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USACE / NAVFAC / AFCEC / NASA **UFGS-02 62 16 (February 2010)**

Preparing Activity: USACE **Superseding**
UFGS-02 62 16 (October 2007)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2017
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SECTION 02 62 16

COMMISSIONING AND DEMONSTRATION FOR SOIL VAPOR EXTRACTION (SVE) SYSTEMS
02/10

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NOTE: This guide specification covers the requirements for commissioning and demonstration 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 items(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)**.**

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PART 1 GENERAL

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NOTE: Commissioning is performed after construction has been completed, and is an ordered process for testing and start-up of SVE system equipment. During commissioning, pre-commissioning checklists are completed, and functional performance tests are performed to test individual components of the system and subsystems. Demonstration serves as a prove-out period. The purpose of the demonstration is to show that the SVE system, as a whole, is ready to be put into service.

This guide specification should be used in conjunction with Section 02 01 50 OPERATION, MAINTENANCE, AND PROCESS MONITORING FOR SOIL VAPOR EXTRACTION SYSTEMS. For small-scale SVE projects,

editing and combining this section with Section 02 01 50 should be considered. Additional guidance on start-up of SVE systems can be found in EM 1110-1-4001 SOIL VAPOR EXTRACTION AND BIOVENTING.

This guide specification should be coordinated with other sections that may also include commissioning requirements for SVE system components, to avoid unnecessary duplication of requirements.

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1.1 MEASUREMENT AND PAYMENT

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NOTE: If there is a separate Measurement and Payment Section, edited versions of these paragraphs should be inserted in that section. Coordinate these paragraphs with the bidding schedule.

Separate, lump sum prices are generally recommended for Baseline Monitoring, Commissioning, and Demonstration. However it is also recommended that bidders be required to provide unit cost amounts for laboratory testing for chemical data. Unit costs will provide a basis for negotiating for additional tests, if determined that more testing than was originally anticipated is required. Under the pricing structure shown below, costs for laboratory analysis are covered under Section 01 35 45.00 10 CHEMICAL DATA QUALITY CONTROL.

It is recommended that the bid sheet be structured so that a portion of the payment (i.e., at least 30 percent) for construction of the SVE system be withheld at least until the full-scale demonstration has been completed. If acceptance of the SVE system is granted before the bugs are worked out, there may not be sufficient incentive for the Contractor to finish fixing problems with the SVE system.

****

Measurement shall be based on completion of contract requirements. Payment will be at the respective contract prices in the bidding schedule.

1.1.1 Baseline Monitoring

Compensation shall be a lump sum price for Baseline Monitoring. Physical and chemical testing performed in the field, and sampling shall be included in this price. Cost for laboratory analysis of samples is covered in Section 01 35 45.00 10 CHEMICAL DATA QUALITY CONTROL and is not included in this price.

1.1.2 Commissioning

****

NOTE: Laboratory analysis of samples is usually not required during Commissioning. Vapor stream monitoring during commissioning typically involves using a field instrument, such as a flame ionization

detector (FID).
****

Compensation shall be a lump sum price for completion of Commissioning. Physical and chemical testing performed in the field, and sampling shall be included in this price. Laboratory analysis of samples will [be] [not be] [_____] required during Commissioning.

1.1.3 Demonstration

****
NOTE: Vapor stream monitoring during the full-scale demonstration typically involves using a field instrument, such as an FID, in conjunction with laboratory analysis of a limited number of samples.
****

Compensation shall be a lump sum price for completion of Demonstration. Physical and chemical testing performed in the field, and sampling shall be included in this price. Costs for laboratory analysis of samples are covered in Section 01 35 45.00 10 CHEMICAL DATA QUALITY CONTROL and are 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.
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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

1.3 GENERAL REQUIREMENTS

****
NOTE: Commissioning and demonstration of the

full-scale SVE system should be preceded by a pilot-scale demonstration. The pilot-scale demonstration (or field demonstration) is usually the last step of the design investigation. Data gained during the pilot-scale demonstration are critical to proper sizing of the blower and other process equipment, and to proper lateral and vertical placement of SVE wells. This section only addresses commissioning and demonstration for full-scale SVE systems.

The specifications for the treatment system, or for components of the treatment system, should include requirements for testing, adjusting and balancing. Blowers, motors and air handling components of the SVE system should be tested in accordance with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS prior to commissioning. Although Section 23 05 93 is oriented primarily toward HVAC systems, the same testing, adjusting, and balancing requirements should be applied to components of the SVE system.

