TCEQ REGULATORY GUIDANCE
Remediation Division
RG–523/PST-11 • March 2017

Operation, Monitoring, and Performance of Remediation Systems at LPST Sites

Introduction

The goals of a successful corrective action plan (CAP) are not only to design and install a cost-effective and efficient remediation system for sites with leaking petroleum-storage tanks (LPSTs), but also to operate the system in a manner that optimizes both efficiency and effectiveness so that the greatest amount of contamination is removed in the shortest period of time. Therefore, an integral component of any CAP is an operation, monitoring, and performance (OMP) plan. These guidelines intend to aid the registered corrective action specialists (RCASs) and licensed corrective-action-project managers (CAPMs) in the development and design of an OMP plan.

The OMP plan is essential for monitoring the progress of the remediation system toward successfully meeting predetermined target concentrations. Since the groundwater monitoring and sampling plan also evaluates system performance and determines if target concentrations are being achieved, these two plans have been merged and incorporated into one, known as the OMP plan.

Once the CAP is approved, installed, and operational, the RCAS and CAPM implement the OMP plan and collect the data as specified in the plan. The RCAS and CAPM should submit the monitoring results and an evaluation of system performance to the TCEQ in the reporting format specified in this document.

OMP Plan

The OMP plan is considered part of the CAP submitted to the TCEQ and must at least include the following information:

- A monitoring plan for the remediation system startup phase, which specifies monitoring and adjusting system components to optimize contaminant mass removal. The plan typically designates where and how often to collect flow measurements, vacuum readings, vapor concentrations, groundwater-pumping data, and biodegradation indicators, as outlined in Tables 1 and 2 of this document, in order to

evaluate system operation and improve system performance to maximize contaminant removal.

- A monitoring plan for long-term system operation in the remedial phase that identifies the type of media to be monitored, monitoring locations and frequency, constituents to be analyzed, and methods for sample collection. The plan should also specify the monitoring of system parameters like flow measurements, vacuum readings, vapor pressure, etc., needed to evaluate system performance.
- A description and schedule of any routine system maintenance, including any anticipated equipment replacements or upgrades.
- A description of the procedures for preventing and abating unauthorized discharges.
- A discussion of how the monitoring data and system performance indicators will be used frequently and routinely to evaluate system performance.
- A description of the procedures for addressing system-performance issues when the system fails to meet the designed performance criteria as specified in the CAP.
- A discussion of how to determine whether the target concentrations have been met or optimum mass removal has been achieved.
- A description of the monitoring and reporting requirements for any discharge permits.

Monitoring Requirements

The RCAS and CAPM are responsible for developing an appropriate OMP plan for the system that will be installed. Table 1 presents the **startup** monitoring requirements for the selected technologies of the different types of remediation systems, and Table 2 presents the **long-term** monitoring requirements associated with the remedial phase. The monitoring requirements specified in both tables are largely based on guidance from the U.S. Environmental Protection Agency (EPA) regarding CAPs (also see *Corrective Action Plans for LPST Sites*, TCEQ publication RG-523/PST-10) and characterize the monitoring necessary to adequately evaluate system operation and performance. Therefore, at a minimum, the parameters in Tables 1 and 2 should be monitored. Depending on the size and type of system, it may be appropriate to adjust the monitoring frequencies or the number of sampling locations, as long as any adjustments made will not directly affect the ability to properly evaluate system performance. If the monitoring frequencies in the OMP plan will be adjusted, reduced or revised (from the requirements in Tables 1 and 2), adequate justification must be provided to the TCEQ by the RCAS and CAPM.

Vapor concentrations must be routinely monitored using the appropriate field instruments, such as photo ionization detectors (PIDs), flame ionization detectors (FIDs), organic vapor analyzers (OVAs), etc. In addition, perform laboratory analyses as necessary to meet any required

operating permits. Conduct laboratory analyses to verify field measurements when evaluating system performance monthly or as necessary to comply with the provisions of any required operating permit.

Groundwater monitoring during the remedial phase is considered part of the OMP activities associated with the remediation system, and is included in the OMP plan along with any work plans for OMP activities. Groundwater monitoring may be quarterly, semi-annually, or annually, depending on site conditions. The data collected from the groundwater-monitoring program should be adequate to monitor contaminant plume movement, the trend in contaminant concentrations versus groundwater fluctuations, and the extent of cleanup remaining. The results are to be documented in the OMP report (OMPR) (TCEQ-00696); therefore, no annual groundwater-monitoring report is required.

