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USACE / NAVFAC / AFCEC / NASA **UFGS-02 62 16.13 10 (August 2018)**

Preparing Activity: USACE **Superseding**
UFGS-02 01 50 (May 2010)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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SECTION 02 62 16.13 10

OPERATION, MAINTENANCE, AND PROCESS MONITORING FOR SOIL VAPOR EXTRACTION (SVE) SYSTEMS

08/18

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NOTE: This guide specification covers the requirements for operation, maintenance, and process monitoring for soil vapor extraction (SVE) systems.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

****

PART 1 GENERAL

****

NOTE: This guide specification covers the initial period of operations (usually a 12 month period following completion of construction, commissioning and demonstration), or periods of operation beyond the initial period. Requirements for start-up and prove-out of SVE systems are covered by Section 02 62 16.16 10 COMMISSIONING AND DEMONSTRATION FOR SOIL VAPOR EXTRACTION (SVE) SYSTEMS.

Operations, Maintenance and Process Monitoring covers requirements to be followed by the operations staff to ensure proper operation of the SVE system equipment (e.g., monitoring vacuum levels and air flow rates, vapor stream monitoring, and performing

preventative maintenance). The operations and maintenance manual should be completed during the initial period of operation (see paragraph, Assistance in Preparation of O & M Manuals). Additional guidance on design and operation of SVE systems can be found in EM 1110-1-4001, Soil Vapor Extraction and Bioventing, June 2002.

The following information should be shown on the project drawings:

a. Individual site plans of each area of contamination with site features such as buildings, roads, utilities, trees, surface covers, locations of *vapor* extraction wells, vadose zone pressure monitoring points, and groundwater monitoring wells. Depths of screened intervals for wells should also be shown in cross-section.

b. Process flow diagram of above-ground process equipment and, piping diagrams showing the locations of devices for monitoring pressure, temperature, flow. Locations of sampling ports and valves should also be shown.

****

1.1 UNIT PRICES

****

NOTE: If there is a separate Price and Payment Procedures Section, edited versions of these paragraphs should be inserted in that section. Coordinate requirements of these paragraphs with the bidding schedule. The bid schedule should include separate unit price items for laboratory analysis of samples for chemical data. Under the pricing structure shown below, costs for laboratory analysis of samples for chemical data are not covered by this section. Unit pricing should also be considered for replacement of granular activated carbon (GAC), if GAC vapor stream treatment will be required.

These paragraphs should be coordinated with Sections 44 13 10.13 VAPOR PHASE ACTIVATED CARBON ADSORPTION UNITS and 43 11 00.10 OFF-GAS FANS, BLOWERS AND PUMPS.

The bid sheet should include separate, optional items for tasks such as: training, pneumatic flow meter testing, and completion testing.

****

Measurement is based on completion of contract requirements. Payment is based on the respective contract prices in the bidding schedule.

1.1.1 Unit Pricing

****

NOTE: Incentives for the Contractor to complete

remedial action in a timely manner should be incorporated into the pricing structure, if possible. Unit pricing alternatives for payment include: hours of operation, volume of air extracted, and mass of contaminants removed.

Although pricing by mass of contaminants removed creates incentive, mass of contaminants removed is more difficult to accurately measure than time or air volumes. Also there is typically a high degree of uncertainty in predicting mass removal rates, which will make it difficult for bidders to assign reasonable prices when preparing bids.

Another performance based payment option is to make periodic payments to the Contractor based on the degree of reduction in contaminant levels. For example, partial payment to the Contractor is made based on the percentage reduction in contaminant levels. However this type of payment scheme should be used with caution, since removal rates typically decrease as contaminant levels decrease; e.g., it may take 3 times as long to go from 25 to 10 mg/kg as it takes to go from 100 to 25 mg/kg.

Lump sum pricing, with performance requirements (see paragraph Operation of the SVE System), is generally recommended for Operations, Maintenance and Process Monitoring. Under this pricing structure, the Contractor receives periodic payments (e.g., monthly) so long as performance requirements are being met. If performance requirements are not met, then the Contracting Officer may withhold payment until the Contractor demonstrates that performance requirements are being met.

If it is expected that large volumes of condensate will be generated, and that treatment or offsite disposal will be required; then a separate paragraph should be added to cover treatment and disposal of condensate. A unit pricing structure would be appropriate to pay for treatment or offsite disposal of condensate.

****

Compensation is based on a lump sum price for Operation of the SVE System, Maintenance, and Process Monitoring. [Include costs for Contaminated Material Storage and Disposal in this price.] [Costs for replacement adsorption media for the vapor stream treatment system is covered under a separate paragraph and not included in this price.] Include physical and chemical testing performed in the field, and sampling in this price. Costs for laboratory analysis of samples is not included in this price.

1.1.2 Training

****

NOTE: If it is expected that close out of the site will be completed within the period of the contract, then Training should be listed as an optional item

on the bid sheet.
****

Compensation is lump sum price for Training.

1.1.3 Disposal and Replacement of Vapor Phase Activated Carbon

****
NOTE: This paragraph should be deleted if any of the following conditions apply: vapor steam treatment will not be required; the vapor stream treatment system does not use activated carbon; or payment for activated carbon is covered under a separate Section.
****

Compensation for disposal of spent vapor phase activated carbon is based on and calculated by the contract unit price schedule for each [_____] [kg pound], based on [the dry weight of the spent activated carbon][_____]. Compensation for replacement of spent vapor phase activated carbon is calculated by the contract unit price schedule for each [_____][kg pound], based on [invoices from the supplier of the replacement activated carbon][_____].

1.1.4 Pneumatic Flow Meter Testing

****
NOTE: This paragraph should be deleted if pneumatic flow meter testing will not be required. If this paragraph is retained, the bid sheet should include a separate, optional item for pneumatic flow meter testing.
****

Compensation for pneumatic flow meter testing by the contract unit price schedule on a per well basis. Include physical and chemical testing performed in the field, and sampling will be included in this price. Costs for laboratory analysis of samples is not included in this price.