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1.3.1 Chemical Testing

Chemical sampling and analysis required in this section shall be conducted in accordance with SECTION 01 35 45.00 10 CHEMICAL DATA QUALITY CONTROL.

1.3.2 Submittal Requirements

Submittals shall be provided in both hard copy, and electronic files on disc. Electronic files shall be compatible with the following software: [_____]. If a part of a submittal is not available in electronic format, include a note describing which items were not provided in electronic format and explaining why the items could not be provided in electronic format. Submit the following:

a. A plan for Baseline Monitoring at least [60] [_____] calendar days before initiating Baseline Monitoring. A period of not less than [30] [_____] calendar days shall be allowed in the schedule for Government review. The plan shall include physical and chemical monitoring requirements, including test parameters, frequency of sampling, number of samples, and sampling locations; and laboratory turn-around-time. Test methods, and other sampling and analysis requirements shall be covered by submittals specified in Section 01 35 45.00 10 CHEMICAL DATA QUALITY CONTROL. The plan shall also include the forms that will be used to record data in the field, and an outline of the Baseline Monitoring Report. A schedule for baseline monitoring, at least [14] [_____] calendar days prior to the start of baseline monitoring. Baseline Monitoring Report not more than [35] [_____] calendar days after completing baseline monitoring.

b. List of team members who will represent the Contractor in the pre-commissioning checks and functional performance tests, at least [14] [_____] calendar days prior to the start of pre-commissioning checks.

c. A plan for Commissioning at least [60] [_____] calendar days before

initiating Commissioning. A period of not less than [30] [_____] calendar days shall be allowed in the schedule for Government review. The Commissioning Plan shall include a list of Pre-Commissioning and Functional Performance Tests. The plan shall also include the forms that will be used to record data in the field. Include detailed procedures for pre-commissioning checks and functional performance tests, at least [35] [_____] calendar days prior to the start of pre-commissioning checks. A period of not less than [21] [_____] calendar days shall be allowed in the schedule for Government review. A schedule for pre-commissioning checks and functional performance tests, at least [14] [_____] calendar days prior to the start of pre-commissioning checks. The Commissioning Report not more than [14] [_____] calendar days after completing commissioning. A period of not less than [14] [_____] calendar days shall be allowed in the schedule for Government review. Completed pre-commissioning checklists and functional performance tests checklists (organized by system and by subsystems) shall be submitted as one package. The results of failed tests shall be included along with a description of the corrective action taken.

d. A plan for Full-Scale Demonstration at least [60] [_____] calendar days before initiating the Full-Scale Demonstration. A period of not less than [30] [_____] calendar days shall be allowed in the schedule for Government review. The plan shall include physical and chemical monitoring requirements, including test parameters, frequency of sampling, number of samples, and sampling locations; and laboratory turn-around-time. Test methods, and other sampling and analysis requirements shall be covered by submittals specified in Section 01 35 45.00 10 CHEMICAL DATA QUALITY CONTROL. The plan shall also include the forms that will be used to record data in the field, and an outline of the Full-Scale Demonstration Report. A Full-Scale Demonstration Report not more than [7] [_____] calendar days after completion of the Demonstration. Operations log sheets attached to the Full-Scale Demonstration Report. The log shall be kept in notebooks organized in chronological order, and shall be submitted with the Full-Scale Demonstration Report not more than [14] [_____] calendar days after completing the Full-Scale Demonstration.

e. Results from laboratory analysis not more than [40] [_____] calendar days after collecting samples. A period of not less than [30] [_____] calendar days shall be allowed in the schedule for Government review. A table comparing field data to the laboratory data, for samples collected at the same time and from the same sampling port, shall be provided with each set of laboratory analysis results. The reports shall be signed and dated by the Contractor's Quality Control representative.

1.3.3 Sequencing and Scheduling

The sequence of work shall be as follows: construction completion, commissioning, and full-scale field demonstration. [Baseline monitoring shall be completed prior to initiating commissioning.] Commissioning of the full-scale system shall not be initiated until after work required in the following Sections has been completed, and test requirements in these Sections have been substantially completed: [Sections 43 11 00 FANS/BLOWERS/PUMPS; OFF-GAS, 31 21 00 PIPING; OFF-GAS, 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS, and 43 13 13.13 VAPOR PHASE ACTIVATED CARBON ADSORPTION UNITS] [_____].

1.4 SUBMITTALS

****

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have designated 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 submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation 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.