If additional monitoring data are required beyond what is specified in Tables 1 or 2, or if a technology other than those listed in Tables 1 and 2 is proposed, contact the TCEQ to discuss the proposed monitoring plan. Startup and long-term monitoring plans should be specifically designed to evaluate the effectiveness of the remediation system. The goal of the OMP plan is to have the remediation system operational a minimum of 85 percent of the time, based on the clock-meter readings, during the reporting time period. During operations, the system must not only be running, but it must also be effective at recovering contamination. It is the responsibility of the RCAS and CAPM to keep track of and document system downtime accrued, to ensure optimum performance as specified in the CAP, or to recommend termination of system operations when results are not beneficial or effective. In such situations, contact the TCEQ immediately to discuss system shutdown and an alternate plan for remedial activities. Include documentation of system downtime accrued in the System-Status Report (SSR) and in the OMPR.

OMP Report (TCEQ-00696)

Complete the OMPR when submitting information collected during the implementation of the OMP plan, and to document the monitoring results and performance evaluation of the remediation system.

A copy of the OMPR is available for download on the TCEQ PST Forms and Guidance webpage at <www.tceq.texas.gov/goto/pst-downloads.>

Submit the OMPR, along with supporting documentation, to the TCEQ at least annually for active remediation systems or ongoing remedial activities. An OMPR must be accompanied by a work plan for continued system operation or the next appropriate action (i.e., modification, or system shutdown). If continued operation is warranted, submit the OMPR along with a work plan for continued OMP activities prior to the expiration of any current span of approved activities to allow the TCEQ adequate time to review the proposed activities.

The OMPR is a standard form designed to be used for all types of remediation systems. Therefore, only complete the appropriate sections of the form, depending on the type of system selected. Although some of the

information requested on the OMPR may also be reported on other TCEQ forms, duplicate it in the OMPR in order to give the TCEQ a complete and comprehensive summary of remedial actions and progress.

A list of required attachments is included with the OMPR. Some attachments may not be applicable, depending on the type of remedial technology. Submit only the information that applies to the type of system in use at the site.

The RCAS and CAPM should evaluate the monitoring data every time it is collected to determine if the progress goals and standards of the system's design criteria are being met. If at any time during the system's operation, monitoring data indicates a modification or termination is anticipated or required, the RCAS and CAPM must submit an OMPR to the TCEQ with all supporting documentation as well as a work plan for the next appropriate action. If the monitoring data indicate that the system did not meet the design criteria or did not operate effectively or efficiently in depleting contaminant concentrations or preventing plume migration for three consecutive quarterly monitoring events, and that the CAP goals are not being met, then it will be necessary for the RCAS and the CAPM to evaluate the system for adjustments or modifications. Modifications may also be necessary if one portion of the contaminant plume meets the target concentrations while other portions of the plume are not showing the desired progress. The RCAS and CAPM must submit an OMPR with all the supporting documentation along with a recommendation for system modification. If the system is operating effectively and efficiently, with minimal repairs, equipment replacement, or modifications, the OMPR may be submitted to the TCEQ annually.

If monitoring data shows that the target concentrations have been met or the mass removal of contaminants has reached a plateau with the current system for two consecutive quarterly monitoring events, the RCAS and CAPM must contact the TCEQ for a determination of whether the system should be temporarily shut down. The RCAS and CAPM must then re-evaluate the overall remedial strategy and revise it if necessary, or request the TCEQ's approval to implement a post-remedial verification monitoring program.

System Status Report

In some situations, if system operating time or performance does not meet the design criteria, or if a receptor is threatened or impacted, the TCEQ may request the submission of a SSR as a progress report rather than waiting until the submission of the annual OMPR to evaluate system performance. The SSR includes current performance data over a shorter period of time, thus allowing the TCEQ to evaluate system performance more closely to ensure that progress goals are being met. This report must include a summary of activities completed, an evaluation of the data included, deviations from the agreed scope of work, and recommendations for additional work needed to ensure optimal system performance or necessary assessment activities to move the site toward closure.

