Bureau Environmental Remediation/Remedial Section Guideline

Considerations for Operations, Maintenance, and Monitoring of Residential Active Subslab Depressurization Systems

BER Policy # BER-RS-53
Date: June 2011
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Bureau Manager: _____ **Date:** 6/30/2011

ORIGINATOR

Originator: Chris Carey **Date: June 2011**

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Preliminary Remarks

This document serves as a guide to KDHE staff and the public on the Agency's recommendations for operations, maintenance, and monitoring (OM&M) of residential active subslab depressurization (SSD) systems installed to mitigate intrusion of volatile organic compound (VOC) vapors from the subsurface into indoor air. Specifically, this document addresses those activities necessary to ensure adequate performance of SSD systems following system startup and necessary post-startup testing and diagnostics. SSD systems are the most common form of active mitigation used to address vapor intrusion in Kansas, which is why this document focuses on OM&M considerations for these systems. However, other mitigation technologies may be more appropriate or necessary to address site-specific and building-specific considerations. OM&M activities specific to those systems should be identified in planning and reporting documentation associated with the installation of the systems. This document does not present SSD design specifications. KDHE strongly recommends that all vapor intrusion mitigation systems be designed with consideration of the U.S. Environmental Protection Agency's (EPA) Engineering Issue entitled *Indoor Air Vapor Intrusion Mitigation Approaches* (EPA 2008) and other available guidance.

The recommendations in this document do not supersede site-specific monitoring objectives or requirements, and not all maintenance and monitoring activities described below may be required for every site. Specific OM&M objectives (e.g., performance thresholds, etc.) and corresponding OM&M activities and frequencies should be identified in the Vapor Mitigation Design and subsequent As-Built Report.

For all sites where SSD systems are installed to mitigate vapor intrusion, it is critical that the systems operate continuously and perform adequately throughout their life cycle. This will likely necessitate a formal agreement between responsible parties and property owners that also applies to future owners of the property. Copies of such agreements should be provided to KDHE. To ensure proper long-term operations, the responsibility for maintenance and monitoring of these systems should not be transferred from responsible parties to individual residential property owners/occupants.

What is SSD?

SSD refers to a specific type of vapor intrusion mitigation system which has been used for many years to mitigate the intrusion of radon gas into overlying structures and can be similarly applied to address intrusion of VOCs. The goal of SSD systems is to create a negative pressure field beneath the foundation of the overlying structure which prevents vapors from moving into the structure. SSD is accomplished by attaching a fan to one or more suction points installed through the building foundation. The fan pulls air from beneath the slab creating a negative pressure field. The size of the fan and number and spacing of suction points can be adjusted to ensure that the pressure field extends beneath the entire structure. The number and spacing of suction points can be determined during the design and/or installation process.

Initial Performance Verification

At sites where vapor intrusion mitigation installation was triggered by the detection of one or more site contaminants of concern (COCs) in indoor air at concentrations above applicable threshold levels, the fundamental objective of the SSD system is the reduction of contaminant concentrations in indoor air to acceptable levels. Similarly, for SSD systems installed based on other available data (e.g., known soil gas impacts, etc.) but where indoor air data are not available, it is still important to verify that indoor air concentrations are below acceptable levels once the system has been installed. The initial performance verification event should occur within 30-60 days of system installation with a comprehensive OM&M event during the following cold weather season to ensure that the system performs adequately under worst-case conditions.

In addition to collecting concentration data, other measurements can be used to help evaluate the system's effectiveness including pressure differential, SSD effluent concentration, and flow and vacuum (at each suction point and cumulative), among others. It is also necessary to confirm that the system satisfies the performance threshold criteria specified in the vapor mitigation work plan within 30-60 days of system startup. This typically involves measuring pressure differential at various locations across the building's foundation to verify that the negative pressure field exerted by the SSD system extends under the entire building footprint at acceptable levels (e.g., EPA 2008 recommends 4-10 Pascal) and measuring vacuum and flow at each suction point.

Based on the results of the initial performance verification event, system modifications, if any, should be implemented and performance documented. The performance verification data and post-startup testing and diagnostics findings are then used to calculate acceptable ranges for indirect measurements. All performance verification data should be presented along with any necessary system modifications and the acceptable ranges for each indirect measurement in the SSD As-Built Report.