1.1.5 Completion Testing

****
NOTE: Completion testing is defined as testing that is performed determine if regulatory requirements have been met, so that the SVE system can be permanently shut down.

This paragraph should be deleted if completion testing will not be included in the contract. If this paragraph is retained, the bid sheet should include a separate, optional item for completion testing.
****

Base compensation for completion testing on a lump sum price. Include physical and chemical testing performed in the field, and sampling in this price. Costs for laboratory analysis of samples is not included in this price.

1.2 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SESDPROC-105-R2	(2013) Groundwater Level and Well Depth Measurement

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 302	Designation, Reportable Quantities, and Notification

1.3 ADMINISTRATIVE REQUIREMENTS

1.3.1 Chemical Testing

Conduct chemical sampling and analysis.

1.3.2 Assistance in Preparing O & M Manuals

****

NOTE: Traditionally, O & M manuals are prepared by the designers of the treatment system, e.g. under Title II services. The draft O & M manual should be required after completing construction of the treatment system. Since unanticipated events often occur during the period of operation (e.g., changes in levels of contaminants), it is not uncommon for operating procedures to deviate from the procedures set out in the draft O & M manual. The authors should seek input from the operators of the treatment system during preparation of the final O & M Manual. The final O & M manual should be required before the period of the operations contract expires.

On some projects, it may be more expedient to have the Contractor prepare the O & M Manuals. If the Contractor will be tasked to prepare the O & M Manuals, this paragraph should be rewritten, and submittal requirements for draft and final O & M Manuals should be added.

****

Provide assistance to the team tasked to prepare the Draft and Final O & M Manuals. Include the following assistance: [providing equipment manufacture's literature, as requested; 24 hours of demonstrating operation, maintenance, and monitoring protocols during facility tours; and 4 hours of answering follow-up questions][_____].

1.3.3 Sequencing and Scheduling

****

NOTE: The initial period of operation should not begin until the Contractor has fulfilled the requirements for commissioning and demonstration of the full-scale SVE system.

****

Do not initiate the first period of operation of the full-scale system until after test and inspection reports in Section 02 62 16.16 10 COMMISSIONING AND DEMONSTRATION FOR SOIL VAPOR EXTRACTION (SVE) SYSTEMS have been submitted and approved. Notify the Contracting Officer not less than [14][_____] calendar days prior to initiating the first period of operation.

1.4 SUBMITTALS

****

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a “G” to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

SVE System Operation Plan; G[, [_____]]

Process Monitoring; G[, [_____]]

Contaminated Material Storage and Disposal; G[, [_____]]

Completion Testing; G[, [_____]]

SD-06 Test Reports

Laboratory Analysis Reports

Completion Testing Report

SD-07 Certificates

Operator Qualifications

Maintenance Schedule

SD-10 Operation and Maintenance Data

Operations Reports; G[, [_____]]

Operations Log; G[, [_____]]

Maintenance Log; G[, [_____]]

Contract Completion Report; G[, [_____]]

1.5 QUALITY ASSURANCE

1.5.1 Permits and Licenses

****

NOTE: It is important for the designer to become familiar with the appropriate state and local requirements to determine if there is a need to obtain an operating permit for the system and to include those requirements in these paragraphs. The designer should also bear in mind that any SVE system operated as part of site remediation under CERCLA authority does not require federal, state or local permits. This includes all NPL and non-NPL sites being remediated under CERCLA authority such as DERP, IRP, FUDS, or BRAC program projects. Permits that have already been acquired should be attached to the specifications and referenced.

These paragraphs should be coordinated with Sections 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS and 44 13 10.13 VAPOR PHASE ACTIVATED CARBON ADSORPTION UNITS (if used).

****

Obtain required federal, state, and local permits for operation of the SVE system.

1.5.2 Air Emissions

****

NOTE: An air pathway analysis should be performed during design to determine if air monitoring will be required. Guidance on air pathway analyses is provided in EP 200-1-24 - Air Pathway Analysis for the Design of Remedial Action Projects, 30 September 2015.

Appropriate federal, state, and local permits should be identified in this paragraph, and site specific permit requirements should also be provided. For projects where a permit is required, usually the State agency will issue an air pollution control permit (or permit equivalent) that will specify emissions control requirements. The following requirement is an example from a State air pollution control permit equivalent, "The maximum emission rate of total VOC not exceed 0.092 lbs/hr".

****

Monitor, control and report air emissions in accordance with the following regulatory requirements: [_____]. [The air pollution control permit equivalent has been acquired and is shown in Appendix [_____]].

1.5.3 Noise Control

****

NOTE: In the equipment specifications there should be a requirement for the blower not to exceed a specified noise level. This paragraph is intended to ensure that the Contractor maintains noise control throughout the period of operation, during all site activities. Ensuring that noise levels are adequately controlled is especially important for

projects near residential areas.
****

Ensure the SVE system [meets state and local noise pollution control regulations.][does not exceed [_____] decibels at any site boundary.]

1.5.4 Operator Qualifications

****
NOTE: Some states may already have licensing or certification requirements for operators at sites where an air pollution control permit is required (e.g., on most RCRA projects). If the project does not require an air pollution control permit (e.g., on some CERCLA projects), then there are usually not any state licensing requirements for operators.

If remediation is not being performed under CERCLA authority (this includes both National Priority List (NPL) and non-NPL sites under Defense Environmental Restoration Program (DERP), Installation Restoration Program (IRP), Formerly Used Defense Sites (FUDS), or Base Realignment and Closure (BRAC) programs), the operator must comply with applicable state or local requirements for certification and training for operation of the SVE system. As some states have these requirements and others do not, the designer must research the state or local requirements and include them in this paragraph.
****

Provide a the chief operator with at least [2][_____] years of experience in operating air emissions control equipment, and at least [3][_____] years of experience working on projects involving clean-up of CERCLA hazardous substances, or RCRA hazardous wastes. Each member of the operations staff is required to possess a [high school diploma or equivalent] [_____]. Submit Operator Qualifications not more than [21][_____] calendar days prior to initiating the first period of operation. Allow a period of not less than [14][_____] calendar days in the schedule for Government review. Provide resume of each member of the operations including a chronology of education, state licenses, and relevant work experience.

