxide, calcium peroxide, hydrogen peroxide, etc.)

_____ (9) ♦ sampling plan includes not just the analysis of samples for petroleum contaminants of concern at a site, but also analyses necessary for any of the following that apply: compliance with the underground injection control

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regulations of Chapter 62-528; compliance with Rule 62-522.300(2)(c); and compliance with the terms of an injection zone of discharge variance. Also, analysis for more than just the reagents may be necessary, depending on the situation. In some cases, if there are environmental or toxicological concerns, it may be necessary to include analysis for intermediate degradation products of the reagents, or intermediate by-products formed by the interaction of those reagents with the petroleum contaminants of concern at a site.

- ♦ other samples and operating parameter measurements for a bioremediation project may inlcude, but are not necessarily limited to the following: pH, DO, ORP, N, P, Temperature, TOC, Alkalinity., microbe counts

XIX. LEAD (this section can also be adapted to other heavy metals if necessary)

_____ (1) discussion of area(s) where groundwater lead concentration exceeds 15 ppb

_____ (2) lead concentrations (ppb): unfiltered (____); filtered (____); background (____)

_____ (3) proposal for lead removal by filtration if unfiltered sample is greater than 15 ppb and filtered sample is less than 15 ppb

_____ (4) method of lead removal, including pertinent design calculations

_____ (5) if lead (or other heavy metals) will not be removed by filtration, then provide details of proposed treatment

XX. INFILTRATION GALLERY

_____ (1) recap of field percolation test results (preferably with double-ring infiltrometer)

_____ (2) infiltration gallery construction details and location (upgradient location if site layout allows)

_____ (3) gallery calculations/assumptions with mounding analysis

_____ (4) piezometer and cleanout pipe in gallery

_____ (5) geotextile filter fabric to be installed around and above gallery

_____ (6) discussion or modeling of gallery for effect on plume migration

XXI. INJECTION WELL (for effluent disposal)

_____ (1) discussion of injection zone and relevant lithology information

_____ (2) recap of information and data from pilot study that is pertinent to full-scale system design, if a pilot was conducted

_____ (3) injection well location and construction details

_____ (4) screened interval appropriate

_____ (5) effluent discharge pump adequately sized for required injection flow rate and pressure

_____ (6) carbon polishing unit (or equivalent)

_____ (6) air release valve at highest point of effluent discharge piping

_____ (7) injection rate (well hydraulics) calculations

_____ (8) Underground Injection Control (UIC) inventory information provided. (RAP or RAP Mod must contain enough information for a technical reviewer to complete the 2-page UIC effluent injection notification.)

_____ (9) evaluation of injection well's effect on potable wells and plume migration

FAC ID No:_____

XXII. ALTERNATIVE EFFLUENT DISPOSAL METHODS

_____ (1) cost-effectiveness comparison of alternatives (including general permit fee of $2,500 per year in the cost estimate for NPDES disposal, if it is one of the alternatives being compared)

_____ (2) for surface water discharge

- ♦ conditions for NPDES general permit met
- ♦ indication that notice of intent for NPDES permit will be submitted after RAP approval

_____ (3) if applicable, consumptive use permit obtained from Water Management District

_____ (4) approval from municipality for sewer discharge, and conditions and effluent standards to be met

_____ (5) applicable permits for stormwater discharge

XXIII. SAMPLING REQUIREMENTS

_____ (1) designated / key monitoring wells and frequency of their sampling per 62-770.700, FAC

_____ (2) analysis of designated / key monitoring well samples for appropriate contaminants of concern for the site

_____ (3) sampling of influent from recovery well(s); daily first 3 days, monthly next 2 months, quarterly thereafter

_____ (4) sampling of system effluent, daily for first three days, monthly for next two months, quarterly thereafter

_____ (5) water level data collected at same time & frequency of monitoring well and recovery well sampling

XXIV. IN SITU CHEMICAL OXIDATION

_____ (1) media to be remediated: groundwater; soil

_____ (2) recap of information and data from pilot study that is pertinent to full-scale system design

_____ (3) design and operating parameters (e.g.: injection well construction details; layout and spacing of wells commensurate with injection radius of influence for adequate horizontal coverage; screened interval of injection wells commensurate with vertical extent of contamination for adequate vertical coverage; flow rates; temperatures; pressures; pH; concentrations, etc.)

_____ (4) amount of reagents required per pound of hydrocarbons to be destroyed (theoretical amount, actual amount)

_____ (5) RAP (or RAP Mod) must contain the necessary underground injection control information required by Chapter 62-528 FAC. [That is, the RAP must contain enough information for a state or local program reviewer to fill out the 2-page UIC notification memorandum titled "Proposed Injection Well(s) for In Situ Aquifer Remediation at a Petroleum Remedial Action Site".] This includes the following information:

- ♦ chemical analysis (composition) of the fluid to be injected. Note: The injected fluid must meet primary and secondary drinking water standards of Chapter 62-550, FAC, and the minimum groundwater criteria of Chapters 62-520 and 62-777 FAC, otherwise Rule 62-522.300(2)(c) may apply and/or a zone of discharge variance may be necessary.
- ♦ no. of injection wells ♦ no. of injection events ♦ injection volume per well per injection event
- ♦ total injection volume (i.e. the total for all injection wells, all injection events)

_____ (6) ♦ sampling plan includes not just the analysis of samples for petroleum contaminants of concern at a site, but also analyses necessary for any of the following that apply: compliance with the underground injection control regulations of Chapter 62-528; compliance with Rule 62-522.300(2)(c); and compliance with the terms of an

FAC ID No:_____

injection zone of discharge variance. Also, analysis for more than just the reagents may be necessary, depending on the situation. In some cases, if there are environmental or toxicological concerns, it may be necessary to include analysis for intermediate degradation products of the reagents, or intermediate by-products formed by the interaction of those reagents with the petroleum contaminants of concern at a site.

- ♦ other samples and operating parameter measurements for a chemical oxidation project may inlcude, but are not necessarily limited to the following: pH, DO, ORP, Temperature, and Alkalinity.

_____ (7) anticipated schedule of injection events for reagents (i.e. the timing and frequency of injections over the life of the project)

_____ (8) safety (items applicable to fire, explosion, toxicological and safe handling of chemicals may include, but are not necessarily limited to those listed below)

- ♦ material safety data sheets, toxicity, or other information pertinent to the chemicals and catalysts involved
- ♦ safe handling of chemicals: avoidance of mixing, premature mixing, or improper storage of incompatible chemicals
- ♦ Lower Explosive Level (LEL) considerations
- ♦ potential for vapor migration, either passively or by convection, or driven by air or other gases used, or generated by the heat of exothermic chemical reactions or the vaporization of free product by such heat
- ♦ the minimum tolerable distance between underground storage tanks and product piping and any in situ heat-generating process
- ♦ the need replace the flammable contents of petroleum storage tanks and their associated piping with non-flammable inerts such as nitrogen or carbon dioxide, in order to reduce risk of fire and explosion.
- ♦ observance of National Electrical Code (typically Series 500 articles for Class I, Group D, Division 1 or 2 hazardous area requirements) (for electrical equipment items located in a hazardous area)
- ♦ appropriate chemical-resistant and/or spark-resistant materials of construction for equipment items
- ♦ personal protection of workers
- ♦ safety considerations regarding neighbors and passersby