The SSR must include at least the following information:

- LPST ID number, facility name, and location.
- A discussion of the type of remediation system and the date installed.
- A detailed chronology covering the reporting period. Include dates of site visits, status of system upon arrival and departure, work performed, and the names of all persons performing the tasks.
- Dates and explanations for non-routine downtime (greater than 24 hours).
- System runtime in percentage calculations, based on clock-meter readings for the reporting period.
- A description of the remediation system effectiveness.
- A site map depicting system configuration and well locations.
- Cumulative tables showing recovery data by
    - phase (water, product, vapor),
    - system operating data (clock-meter readings, vacuum readings, airflow rate, groundwater-pumping rate, totalizer readings, and vapor-treatment-unit temperature and pressure, etc.), and
    - operating data from each of the active recovery wells (vacuum, airflow rate, cycle counter or clock meter, and pumping rate, if the device is installed).
- Cumulative tables of
    - groundwater analytical data along with vapor (influent and effluent) samples from each of the active recovery wells,
    - dynamic gauging data for each of the active recovery wells (depth to product, depth to water, and depth to pump inlet during pumping), and
    - groundwater analytical data from the groundwater-monitoring event.
- Maps of
    - dissolved-phase contaminant concentrations,
    - groundwater gradient, and
    - monitoring wells containing non–aqueous phase liquid (NAPL) encountered during the groundwater-monitoring event.
- Analytical laboratory reports with documentation of each chain-of-custody (COC).
- Any applicable waste manifests and discharge reports.

Additional Information

For assistance in preparing OMP plans and the OMPR, the latest version of the EPA guidance document *How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites: A Guide for Corrective*

Action Plan Reviewers (EPA 510-B-94-003; EPA 510-B-95-007; EPA 510-R-04-002; and EPA 510-B-16-005) can be downloaded at

<www.tceq.texas.gov/goto/pst-downloads>.

The forms and guidance developed by the TCEQ for preparing CAPs and OMP plans as well as their requirements are based largely upon the information presented in the referenced EPA publication. The TCEQ uses it as the principal guide for reviewing CAPs and OMP plans.

Table 1 - Monitoring Frequencies for a Remediation System During the Startup Phase[1]

Type of System	Monitoring Frequency	What to Monitor[2]		Where to Monitor
Air Sparging	3 site visits during system startup within the first 7 days	• airflow rate		• sparging wellhead and/or manifold
		• sparging pressure		• sparging wellhead and/or manifold
		• operating time		• clock meter[3]
		• dissolved-oxygen concentration		• monitoring well
Dual-Phase Extraction	New system – daily for 3 days Refurbished or reused system – daily for 5 days	• airflow rate		• extraction wellhead and manifold
		• vacuum reading		• extraction wellhead and manifold
		• vapor (influent and effluent) samples (1 set during startup)		• manifold sampling port and effluent sampling port
		• vapor concentrations via field equipment		• manifold sampling port and effluent sampling port
		• vapor-treatment-unit pressure		• vapor-treatment-unit
		• groundwater-pumping rate		• extraction wellhead and totalizer
		• operating time		• clock meters for SVE and GWE[5]
Enhanced Aerobic Bioremediation	Weekly for the first 14 days	**Injection**	• flow rate	• injection wellhead and manifold
			• injection pressure	• injection wellhead and manifold
			• dissolved-oxygen concentration[4]	• monitoring well
			• operating time	• clock meter[3]
		Extraction	• refer to Soil-Vapor Extraction	• refer to Soil-Vapor Extraction
Groundwater Pump & Treat	New system – daily for 3 days Refurbished or reused system – daily for 5 days	• pumping rate and total volume		• manifold and totalizer
		• depth to water and gauging (elevation) of the pump inlet		• pumping well
		• water (influent and effluent) samples (1 set during startup)		• effluent sampling port and manifold
		• operating time		• clock meter[3]
NAPL-Only Recovery System	Monthly	• depth to water and NAPL		• monitoring well
		• depth to pump inlet		• monitoring well
		• amount of fluid in holding tank		• holding tank
		• operating time		• clock meter[3]
Soil-Vapor Extraction	New system – daily for 3 days Refurbished or reused system – daily for 5 days	• airflow rate and vacuum readings		• extraction wellhead and manifold
		• vapor (influent and effluent) samples (1 set during startup)		• vapor sampling port and effluent sampling port
		• vapor concentrations via field equipment		• manifold sampling port and effluent sampling port
		• vapor-treatment-unit temperature		• vapor-treatment-unit
		• operating time		• clock meter[3]

[1] The startup period is 7 days, except for enhanced aerobic bioremediation, which is 14 days. Startup visits must begin immediately after installation unless otherwise approved by the TCEQ. Scheduled daily visits need not be consecutive but must be conducted within the designated startup period.