1.6 PROJECT/SITE CONDITIONS

****
NOTE: Include any pertinent information regarding project/site conditions in this paragraph and on the drawings.
****

Approximate locations of contaminated zones are shown on the drawings. Chemical analysis of contaminated material and soil gas testing [has not been performed][has been performed and is shown in Appendix [_____]]. Boring logs are shown [on the drawings][in Appendix [_____]]. Ground water is approximately [_____] meters feet below ground surface. [A pilot-scale SVE demonstration has been performed and the report is shown in Appendix [_____]].

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Spill Response Materials

Keep the following spill response materials on site: [containers, adsorbents, shovels, and personal protective equipment][_____]. Keep spill response materials available at all times in which hazardous materials/wastes are being handled or transported. Ensure spill response materials are compatible with the type of materials being handled, and are located [as shown on drawings][_____].

PART 3 EXECUTION

3.1 APPLICATION

3.1.1 SVE System Operation

****

NOTE: The length of the initial period of operation should be defined in the bid schedule, typically the construction Contractor is required to operate the treatment system for a period of about 12 months, after completion of the prove-out period. Contracts may also be written to include options for additional periods of operation. The length of the periods of operation should be based on the expected time to complete the remedial action. Use of optional periods of operation makes for a more flexible contract. Once clean-up goals have been reached, any remaining options for additional periods of operation would not be exercised.

****

Submit an SVE System Operation Plan not more than [30][_____] calendar days after notice to proceed. Allow a period of not less than [30][_____] calendar days in the schedule for Government review. In the plan, include an outline of the Operations Reports. The period of operation begins after approval of the following plans, and receipt of written approval from the Contracting Officer: (a) System Operation, (b) Maintenance Plan, (c) Process Monitoring Plan, and (d) Contaminated Material Storage and Disposal Plan.

3.1.1.1 Period of Operation

Operate the SVE system for a period of [365][_____] calendar days. Do not include time required to complete commissioning and demonstration in the period of operation.

3.1.1.2 Hours of Operation and Reliability

****

NOTE: The reliability requirement should allow enough downtime for the Contractor to perform scheduled maintenance.

****

Unless otherwise directed by the Contracting Officer, keep the SVE system

in operation [24 hours per day, 7 days a week][_____]. Reliability is the percent of time that the system is on, and minimum airflow rates are being maintained. Ensure the reliability of the system is at least [95 percent][_____] of the total hours available in each 30 calendar day period. Record hours of operation and downtime in the Operations Log, at least once every [14][_____] calendar days. Keep the Operations Log at the facility, and available for inspection.

3.1.1.3 Operational Airflow Rates

For the SVE system to be considered in operation, turn the blower on and ensure air is flowing from the wells designated in Table 1 at the flow rates shown in Table 1, [except during off-cycle periods as designated in Table 2][_____].

TABLE 1 - AIRFLOW RATES	
WELL IDENTIFICATION	MINIMUM AIRFLOW RATE
[_____]	[_____]

3.1.1.4 Intermittent Operation of Wells

****

NOTE: This paragraph should be deleted unless there are wells that will be operated intermittently.

Periodic shutdown of selected SVE wells can be used to allow time for subsurface VOC levels to rebound, and to thereby maintain higher recovery rates from active wells. The length of the shut down period is site specific, and should be based on soil gas monitoring at the site. At some sites soil gas VOC levels will increase very slowly after shutdown, and a longer shutdown period may be required. Periodic sampling of the soil gas concentrations during the shutdown can also assist in assessment of the remaining mass in the site. Refer to Appendix F of EM 1110-1-4001.

The frequency of vapor stream monitoring should be increased immediately after bringing SVE wells back on line, in order to measure the rebound spike. Periodic rebound testing is a useful tool for assessing the progress of SVE operations. See paragraph, Rebound Testing.

****

Cycle operation of designated wells in accordance with Table 2.

TABLE 2 - SCHEDULE FOR CYCLICAL OPERATION OF WELLS		
WELL IDENTIFICATION	ON-CYCLE PERIOD	OFF-CYCLE PERIOD

TABLE 2 - SCHEDULE FOR CYCLICAL OPERATION OF WELLS		
[_____]	[_____]	[_____]

3.1.1.5 Adjustments to Mode of Operation

****

NOTE: After the system has been in continuous operation for a few months (and vapor stream data has been reviewed), strategies that may hasten completion of the project (and reduce operating costs) should be considered. Such strategies may include: installing impermeable surface covers; increasing, decreasing or stopping air flow from certain wells; and periodic cycling of designated wells. In extremely arid climates, controlled irrigation may improve contaminant removal rates. Also see paragraph, Pneumatic Flow Meter Testing. Any changes may require that the contract be modified

Value Engineering (VE) Clauses are usually included in contracts to provide incentive for the Contractor to identify areas where savings can be realized. If there are clearly areas that show a strong potential for substantial cost savings, then it may be worthwhile to request that the Contractor submit a VE proposal to change the mode of operation. The Design Team should verify that a VE Clause is included in the contract.

Remedial System Evaluations(RSE) offer another way to assess the performance of the system, and to determine if changes should be made to hasten completion of the project, and reduce operating costs. A description of RSEs and RSE checklists can be found at the following internet site: . RSEs are typically performed after a treatment system has been in operation for at least one year. If RSE recommendations will require costly modifications to the treatment system equipment, and the period of the Contract is nearly over, then it may be best to build these recommendations into a future contract. The Contractor tasked to make substantial changes to the treatment system should be responsible for a minimum period of operation after the changes have been implemented.

****

Obtain written approval from the Contracting officer before implementing any changes to the mode of operation.