Use the "S" classification only in SD-11 Closeout Submittals. The "S" following a submittal item indicates that the submittal is required for the Sustainability Notebook to fulfill federally mandated sustainable requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

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

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Baseline Monitoring Plan; G[, [_____]]
Commissioning Team
Commissioning Plan; G[, [_____]]
Full-Scale Demonstration Plan; G[, [_____]]
Pre-Commissioning Tests; G[, [_____]]
Baseline Monitoring Schedule

Pre-commissioning checks

SD-06 Test Reports

Baseline Monitoring Report
Commissioning Report
Full-Scale Demonstration Report
Full-Scale Demonstration Log
Laboratory Analysis Report

1.5 REGULATORY REQUIREMENTS

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 02 01 50 OPERATION, MAINTENANCE, AND PROCESS MONITORING FOR SOIL VAPOR EXTRACTION (SVE)SYSTEMS.

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As required by regulations, obtain federal, state, and local permits for commissioning and demonstration of the SVE system. [Permits that have already been acquired are attached to the specifications.]

1.5.2 Air Emissions

****

NOTE: Federal, state, and local air quality requirements (as necessary during commissioning and demonstration) should be identified in this paragraph.

This paragraph should be deleted if air emissions monitoring will not be required during commissioning and demonstration.

****

Air emissions shall be monitored, controlled, and reported in accordance with the following regulatory requirements: [_____].

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 during commissioning and demonstration. Ensuring that noise levels are adequately controlled is especially important for projects near residential areas.

****

The SVE system shall [meet state and local noise pollution control regulations.] [not exceed [_____] decibels at any site boundary.]

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 BASELINE MONITORING

Baseline monitoring shall not be initiated until after the Baseline Monitoring Plan has been approved, and written approval has been received from the Contracting Officer. Notify the Contracting Officer at least [14] [_____] calendar days before starting baseline monitoring.

3.1.1 Temperature and Precipitation

Ambient temperature readings shall be recorded at least daily during baseline monitoring. Temperature readings shall also be recorded each time that barometric pressure readings are recorded. Temperature readings shall be recorded to the nearest 0.5 degree C 1.0 degree F. Precipitation shall be measured daily during baseline monitoring activities. Precipitation readings shall be recorded to the nearest 2.0 mm 0.1 inch.

3.1.2 Barometric Pressure and Vadose Zone Pressure

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NOTE: The subsurface response to changes in barometric pressure should be established during baseline monitoring. At sites with low permeability layers there may be a pressure differential between the atmosphere and the subsurface, or there may be a lag period before the subsurface equilibrates with the atmosphere.

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Barometric pressure readings shall be recorded 3 times per day for 3 consecutive days at the following times: [0800, 1200, and 1700 hours] [_____]. To establish subsurface response to changes in barometric pressure, vadose zone pressures shall also be recorded within 15 minutes of the barometric pressure readings at the following soil vapor extraction wells and vadose zone monitoring points: [_____]. Pressure readings shall be recorded to the nearest 2.0 mm 0.1 inch of mercury.

3.1.3 Soil Gas Monitoring

****

NOTE: This paragraph should be deleted if baseline soil gas sampling has already been performed. In addition to contaminants of concern, testing for the following parameters should be considered: total

volatile hydrocarbons, oxygen, carbon dioxide, and methane.

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.

****

Prior to start-up of the system, soil gas monitoring shall be performed by extracting air from the following soil vapor extraction wells and vadose zone monitoring points: [_____]. [In addition, a soil gas survey shall be performed to collect samples from the following locations and depth intervals: [_____].] Soil gas sampling shall be performed by either collecting whole-air samples, or by passing a known volume of extracted soil gas through an adsorption device. Samples shall be tested for the following analytes: [_____].

3.1.4 Groundwater Levels

Water levels shall be recorded for each of the following wells: [_____]. Water level measurements for all designated wells shall be completed in not more than [72] [_____] hours, from start to finish. Water level measurement shall be performed in accordance with EPA SESDPROC-105-R2. Water level readings shall be recorded to the nearest 3.0 mm 0.01 foot. The part of the measuring device that was wetted shall be decontaminated after each measurement.

3.1.5 Soil Boring Sampling

****

NOTE: This paragraph should be deleted if the soil boring sampling has already been performed. In addition to contaminants of concern, testing for the following parameters should be considered: percent moisture, and fraction organic carbon.

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.