[2] During the startup period, collect one set of (1) vapor samples or (2) water influent and effluent samples, or both, for laboratory analysis. Conduct and record field screening for vapor extraction during the site visit.

[3] When a clock meter is not available, use the telemetry unit to record and report system operating time.

[4] For enhanced aerobic bioremediation, dissolved-oxygen must be field screened.

[5] A dual-phase extraction system is integrated with soil-vapor extraction (SVE) and groundwater-extraction (GWE) units.

[6] Other than a stand-alone remediation system, groundwater extraction (pump and treat) can be used as an interim containment measure or to enhance the effectiveness and efficiency of an alternative remedial method (e.g., soil-vapor extraction, air sparging or enhanced aerobic bioremediation).

Table 2 - Long-Term Monitoring Frequencies[1] for a Remediation System

Type of System	Monitoring Frequency	What to Monitor[2]		Where to Monitor
Air Sparging	Monthly	• airflow rate		• sparging wellhead and/or manifold
		• sparging pressure		• sparging wellhead and/or manifold
		• operating time		• clock meter[2]
Dual-Phase Extraction	Weekly	• airflow rate and vacuum reading		• extraction wellhead and manifold
		• vapor concentrations via field equipment		• manifold
		• treatment-unit temperature		• vapor-treatment-unit
		• pumping rate		• extraction well
		• total groundwater volume pumped		• totalizer
		• depth to water and gauging (elevation) of the pump inlet		• extraction well[3]
		• operating time		• clock meter[2]
	Monthly	• vapor and water (influent[4] and effluent) samples		• manifold and discharge point
Enhanced Aerobic Bioremediation	Monthly	Injection	• flow rate	• injection wellhead and manifold
			• injection pressure	• injection wellhead and manifold
			• operating time	• clock meter[2]
		Extraction	• refer to Soil-Vapor Extraction	• refer to Soil-Vapor Extraction
Groundwater Pump & Treat	Monthly	• pumping rate		• manifold and pumping well
		• total groundwater volume pumped		• totalizer
		• depth to water and gauging (elevation) of the pump inlet		• pumping well[3]
		• water influent and effluent samples		• extraction well sampling port and discharge point
		• operating time		• clock meter[2]
NAPL-Only Recovery System	Monthly	• depth to water and NAPL		• monitoring well
		• depth to pump inlet		• monitoring well
		• amount of fluid in holding tank		• holding tank
		• operating time		• clock meter[2]
Soil-Vapor Extraction	Weekly	• airflow rate		• extraction wellhead and manifold
		• vacuum reading		• extraction wellhead and manifold
		• vapor concentrations via field equipment		• manifold
		• vapor-treatment-unit temperature		• vapor-treatment-unit
		• operating time		• clock meter[2]
	Monthly	• vapor (influent[4] and effluent) samples		• manifold and discharge point

[1] Long-term monitoring includes quarterly sampling of the monitoring wells - and in some cases semi-annually or annually. Refer to RG-523/PST-06 for additional information.

[2] When a clock meter is not available, use the telemetry unit to record and report system operating time.

[3] Gauge the depth to water and the pump inlet during each site visit and adjust the pump position accordingly in order to pump the uppermost (top) 2 feet of the contaminated groundwater or NAPL.

[4] Vapor and water influent samples collected from the sampling ports of each individual extraction well will also be required during the quarterly groundwater sampling-and-monitoring program for the first two years of system operations. After that, vapor and water influent samples from each individual extraction well may be reduced, on a case-by-case basis, with TCEQ approval.

[5] Biodegradation indicators—Fe^{+3}, dissolved O_2, pH, and CO_2—should be analyzed quarterly along with the groundwater samples collected during the groundwater sampling and monitoring program.

[6] Other than a stand-alone remediation system, groundwater extraction (pump and treat) can be used as an interim containment measure or to enhance the effectiveness and efficiency of an alternative remedial method (e.g. soil-vapor extraction, air sparging, or enhanced aerobic bioremediation).