3.1.1.6 Operations Reports

Submit Reports as specified and scheduled as follows: [weekly for the 1st two weeks; every 4 weeks for the 3rd through the 10th week; and every 3 months thereafter][_____]. Submit reports within 7 [_____] days of the

end of the period covered by the report. Allow a period of not less than [30][_____] calendar days in the schedule for Government review. For the period covered by each Operations Report, provide the following data: [hours of operation and hours of downtime; the amount of time that each SVE well was in use; and the cumulative total hours of operation][_____]. Organize results of Process Monitoring according to category, and shown chronologically within each category. Include Meteorological and Subsurface Monitoring data, and Process Air Stream and Equipment Monitoring data in each report. Provide the following graphs with each Operations Report. For each SVE well, plots of: volume of air extracted versus time, cumulative volume of air extracted versus time, field measurements of concentration of [contaminants of concern] [_____] versus time, vacuum responses in [all] vacuum monitoring points [_____], mass removal rate of [contaminants of concern] [_____] versus time, and cumulative mass of [contaminants of concern] [_____] removed versus time. For the SVE system as a whole, plots of: the concentration of [contaminants of concern] [_____] versus time, mass removal rate of [contaminants of concern] [_____] versus time, and cumulative mass of [contaminants of concern] [_____] removed versus time. Sign and date the reports by the Contractor's Quality Control representative. If warranted, provide in the reports any recommendations for changing airflow rates from individual wells, and other proposed adjustments to the mode of operation.

3.1.1.7 Operations Log

Submit copies of operations log sheets with each Operations Report for the period covered by the Operations Report. Keep the original log sheets in notebooks organized in chronological order, and submitted with the Contract Completion Report not more than [14][_____] calendar days after completing work at the site.

3.1.2 Process Monitoring

****

NOTE: Periodically the monitoring parameters, and the frequency of monitoring should be re-evaluated to determine if monitoring requirements should be changed. For most projects, the frequency of monitoring can be decreased as more operational data is generated.

Labor costs and the accessibility of the site should be factored into the monitoring schedule. For small-scale SVE systems that are designed to operate with minimal operator attention, the frequency of monitoring should be less than that of a large-scale, more complex SVE system.

****

Evaluate the monitoring schedule every [6 months][_____]. Propose recommended changes to the monitoring schedule, if warranted. Obtain written approval from the Contracting officer before implementing any changes to the monitoring schedule. Submit a plan for Process Monitoring not more than [30][_____] calendar days after notice to proceed. Allow a period of not less than [30][_____] calendar days in the schedule for Government review. Include physical and chemical monitoring requirements, including test parameters, frequency of sampling, number of samples, and sampling locations; and laboratory turn-around-time in the plan.

3.1.2.1 Meteorological and Subsurface Monitoring

Perform meteorological and subsurface monitoring to assess the response of the subsurface to the SVE system.

3.1.2.1.1 Meteorological Monitoring

****

NOTE: Automated monitoring equipment can be used to collect meteorological data. Meteorological data may also be available from a monitoring site in the immediate vicinity (e.g., an airport).

****

Record the following data at least once every [Monday, Tuesday, Wednesday, Thursday, and Friday][_____]: ambient temperature, and daily amount of precipitation. Record the barometric pressure each time that airflow rate monitoring is performed.

3.1.2.1.2 Vadose Zone Pressure Monitoring

****

NOTE: Vadose zone pressure should be monitored periodically, and each time that changes are made to the air extraction rates, or to the configuration of active extraction wells. Ideally, the site should be equipped with nested pressure monitoring points, placed at discrete depth intervals (corresponding to the depths of contaminated zones), and at several locations within the contaminated zones. It is also important to monitor from locations in the contaminated zone that are mid-way between SVE wells, and at relatively long distances from SVE wells, since "stagnant zones" (or reduced airflow rates) may occur at these locations.

Vadose zone pressure monitoring should be performed as part of the assessment of the zone of influence. Determination of air velocity (or travel time), rather than just vacuum levels, at vadose zone monitoring points should be used to assess the zone of influence. If vadose zone modeling will be performed, then data requirements for the model should be consistent with the monitoring procedures.

****

Perform vadose zone pressure monitoring at least once every [28][_____] calendar days, and each time that changes are made to the configuration of active SVE wells. Monitor at the following locations: [_____].

3.1.2.1.3 Groundwater Levels

****

NOTE: Groundwater level monitoring may be necessary to determine if operation of the SVE system results in upwelling of the water table, or if fluctuations in the water table (not related to SVE operations) are limiting the effective depth of SVE. If upwelling is occurring, then soils that were

previously part of the lower vadose zone may become saturated and thus will not be treated via operation of the SVE system. Upwelling is usually localized around extraction wells (especially in porous soils), but some monitoring may be necessary to determine the extent of upwelling. If the contaminated zones are well above the water table then groundwater level monitoring may not be necessary.

Site-specific considerations should be incorporated into the monitoring schedule. Water levels may be influenced by factors such as tidal cycles, and seasonal pumping from irrigation wells.

****

Measure groundwater levels at least once every [90][_____] calendar days at the following monitoring wells: [_____]. Perform water level measurement in accordance with EPA SESDPROC-105-R2. Record water level readings to the nearest 3.0 mm 0.01 foot. Decontaminate the part of the measuring device that was wetted after each measurement.

3.1.2.1.4 Pneumatic Flow Meter Testing

****

NOTE: This paragraph should be deleted if pneumatic flow meter testing will not be required. If it has not already been performed, pneumatic flow meter testing of the SVE wells should be considered. Ideally, pneumatic flow meter testing should be performed during design investigations. However, information gained from these tests can be used as part of a systematic plan to optimize operation of an SVE system.

Pneumatic logging of SVE wells is analogous to borehole flow meter testing of groundwater wells. A probe accurately measures the incremental increases in airflow as it moves up from the bottom of the well while air is extracted from the well. A sampling port on the probe allows the determination of the soil gas concentration in the well at the depth of the probe. The sampling data, coupled with the flow data, allows a determination of the contaminant mass input at different depths.

Pneumatic logging data is useful for producing vertical air permeability profiles, evaluating the distribution of contaminants, tailoring well construction, and changing operating strategy. Pneumatic logging data may also be used to define input values for vadose zone modeling.