****

Soil boring samples shall be collected from the following locations and depth intervals: [_____]. Soil boring sampling shall be performed in accordance with Section 02 32 00 SUBSURFACE DRILLING, SAMPLING, AND TESTING. Samples shall be tested for the following analytes: [_____].

3.1.6 Baseline Monitoring Report

Submit a baseline monitoring report. A period of not less than [30]

[_____] calendar days shall be allowed in the schedule for Government review. Results of Baseline Monitoring shall be organized according to category, and shown chronologically within each category. The report shall include monitoring locations (and depths, if applicable), and sample identification numbers. Separate plan view maps shall also be prepared, showing monitoring locations and depths, and the results of [soil gas monitoring, groundwater levels, and soil boring sampling] [_____]. The report shall be signed and dated by the Contractor's Quality Control representative.

3.2 COMMISSIONING

Commissioning shall not be initiated until the Commissioning Plan has been approved, and written approval has been received by the Contracting Officer. Notify the Contracting Officer at least [14] [_____] calendar days before starting commissioning. Combustible organic vapor monitoring shall be performed during commissioning in accordance with paragraph, Combustible Organic Vapor Monitoring.

3.2.1 Commissioning Team and Checklists

****

NOTE: The "design Agent's Representative" will be a member of the design team, i.e. from the AE or from Engineering Division. Where possible, the "Design Agent's Representative" should be included as a member of the commissioning team for the pre-commissioning checklists. The Design Agent's Representative will participate in functional performance tests. The planning, programming and funding for the Design Agent's Representative, whether in-house or A-E personnel will be used, must be addressed no later than the Predesign Conference.

The number of team members required to be present during commissioning should be based on the scale and complexity of the SVE system. The disciplines that need to be represented should be based on the types of equipment incorporated into the SVE system. Commissioning of a relatively simple system will require fewer individuals.

The checklists provided are to be used as guides for the preparation of project-specific checklists. An appropriate checklist should be included for each major component of the SVE system. The designer should insert additional checklists for equipment or systems not included in this guide specification, or modify the checklists where necessary for project-specific requirements.

****

Designate team members to participate in the pre-commissioning checks and the functional performance testing. In addition, the Government will be represented by a representative of the Contracting Officer, the Design Agent's Representative, and the Using Agency. The team members shall be as follows:

Designation	Function
Q	Contractor's Chief Quality Control Representative
M	Contractor's Mechanical Representative
E	Contractor's Electrical Representative
T	Contractor's Testing, Adjusting, and Balancing Representative
C	Contractor's Controls Representative
D	Design Agent's Representative
O	Contracting Officer's Representative
U	Using Agency's Representative

Each checklist shown in Appendices A and B shall be completed by the commissioning team. Acceptance by each commissioning team member of each pre-commissioning checklist item shall be indicated by initials and date unless an "X" is shown indicating that participation by that individual is not required. Acceptance by each commissioning team member of each functional performance test checklist shall be indicated by signature and date.

3.2.2 Tests

The pre-commissioning checks and functional performance tests shall be performed in a manner that essentially duplicates the checking, testing, and inspection methods established in the related Sections. Where checking, testing, and inspection methods are not specified in other Sections, methods shall be established and documented which will provide the information required. Testing and verification required by this section shall be performed during the Commissioning phase. Requirements in related Sections are independent from the requirements of this Section and shall not be used to satisfy any of the requirements specified in this Section. Provide all materials, services, and labor required to perform the pre-commissioning checks and functional performance tests. A pre-commissioning check or functional performance test shall be aborted if any system deficiency prevents the successful completion of the test or if any participating non-Government commissioning team member of which participation is specified is not present for the test. Reimburse the Government for all costs associated with effort lost due to tests that are aborted. These costs shall include salary, travel costs and per diem (where applicable) for Government commissioning team members.

a. Pre-commissioning Tests: Pre-commissioning checks shall be performed for the items indicated on the checklists in Appendix A. Deficiencies discovered during these checks shall be corrected and re-tested in accordance with the applicable contract requirements.

b. Functional Performance Tests: Functional performance tests shall be done for the items indicated on the checklists in Appendix B. Functional performance tests shall begin only after all pre-commissioning checks have been successfully completed. Tests shall

prove all modes of the sequences of operation, and shall verify all other relevant contract requirements. Tests shall begin with equipment or components and shall progress through subsystems to complete systems. Upon failure of any functional performance test checklist item, correct all deficiencies in accordance with the applicable contract requirements. The checklist shall then be repeated until it has been completed with no errors. Submit a Commissioning Report as specified in the Submittals paragraph.