****

Perform pneumatic flow meter testing at the following SVE wells [_____]. Monitor the following parameters continuously during testing: [airflow rate, vacuum, probe depth, and PID or FID response][_____].

3.1.2.2 Process Air Stream and Equipment Monitoring

Perform process air stream and equipment monitoring as part of the overall assessment of the SVE system, and to monitor operation of SVE system equipment.

3.1.2.2.1 Combustible Organic Vapor Monitoring

****

NOTE: Some SVE systems are designed to handle vapor stream contaminant levels that are above the lower explosive limit. However, even if an explosion-proof blower and motor are being used, ignition of an organic-laden vapor stream is still possible (e.g., static electricity may build up inside piping that is not grounded, and a spark may be released). Combustible organic vapor monitoring should be performed to reduce the risk of a fire or explosion during operation of SVE systems.

A flame ionization detector (FID) is usually recommended for this type of monitoring. Combustible gas indicators (CGI) can also be used, but only if oxygen levels are also being monitored. Combustible gas indicators can produce false readings if the level of oxygen in the sample is less than the minimum level of oxygen required for the instrument to function properly.

Site-specific action levels should be established prior to initiating the first period of operation. Action levels should be based on the types of volatile organic compounds present in the vadose zone, and the specific monitoring instrument and calibration gas being used. The action levels may require modification as more monitoring data is generated.

****

After opening the valves to begin extracting air from an extraction well that is being brought on-line for the first time, initiate monitoring during the following time intervals: [0-1 minute, 30-45 minutes, 60-75 minutes, and 120-135 minutes][_____]. In addition, monitor at least one time daily during the first [_____][200 hours] of operation of the SVE system, and at least one time daily until each extraction well has been in continuous operation for a minimum of [_____][72 hours]. During each monitoring event, record [at least 3 readings, separated by 1 minute increments,] [_____]. Monitor at the following location: [in the combined piping manifold (upstream from the inlet bleed line)] [_____]. If the [flame ionization detector][_____] indicates that the vapor stream has reached [5000 ppmV as isobutylene][_____], then immediately make adjustments to decrease the level of organic compounds in the vapor stream. Such adjustments may include adjusting airflow rates from selected wells. Repeat the monitoring and adjustment procedure until the organic vapor level of the vapor stream has been decreased to less than [5000 ppmV as isobutylene][_____].

3.1.2.2.2 Airflow Rate Monitoring

****

NOTE: To accurately determine volumetric airflow rates the density of the air stream should be calculated. Air density is dependent on relative humidity, temperature and barometric pressure. The Contractor's measurement of airflow rates should periodically be independently verified by a NEEB or AABC certified Testing, Adjusting, and Balancing specialist.

****

Monitor pressures, temperatures, and airflow rates at the following locations at least once every [14][_____] calendar days: [in piping from each individual SVE well being used; in the combined piping manifold (upstream from the inlet bleed line); in the inlet bleed line; and at the discharge stack][_____]. Monitor airflow rate in accordance with manufacturer's instructions for the airflow monitoring devices. Record instrument readings, and provide, in each Operations Report, any assumed values that were used to calculate airflow rates. Verify measurement of airflow rates independently by a NEEB or AABC certified Testing, Adjusting, and Balancing specialist at least once every [90][_____] calendar days, and perform in accordance with Section 23 05 93 TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS. Attach a copy of the airflow rates determined and signed by the NEEB or AABC certified Testing, Adjusting, and Balancing specialist to the Operations Report for the period when the airflow rate was verified.

3.1.2.2.3 Air/Water Separator and Condensate

****

NOTE: During cold weather, greater volumes of condensate may accumulate than during warm weather. More frequent monitoring may be necessary during periods of cold weather.

****

Record the volume of condensate in the air/water separator at least once every [14][_____] calendar days. Also record the volume of condensate generated since the previous monitoring event and cumulative total volume of condensate.

3.1.2.2.4 Blower and Particulate Filter

Record the following parameters at least once every [14][_____] calendar days: hour meter readings from the totalizing hour meter on the blower; pressures and temperatures immediately upstream from the blower and immediately downstream from the blower; and pressures immediately upstream and downstream from the inlet particulate air filter.

3.1.2.3 Vapor Stream Contaminant Level Monitoring

****

NOTE: Real-time vapor monitoring instruments are sensitive to the gasoline, or light fuel fraction contaminants such as benzene, toluene, ethyl benzene, and xylene (BTEX). A photo-ionization detector (PID) or flame-ionization detector (FID)

may be used to detect constituents normally found in gasoline such as BTEX. For some types of contaminants (e.g., PCE and TCE), use of an FID is preferred over a PID. For SVE applications, an FID is usually recommended over a PID because the vapor stream is commonly moist, and an FID is less sensitive to moisture.

Vapor stream monitoring requirements are site specific, and must be in accordance with regulatory requirements. Regulatory representatives should be provided the opportunity to provide input on vapor stream monitoring requirements in the early stages of remedial design. The monitoring protocol shown below is provided as an example only, and has no regulatory basis.

****

Perform vapor stream monitoring within the first hour after startup, every six hours for the first two days, and once per day for the next five days. Monitor in accordance with regulatory requirements.

3.1.2.3.1 Field Analysis

Perform vapor stream monitoring at least once every [14][_____] calendar days. During each monitoring event, record [at least 3 readings, separated by 2 minute increments,] [_____]. Collect in each monitoring event the [flame ionization detector readings][_____] from the following locations: [each individual SVE well being used; in the combined piping manifold (upstream from the inlet bleed line); the inlet of the vapor stream treatment system; between the lead and lag vapor stream treatment units; and from the discharge stack][_____].

3.1.2.3.2 Laboratory Analysis

Perform laboratory analysis of vapor stream samples as follows: [weekly for the first 2 weeks, every 4 weeks for week 3 through 11, and at least once every 90 calendar days thereafter.][_____]. Collect one air stream sample for laboratory analysis from each of the following locations: [in the combined piping manifold (upstream from the inlet bleed line); the inlet of the vapor stream treatment system; and from the discharge stack] [_____]. Take the sample for laboratory analysis immediately after collecting the sample for field analysis at each sample port. Test samples for the following analytes: [_____].