3.3 DEMONSTRATION OF FULL-SCALE SYSTEM

Demonstration of the full-scale system shall not be initiated until after commissioning has been successfully completed, the Full-Scale Demonstration Plan has been approved, and written approval has been received from the Contracting Officer. Notify the Contracting Officer at least [14] [_____] calendar days before starting the demonstration, and shall provide a schedule of demonstration activities at least [7] [_____] calendar days before starting the demonstration.

3.3.1 Period of Demonstration

The SVE system shall be continuously operated for a period of at least [120] [_____] hours. Time required to complete commissioning shall not be included in the period of demonstration.

3.3.2 Hours of Operation and Downtime

Unless otherwise directed by the Contracting Officer, operate the SVE system [24] [_____] hours per day. Downtime of the SVE system shall not exceed [6 hours during the 120 hour demonstration period] [_____]. If downtime exceeds [6 hours during the 120 hour demonstration period] [_____], then the demonstration shall be re-started, until the continuous operation requirement is satisfied. Hours of operation and downtime shall be recorded in the Demonstration Log, at least once every [24] [_____] hours. The Full-Scale Demonstration Log shall be kept at the facility, and available for inspection.

3.3.3 Operational Airflow Rates

For the SVE system to be considered in operation, the blower shall be on and air shall be flowing from those wells designated in Table 1 at the flow rates shown in Table 1.

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

3.3.4 Process Monitoring

****

NOTE: Monitoring requirements for demonstration of the SVE system should be similar to that for operation of the full-scale system, but usually with a greater frequency of monitoring.

****

Obtain written approval from the Contracting officer before implementing any changes to the Baseline Monitoring Schedule.

3.3.4.1 Meteorological Monitoring

The following data shall be recorded [daily] [_____] during the full-scale demonstration: [ambient temperature, daily amount of precipitation, and barometric pressure] [_____].

3.3.4.2 Vadose Zone Pressure Monitoring

Vadose zone pressure monitoring shall be performed at least [daily] [_____] during the full-scale demonstration. Monitoring shall be performed at the following vadose zone monitoring points: [_____].

3.3.5 Groundwater Levels

Groundwater levels shall be measured on the [first and third] [_____] day of the full-scale demonstration, while the system is in operation, at the following monitoring wells: [_____].

3.3.6 Process Air Stream and Equipment Monitoring

Process air stream and equipment monitoring shall be performed as part of the overall assessment of the SVE system, and to monitor operation of SVE system equipment.

3.3.6.1 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-rich vapor stream it 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 commissioning. 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 each extraction well for the first time, monitoring shall be initiated during the following time intervals: [0-1 minute, 30-45 minutes, 60-75 minutes, 120-135 minutes] [_____]. In addition, monitoring shall be performed at least once every [8] [_____] hours during the full-scale demonstration. During each monitoring event, [at least 3 readings, separated by 1 minute increments,] [_____] shall be recorded. Monitoring shall be performed 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 organic vapor level. Such adjustments may include increasing and/or decreasing airflow rates from selected wells. The monitoring and adjustment procedure shall be repeated until the organic vapor level of the vapor stream has been decreased to less than [5000 ppmV as isobutylene] [_____].

3.3.6.2 Airflow Rate Monitoring

****

NOTE: The Contractor's measurement of airflow rates should be independently verified by a NEEB or AABC certified Testing, Adjusting, and Balancing specialist.

****

Pressures, temperatures, and air flow rates shall be monitored at the following locations at least [daily] [_____] during the full-scale demonstration: [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] [_____]. Airflow rate monitoring shall be in accordance with manufacturer's instructions for the air flow monitoring devices. Record instrument readings, and provide, in the Full-Scale Demonstration Report, any assumed values that were used to determine airflow rates. Measurement of airflow rates shall be independently verified by a NEEB or AABC certified Testing, Adjusting, and Balancing specialist during the first day of the full-scale demonstration, and shall be performed in accordance with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS. A copy of the airflow rates determined and signed by the NEEB or AABC certified Testing, Adjusting, and Balancing specialist shall be attached to the Full-Scale Demonstration Report.

3.3.6.3 Air/Water Separator and Condensate

The volume of condensate in the air/water separator shall be recorded at least [daily] [_____] during the full-scale demonstration. The volume of condensate generated since the previous monitoring event and cumulative total volume of condensate shall also be recorded.

3.3.6.4 Blower and Particulate Filter

The following parameters shall be recorded at least once every [24] [_____] hours during the full-scale demonstration: 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 air filter.