3.1.2.4 Vapor Stream Treatment System

****

NOTE: These paragraphs should be deleted if vapor stream treatment will not be required. If the vapor stream treatment system involves a process other than granular activated carbon adsorption, then these paragraphs should be revised accordingly.

****

Whenever soil vapor is being extracted, route the vapor stream continuously through [2 adsorption vessels, configured in series,] [_____] before being released to the atmosphere.

3.1.2.4.1 Vapor Stream Heating

****

NOTE: If granular activated carbon is being used for vapor stream treatment, then the relative humidity of the vapor stream should be less than 50 percent before entering the carbon vessels. Adsorption efficiency will be reduced, and carbon consumption will increase as the relative humidity increases. The heat generated by the blower can often be used to decrease the relative humidity of the vapor stream. A temperature rise of about 11 degrees F 20 degrees F is usually sufficient to reduce the relative humidity of the vapor stream to about 50 percent. If the temperature and pressure of the vapor stream are being monitored at locations upstream and downstream of the blower, then the change in relative humidity across the blower can be calculated.

****

Before entering the lead adsorption vessel, heat the vapor stream to at least [11 degrees C 20 degrees F] [_____] higher than the temperature coming out of the extraction wells.

3.1.2.4.2 Pressure and Temperature

Monitor pressures, and temperatures of the vapor stream at the following locations at least once every [14][_____] calendar days: [at the inlet to the lead adsorption vessel; between the lead and lag adsorption vessels; and at the outlet of the lag adsorption vessel][_____].

3.1.2.4.3 Change-Out of Adsorption Vessels

****

NOTE: Site-specific action levels should be established prior to initiating the first period of operation. Action levels should be based on the types of volatile organic compounds present in the vadose zone, and the specific monitoring instrument and calibration gas being used. The action levels may require modification as more monitoring data is generated.

****

Not more than [72][_____] hours after detection of breakthrough, replace the lead vessel by the lag vessel and place a fresh vessel in the lag position. Breakthrough is defined as follows: when field analysis indicates that contaminant concentrations at the outlet of the lead vessel [has reached the level that corresponds to the permitted maximum emission rate][exceed [_____]% of the influent concentrations]. Record the volume of air that was treated from the time that the vessel was placed in the upstream position until breakthrough was consistently determined as the breakthrough volume. Submit to the Contracting Officer a written record of the field analysis data, and the breakthrough volume, not more than [24][_____] hours after breakthrough was detected.

3.2 QUALITY CONTROL

3.2.1 Completion Testing

****

NOTE: This paragraph should be deleted if completion testing will not be included in the contract. There is often a great deal of uncertainty regarding how long the treatment system will be required to operate. At some sites, completion testing may not be appropriate until after the contract for construction and the initial period of operation of the treatment system has been completed. However, it may be advantageous to include a separate, optional item in the contract for completion testing. If it is not possible to determine the completion testing requirements when this contract is being written, then a contract modification may be required as soon as the completion testing requirements have been determined.

Many military facilities have base-wide sampling and analysis plans that have been approved by the applicable regulatory agencies. However these plans may not specify the number of confirmation samples which must be taken. The number of confirmation samples should be based on the depth and area extent of the contaminated zone and regulatory requirements. The following reference provides guidance on the design of statistically based sampling intervals: EPA 230/02-89-042 - Methods of Evaluation and Attainment of Cleanup Standards.

Some of the samples used for completion testing should be collected from locations that are mid-way between SVE wells, and near the perimeter of the area of concern, to determine if SVE operations have adequately remediated the contaminated zone. One or more lines of evidence may be required as part of completion testing. The following reference includes guidance for obtaining closure of SVE operations: Evaluation of Mass Flux to and from Groundwater Using a Vertical Flux Model (VFLUX): Application to the Soil Vapor Extraction Closure Problem; DiGiulio, et al., Groundwater Monitoring and Remediation, Spring 1999, Vol. 19, No. 2; Soil Vapor Extraction System Optimization, Transition, and Closure Guidance, PNNL-21842, February 2013, available at https://bioprocess.pnnl.gov/SVEET_Request.htm.

Completion testing requirements are site specific, and must be in accordance with regulatory requirements. Regulatory representatives should be provided the opportunity to provide input on completion testing requirements during design. If attainment of the original completion requirements is later determined to be technically impractical, then regulatory input will be required to explore

the possibility of revising the completion testing requirements. The requirements shown below are provided as examples only, and have no regulatory basis.

****

a. Completion testing is defined as testing to determine whether to continue, or shutdown, operation of the SVE system. Provide written notification to the Contracting Officer not less than [14] [_____] calendar days prior to performing completion testing. Include the following information in the notification: the type of testing to be performed, the date and time of testing, and the names of the Contractor's representatives who will be present. Submit a plan for Completion Testing not more than [14] [_____] calendar days after requested. Allow a period of not less than [30] [_____] calendar days in the schedule for Government review. Address testing requirements for determining if regulatory clean-up criteria have been met, and for determining if the SVE system can be permanently shut down in the plan.

b. Submit a Completion Testing Report not more than [45] [_____] calendar days after finishing Completion Testing. Allow a period of not less than [30] [_____] calendar days in the schedule for Government review. Include narrative descriptions of each type of testing that was performed, and scaled drawings showing: [type of sample; sampling locations (and depths, if applicable); and sample identification numbers] [_____]in the report. Organize results of testing according to category, and shown chronologically within each category. Ensure the report is signed and dated by the Contractor's Quality Control representative.

3.2.1.1 Soil Boring Sampling

****

NOTE: This paragraph should be deleted if soil boring sampling will not be a required component of completion testing. Immunoassay field kits are available that are sensitive to light fuel fractions. EM 200-1-2, Appendix G, provides additional guidance on field analysis methods. See ASTM D4700, Standard Guide for Soil Sampling from the Vadose Zone, for additional information on sampling methods.