3.3.7 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.

It is important to perform frequent monitoring during the initial stage of the demonstration. Comparison of the initial contaminant level "spike" to subsequent rebound spikes is one of the best tools available for assessing the progress of SVE operations, and determining when to shut down the SVE system. On some projects rebound testing is performed on a regularly scheduled basis (e.g., every 4 months) so that initial contaminant level spikes can be compared to subsequent rebound spikes. See paragraph Rebound Testing, in Section 02 01 50 OPERATION, MAINTENANCE, AND PROCESS MONITORING FOR SOIL VAPOR EXTRACTION (SVE) SYSTEMS.

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Vapor stream contaminant level monitoring shall be performed within [2] [_____] hours of airflow rate monitoring to allow mass removal rates to be determined. Monitoring shall be performed in accordance with regulatory requirements.

3.3.7.1 Field Analysis of Vapor Stream Samples

Vapor stream monitoring shall be performed [every 30 minutes for the first 4 hours, every hour for the 4th through the 24th hour, every 4 hours for the 24th through the 48th hour, and at least once every 8 hours thereafter] [_____]. During each monitoring event, [at least 3 readings, separated by 2 minute increments,] [_____] shall be recorded. Data collected each monitoring event shall include [FID 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] [_____].

3.3.7.2 Laboratory Analysis of Vapor Stream Samples

Laboratory analysis of vapor stream samples shall be performed on the [first and last day] [_____] of the full-scale demonstration. One air stream sample shall be collected 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] [_____]. The sample for laboratory analysis shall be taken immediately after collecting the sample for field analysis at each sample port. Samples shall be tested for the following analytes: [_____]. Submit the Laboratory Analysis Report as specified in the Submittals paragraph.

3.3.7.3 Full-Scale Demonstration Report

Submit a full-scale demonstration report. A period of not less than [14] [_____] calendar days shall be allowed in the schedule for Government review. The report shall include 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] [_____]. Results of Process Monitoring shall be organized according to category, and shown chronologically within each category. Meteorological and Subsurface Monitoring data, and Process Air Stream and Equipment Monitoring data shall be included in each report. The following graphs shall be provided in the Report. For each SVE well, plots of: volume of air extracted versus time, cumulative volume of air extracted versus time, 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. 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. The reports shall be signed and dated by the Contractor's Quality Control representative. If warranted, the reports shall also provide recommendations for changing airflow rates from individual wells, and other proposed adjustments to the mode of operation.

APPENDIX A

PRE-COMMISSIONING CHECKLISTS

Pre-commissioning checklist - Piping								
For SVE System Piping								
Checklist Item	Q	M	E	T	C	D	O	U
Installation								
Piping complete.			X		X			
Piping flushed / cleaned.			X		X			
Leak testing complete (except for joints that have to be tested while the blower is operating).			X		X			
Valves installed as required.			X		X			
Heat tracing installed as required.			X		X			
Piping insulated as required.								
Thermometers, gauges, sampling ports, and monitoring ports installed as required.			X		X			
Verify operation of valves.			X					
Flexible connectors installed as required.			X		X			
Verify that piping has been labeled and valves identified as required.			X					
If potentially flammable organic vapors will be extracted, verify that piping is properly grounded.					X			
As-built shop drawings submitted.			X		X			
Testing, Adjusting, and Balancing (TAB)								
Monitoring ports and airflow monitoring devices installed and properly positioned.			X		X			

Pre-commissioning checklist - Air / Water Separator								
For Air / Water Separator Unit: [_____]								
Checklist Item	Q	M	E	T	C	D	O	U
Installation								
Leak testing complete.			X		X			

Pre-commissioning checklist - Air / Water Separator								
For Air / Water Separator Unit: [_____]								
Checklist Item	Q	M	E	T	C	D	O	U
Valves installed as required.			X	X	X			
Verify operation of valves.			X	X				
Verify that piping has been labeled and valves identified as required.			X	X	X			
Condensate drainage is unobstructed. (Verify by draining water from collection vessel of air / water separator).			X	X	X			

Pre-commissioning checklist - Blower								
For Blower Unit: [_____]								
Checklist Item	Q	M	E	T	C	D	O	U
Installation								
Vibration isolation devices installed [and freed to float with adequate movement and seismic restraint] as specified.			X	X	X			
Casing undamaged.			X	X	X			
Silencers undamaged			X	X	X			
Proper belt tension, if belt driven.			X	X	X			
Protective covers over rotating equipment.			X	X	X			
Manufacturer's required maintenance clearance provided.			X	X	X			
Spare inlet air filters present on-site.			X	X	X			
Pressure/temperature gauges installed.			X					
Verify proper installation of air cooling equipment, for cooling blower exhaust, if used.			X					
Verify that special tools and spare parts are present on site.			X	X	X			

Pre-commissioning checklist - Blower								
For Blower Unit: [_____]								
Checklist Item	Q	M	E	T	C	D	O	U
Electrical								
Power available to unit disconnect.				X				
Power available to unit control panel.				X				
Control system interlocks functional.				X				
Motor and blower rotation checked.				X	X			
Verify that power disconnect is located within sight of the unit it controls.				X				
Grounding properly installed.				X				
Controls								
Control valves/actuators properly installed.			X					
Control valves/actuators operable.			X					
Control interlocks properly installed.			X	X				
Control interlocks operable.			X	X				
Testing, Adjusting, and Balancing (TAB)								
Construction filters removed and replaced.			X		X			
Pressure/temperature gauges installed.			X		X			

Pre-commissioning checklist - SVE System Controls								
For SVE System: [_____]								
Checklist Item	Q	M	E	T	C	D	O	U
Installation								
As-built shop drawings submitted.			X	X				
Layout of control panel matches drawings.			X	X				
Components properly labeled (on inside and outside of panel).			X	X				
Control components piped and/or wired to each labeled terminal strip.				X				
Control wiring and tubing labeled at all terminations, splices, and junctions.				X				
Shielded wiring used on electronic sensors.				X				
Main Power								
Power available to panel.				X				

Pre-commissioning checklist - Vapor Stream Treatment System								
For Vapor Stream Treatment System: [_____]								
Checklist Item	Q	M	E	T	C	D	O	U
Installation								
Piping complete.			X		X			
As-built shop drawings submitted.			X		X			
Leak testing complete.			X		X			
Valves installed as required.			X		X			
Piping insulated as required.			X		X			
Thermometers, gauges, sampling ports, and monitoring ports installed as required.			X					

Pre-commissioning checklist - Vapor Stream Treatment System								
For Vapor Stream Treatment System: [_____]								
Checklist Item	Q	M	E	T	C	D	O	U
Verify operation of valves.			X					
Flexible connectors installed as required.			X	X	X			
Verify that piping has been labeled and valves identified as required.			X					
Verify use of flexible lines and connectors for changing positions of lead, lag, and spare vessels, as required.			X	X	X			
Spare vessel on-site, if required.			X	X	X			
Verify status of air pollution control permit, if required.		X	X	X	X			

Pre-commissioning checklist - Ancillary Equipment								
For SVE System: [_____]								
Checklist Item	Q	M	E	T	C	D	O	U
Installation								
Field monitoring instruments calibrated.					X			
Lighting installed and functional.		X		X				

APPENDIX B

FUNCTIONAL PERFORMANCE TESTS CHECKLISTS

Functional Performance Test Checklist - Piping

For SVE System Piping

1. Functional Performance Test: Contractor shall verify operation SVE system piping in accordance with specification. The following shall be verified while the blower is operating:

a. Check vacuum response at each SVE wellhead before and after valving on each well.

b. With the valves to all SVE wells in the open positions, gradually modulate the inlet bleed valve from fully open position, adjusting toward the fully closed position.

c. As wells are valved on, leak-test joints not previously tested. Also leak-test accessible portions of SVE wells and pressure monitoring points. Note the locations of any leaks.

2. If piping system includes drainage points, check for water at drainage points at the end of each day during commissioning.

3. Independent measurement of air flow rates (from each extraction well, and total extraction airflow rate) by Contractor and TAB specialist. Results differ by no more than 10 percent.

4. Verify operation of heat tracing.

5. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Functional Performance Test Checklist - Air / Water Separator

For Unit: [_____]

1. Start blower.

a. Check inlet and outlet connections for any signs of leaks. Note the

Functional Performance Test Checklist - Air / Water Separator

For Unit: [_____]
locations of any leaks.

b. Check pressure drop across air / water separator:

Inlet pressure		kPa gauge psig
Outlet pressure		kPa gauge psig

c. If equipped with a sight glass, check for unobstructed view of water level.

d. Compare airflow rate and pressure drop to contract specifications, and manufacturer's performance specifications.