****

Collect soil boring samples from the following locations and depth intervals: [_____]. Record locations of samples in the field, and documented on the as-built drawings. Perform soil boring sampling in accordance with Section 02 32 13 SUBSURFACE DRILLING AND SAMPLING. Samples are to be tested for the following analytes: [_____].

3.2.1.2 Groundwater Sampling

****

NOTE: This paragraph should be deleted if groundwater testing will not be a required component of completion testing. Groundwater monitoring may be necessary after the levels of volatile organics in the vapor stream have dropped to asymptotic levels. If high levels of volatile organics are

present in groundwater, then VOCs from groundwater may be continually migrating into, and re-contaminating, the vadose zone. Volatile organic vapors can also transfer contamination to the ground water.

****

Perform groundwater sampling as part of an assessment of the mass transfer rate of volatile organic contaminants from groundwater to the vadose zone. Perform sampling at the following monitoring wells: [_____]. Test samples for the following analytes: [_____].

3.2.1.3 Rebound Testing

****

NOTE: This paragraph should be deleted if rebound (or equilibrium) testing will not be a required component of completion testing. If the level of contaminants represented by the "rebound spike" is less than about ten times the level of the initial contaminant level spike (from when the system was first started up), this may indicate that recovery of volatiles has become diffusion limited and that continued operation of the SVE system will be of limited value. However, it still may be possible to increase contaminant removal rates through other means, see Analysis of Selected Enhancements for Soil Vapor Extraction, EPA-542-R-97-007, Sept. 1997.

Periodic rebound testing is a useful tool for assessing the progress of SVE operations. On some projects rebound testing is performed on a regularly scheduled basis (e.g., every 4 months). Comparison of the initial contaminant level spike to subsequent rebound spikes should play into the decision on whether to continue SVE operations. Analysis of rebound behavior can provide information on the remaining mass and progress toward closure. References that can guide the analysis include Brusseau, Rohay, and Truex, 2010, Analysis of Soil Vapor Extraction Data to Evaluate Mass-Transfer Constraints and Estimate Source Zone Mass Flux, Groundwater Monitoring and Remediation, Vol. 30, No.3, pp. 57-64 and Appendix F of the US Army Corps of Engineers Soil Vapor Extraction and Bioventing Engineer Manual EM 1110-1-4001, 2002 (see www.publications.usace.army.mil/LinkClick.aspx?fileticket=2t7j4pDfSiA%3ddtab **).**

The length of the shut down period is site specific, and should be based on soil gas monitoring at the site. At some sites soil gas VOC levels will increase very slowly after shutdown, and a longer shutdown period may be required.

****

a. After the level of contaminants in the vapor stream have reached asymptotic levels, and written approval has been received from the Contracting Officer, shut the SVE system down for a period of

[28][_____] calendar days. After the SVE system has remained idle for the prescribed time period, turn the system back on. Commence vapor stream monitoring immediately after turning the SVE system back on. perform vapor stream monitoring [every 30 minutes for the first 4 hours, every hour for the 4th through the 24th hour, and every 4 hours for the 24th through the 60th hour] [_____]. During each monitoring event, record [at least 3 readings, separated by 2 minute increments,][_____]. Data collected each monitoring event will include [flame ionization detector readings][_____] from the following locations: [each individual SVE well being used; and in the combined piping manifold (upstream from the inlet bleed line)][_____].

b. Submit Laboratory Analysis Reports for the vapor stream contaminant as specified in the Submittals paragraph. Results from laboratory analysis not more than [40][_____] calendar days after collecting samples. Allow a period of not less than [30][_____] calendar days in the schedule for Government review. Provide a table comparing field data to the laboratory data, for samples collected at the same time and from the same sampling port, with each set of laboratory analysis results. Sign and date the reports along with the Contractors Quality Control representative.

3.2.1.4 Soil Gas Monitoring

****

NOTE: This paragraph should be deleted if soil gas monitoring will not be a required component of completion testing. Use of passive soil gas sampling devices is generally not recommended at SVE sites; i.e., air should be withdrawn from the vadose zone to collect soil gas samples. If levels of volatile organics in whole air samples are below detection limits, they can be concentrated by passing a known volume of extracted soil gas through an adsorption device. See ASTM D5314, Standard Guide for Soil Gas Monitoring in the Vadose Zone, for additional information.

****

Perform soil gas monitoring by extracting air from the following soil vapor extraction wells and vadose zone monitoring points: [_____]. [In addition, perform a soil gas survey to collect samples from the following locations and depth intervals: [_____].] Perform soil gas sampling by either collecting whole-air samples, or by passing a known volume of extracted soil gas through an adsorption device. Test samples for the following analytes: [_____].

3.3 CLOSEOUT ACTIVITIES

3.3.1 Training

****

NOTE: If continued operation of the treatment system will be required after the contract expires, then the outgoing Contractor should be required to train the incoming Contractor. This paragraph should be coordinated with training prescribed in Sections 43 11 00.10 OFF-GAS FANS, BLOWERS AND

PUMPS; OFF-GAS and 44 13 10.13 VAPOR PHASE ACTIVATED CARBON ADSORPTION UNITS.
****

Provide a minimum of [32 hours][_____] of training to the incoming Contractor prior to completion of the contract. Scheduling of training will be subject to approval by the Contracting Officer. In the Training sessions, include: [familiarizing the incoming Contractor with the O & M Manual; touring the treatment facility; demonstrating the use of each piece of equipment; demonstrating the use all interlocks and system controls; demonstrating start-up and shut-down of system; demonstrating maintenance procedures; demonstrating process monitoring requirements and sampling procedures during a scheduled monitoring event; providing written inventory and showing the locations of materials and spare parts that will be left on-site; and answering questions][_____].

3.3.2 Contract Completion Report

****
NOTE: In addition to progress photos, video tapes have been used at some sites to record site activities.
****

Submit [_____] copies of Contract Completion Report not more than [14][_____] calendar days after completing work at the site. Allow a period of not less than [30][_____] calendar days in the schedule for Government review. Label the report with the contract number, project name, location, date, name of general Contractor, and the Corps of Engineers District Contracting for the work. Include in the report the following information as a minimum:

a. A cover letter signed by a [responsible Contractor representative] [Professional Engineer registered in the State of [_____] who is a responsible Contractor representative] certifying that all services involved have been performed in accordance with the terms and conditions of the contract specifications.

b. A narrative report including but not limited to the following:

   (1) site conditions, ground water elevation, and clean-up criteria;

   (2) monitoring locations and methods;

   (3) dates of the last 3 monitoring events;

c. Copies of the most recent test results and the final Operations Report.

d. Copies of manifests.

e. For materials that required offsite disposal, copies of certifications of final disposal signed by the responsible disposal facility official, and waste profile sheets.

3.4 MAINTENANCE

3.4.1 Contaminated Material Storage and Disposal

****

NOTE: For SVE systems, the most common type of potentially-contaminated media that may require collection and disposal is condensate from the air/water separator. However, the level of volatile contaminants in the condensate will be limited by the continuous flow of air through the piping. If significant volumes of condensate accumulate in the air/water separator, periodic testing may be necessary to determine storage and disposal requirements.

If activated carbon is being used for vapor stream treatment, then spent activated carbon will have to be regenerated or sent to a disposal facility.

For RCRA sites, hazardous waste can be stored in a drum or roll-off unit for up to 90 days without a permit. For temporary storage of more than 90 days, dual containment of hazardous liquid and some hazardous solids is required. Containment system requirements are described in 40 CFR 264.175 - Containment.

Storage requirements will depend on factors such as whether the contaminated material is determined to be hazardous waste. If there are site-specific factors that dictate the need for dual containment, this paragraph should be revised accordingly. The Contractor may be required to identify all necessary permits or permit equivalents and actions necessary to comply with applicable regulations.

****

Ensure the methods of contaminated material storage are in accordance with regulatory requirements. If multiple storage units are required, label each unit clearly with an identification number and keep a written log to track the source of contaminated material in each temporary storage unit. Submit a plan for Contaminated Material Storage and Disposal not more than [30] [_____] calendar days after notice to proceed. Allow a period of not less than [30] [_____] calendar days in the schedule for Government review. Include testing requirements, including test parameters, frequency of sampling, number of samples, and sampling locations; laboratory turn-around-time in the plan.

3.4.1.1 Liquid Storage

Store liquid collected temporarily in [220 L 55 gallon barrels] [[2000] [_____] L [500] [_____] gallon tanks]. Ensure liquid storage containers have no leaks and are be located [as shown on the drawings] [_____].

3.4.1.2 Sampling Liquid

****

NOTE: The frequency of testing should be based on the rate of liquid generation, the size of the storage containers, and regulatory requirements. Offsite disposal may require additional testing and analysis prior to disposal. NPDES requirements must be considered for onsite disposal of liquids.

****

Sample liquid collected at a frequency of at least once every [2,000] [_____] L [500] [_____] gallons of liquid collected. Test samples for the following analytes: [_____].

a. Chemical Parameter: [_____].

b. Regulatory Limit: [_____].

Treat liquid with contaminant levels that exceed regulatory limits [offsite. Analyses for contaminated liquid to be taken to an offsite treatment facility conforming to local, state, and federal criteria as well as to the requirements of the treatment facility. Furnish documentation of all analyses performed to the Contracting Officer. Additional sampling and analysis required by the receiving off-site treatment, storage or disposal (TSD) facility is the responsibility of the Contractor] [onsite. Treat liquid in accordance with Section [_____]].

3.4.2 Spills

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NOTE: Regarding pre-established spill reporting procedures, the designer should consult CEMP-RT memorandum of 20 July 1995, Subject: Spill Reporting Procedures for USACE Personnel Involved in HTRW Projects.

****

In the event of a spill or release of a hazardous substance (as designated in 40 CFR 302), pollutant, contaminant, or oil (as governed by the Oil Pollution Act (OPA), 33 U.S.C. 2701 et seq.), notify the Contracting Officer immediately. If the spill exceeds the reporting threshold, follow the pre-established procedures for immediate reporting to the Contracting Officer. Take immediate containment actions to minimize the effect of any spill or leak. Clean-up in accordance with applicable federal, state, and local regulations. Additional sampling and testing may be required to verify spills have been cleaned up. Perform spill clean-up and testing at no additional cost to the Government.

3.4.3 Disposal Requirements

Dispose of contaminated material offsite in accordance with SECTION 02 81 00 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS.

3.4.4 Maintenance

****

NOTE: Proper servicing of equipment is especially important for equipment that will remain onsite after the contract expires. Maintenance oversight for equipment that will be retained by the Contractor may not be necessary.

****

3.4.4.1 Equipment Maintenance Schedules

Perform maintenance of equipment in accordance with manufacture's

recommendations. Submit a preventative maintenance schedule for inspecting equipment, and a schedule for servicing of major equipment items. Submit a plan for Maintenance of the SVE System not more than [30][_____] calendar days after notice to proceed. Allow a period of not less than [30][_____] calendar days in the schedule for Government review. Perform maintenance according to schedule, and in response to monitoring data.

3.4.4.2 Maintenance Logs

Keep maintenance logs for each of the following units of equipment: [air/water separator, particulate filters, blower, motor, instrumentation and control system, and vapor stream treatment system][_____]. Each time one of these units is serviced, make an entry in the maintenance log. Include the following entries in the maintenance log: date, reason for servicing, description of service performed, a list of the parts that were replaced, name of the service organization and technician performing the maintenance, and signature of the Contractor's Quality Control Representative. Keep the Maintenance Log at the facility, and available for inspection. Submit maintenance log sheets attached to each Operations Report for the period covered by the Operations Report. Keep the original log sheets in notebooks organized in chronological order, and submit with the Contract Completion Report not more than [14][_____] calendar days after completing work at the site.

-- End of Section --