	CONTRACT	MANUFATURER'S RANGE	ACTUAL
Airflow Rate (L/s) (CFM)			
Inlet pressure (kPa gauge) (PSIG)			
Outlet pressure (kPa gauge) (PSIG)			

2. Turn blower off.

a. Check operation of drain valve for condensate holding vessel.

b. Check setting of high level alarm in condensate holding vessel.

c. If the unit is designed to allow the drain valve to be used while the blower is operating, check operation of drain valve for condensate holding vessel while the blower is operating.

3. Unusual vibration, noise, etc.

_____

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative

	_____
Contractor's Controls Representative	_____
Contracting Officer's Representative	_____
Using Agency's Representative	_____

Functional Performance Test Checklist - Blower

For Blower Unit: [_____]

1. Functional Performance Test: Contractor shall verify operation of blower in accordance with specification. The following shall be verified after the blower has been operating for a minimum period of [30] [_____] minutes:

a. Record current draw from blower, and voltage.

Amperage _____
Voltage _____

b. Record blower air flow rate and air temperatures.

Air flow rate		L/s cfm
Inlet air temperature		degrees C F
Outlet air temperature		degrees C F

c. Record blower fan speed. _____ rpm

d. Check noise level. _____ [decibels at 1 meter][_____]

e. Verify operation of variable speed (if equipped). _____

f. Verify setting of vacuum relief valve. _____

g. Verify setting of pressure relief valve. _____

h. Verify setting of high-temperature shutdown. _____

2. Plot test readings of pressure and airflow rate on blower curve, compare results to manufacture's specifications, and submit testing, adjusting, balancing (TAB) report. TAB results within acceptable ranges.

_____

3. Unusual vibration, noise, etc.

_____

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Functional Performance Test Checklist - SVE System Controls

For Control Unit: [_____]

1. Functional Performance Test: Contractor shall verify operation of SVE controls in accordance with specification. The following tests shall be performed:

a. Verify that controller is maintaining the set point by manually measuring the controlled variable with a thermometer, differential pressure gage, etc.

b. Verify sensor/controller combination by manually measuring the controlled medium. Take readings from control panel display and compare readings taken manually. Record all readings.

Sensor	
Manual measurement	
Panel reading value	

c. Verify that interlocks function in accordance with specifications.

d. Verify interlock with other SVE controls.

2. Verify that operation of control system conforms to that specified in the sequence of operation.

3. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contractor's Officer's Representative _____

Using Agency's Representative _____

Functional Performance Test Checklist - Vapor Stream Treatment System

For Vapor Stream Treatment Unit: [_____]

1. Functional Performance Test: Contractor shall verify operation of the Vapor Stream Treatment System in accordance with specification. The following shall be verified while the system is operating:

a. Check inlet and outlet connections for any signs of leaks. Note the locations of any leaks.

b. Check airflow rates at inlet and outlet of vapor stream treatment system:

Inlet Airflow Rate		L/s cfm
Outlet Airflow Rate		L/s cfm

c. Check temperature and pressure across [lead treatment vessel] [_____]:

Inlet pressure		kPa gauge psig
Outlet pressure		kPa gauge psig
Inlet temperature		degrees C F
Outlet temperature		degrees C F

d. Check temperature and pressure across [lag treatment vessel] [_____]:

Inlet pressure		kPa gauge psig
Outlet pressure		kPa gauge psig
Inlet temperature		degrees C F
Outlet temperature		degrees C F

e. Compare vapor stream temperatures, pressures and airflow rates, to contract specifications, and manufacturer's performance specifications.

	CONTRACT	MANUFACTURER'S RANGE	ACTUAL
Inlet airflow rate (L/s) (CFM)			
Inlet temperature (degrees C F)			

	CONTRACT	MANUFACTURER'S RANGE	ACTUAL
Inlet pressure (kPa gauge) (psig)			
Outlet airflow rate (L/s) (CFM)			
Outlet temperature (degrees C F)			
Outlet pressure (kPa gauge) (psig)			
Pressure drop across lead vessel (kPa gauge) (psig)			
Pressure drop across lag vessel (kPa gauge) (psig)			

f. Using a [flame ionization detector] [_____], check organic vapor level readings of the vapor stream at the following locations:

Inlet of Vapor Stream Treatment System		ppmV as [isobutylene] [_____]
Between Lead and Lag Vessels		ppmV as [isobutylene] [_____]
Outlet of Vapor Stream Treatment System		ppmV as [isobutylene] [_____]

2. Unusual vibration, noise, etc.

_____

3. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

-- End of Section --