Components of the Long-Term OM&M Program

The long-term OM&M program for SSD systems often includes both direct (e.g., indoor air sampling) and indirect measurements of system performance (e.g., pressure differential testing, etc.); however, not all measurements are typically required during each monitoring event. It may be appropriate to reduce (but not eliminate) the frequency of direct measurements if the proposed monitoring program includes a rigorous indirect monitoring component, or vice versa. Long-term OM&M activities continue throughout the life cycle of an SSD system; however, the long-term monitoring program should not be 'fixed' at startup. Sample results, general site conditions, and system inspection findings should be used to facilitate modifications/enhancements to the OM&M program over the SSD system's life cycle.

General System Inspections

Routine system inspections should be conducted on an annual basis to help ensure that SSD systems operate continuously and reliably throughout their lifecycle. To streamline the inspection process and ensure consistency between inspection events, a site-specific inspection form should be prepared to document inspection findings. These forms should include spaces to document any samples collected, abnormalities identified and concerns that property owners, residents, and/or other stakeholders may have. The results of system inspections should be provided to KDHE as a component of OM&M reports. The list below summarizes some general elements of system inspections; however, a comprehensive list of inspection tasks, an inspection schedule, and expected lifetime of system components should be developed and approved as part of the Vapor Mitigation System Design and As-Built Report.

- **SSD Components:** Inspect all visible system components (system piping, fans, alarms, manometer, etc.) noting any cracks in piping or other operational issues (too much or new noises, improper moisture drainage, etc.);
- **Cracks and Gaps:** Inspect visible basement walls and floors noting the size and location of any cracks and gaps that have not been sealed or where seal integrity may be compromised;
- **Seals:** Inspect seals around sump, if present;
- **Labels:** Make sure that the SSD system is properly labeled and contact information provided is up-to-date; and,
- **Alarms:** Make sure that all visual and audible alarms are functioning properly.

As part of each routine inspection, inspectors should identify any of the conditions listed below which have occurred or are planned in the near future. Recognition of these issues upfront may significantly reduce the cost and level of effort required to remedy operational issues and ensure continued performance of SSD systems:

- Changes in the community (surrounding land use);
- Changes in building use/occupants (finished basement, daycare, etc.);
- Changes in building structure (new addition, etc.); and,
- Changes in heating, ventilation and air conditioning (HVAC) system/operations or installation of new combustion or vented appliances which may allow for back drafting.

Indirect Performance Monitoring

Indirect performance monitoring should be conducted concurrently with system inspections. The purpose of performance monitoring is to confirm that the SSD system is performing within acceptable limits. To streamline performance monitoring efforts, site-specific forms should be developed to guide field staff when conducting the evaluations. Components of the site-specific performance monitoring program may include but are not limited those listed below. It is not KDHE's intent to require all indirect performance monitoring activities during each monitoring event.

- **Pressure differential measurements at each monitoring point.** The pressure differential measurements should be evaluated with respect to the performance thresholds established in the As-Built Report and to determine whether the negative pressure field still extends under the entire building footprint. In most cases, indoor air quality should be acceptable when the negative pressure field is maintained under the entire building footprint.

- **Flow and vacuum measurements for the system and individual suction points.** The flow and vacuum measurements should be evaluated with respect to the performance thresholds specified in the As-Built Report. A significant increase or decrease in flow or vacuum may indicate the system is not operating properly (e.g., short-circuiting, water or other obstruction in suction pit or piping, etc.).

- **Subslab vapor samples.** The collection of subslab vapor samples is considered an indirect performance measurement because the measurement does not represent the contaminant concentration at the point of exposure. Subslab vapor samples provide an indication of the contaminant concentrations which could pose a vapor intrusion threat if the SSD system is not operational. In addition, it is expected that subslab concentrations will decrease substantially as a result of SSD operations; however, this is not always observed. Subslab vapor samples are not commonly a requisite component of OM&M programs but may be appropriate under upset conditions (e.g., systems inoperable, significant change in site conditions, unexpected direct or indirect performance monitoring results, etc.) and/or to support shutdown and decommissioning.

- **SSD effluent samples.** Effluent samples provide an indication of the contaminant levels being addressed by the SSD system. These measurements can be compared over time to evaluate trends. SSD effluent samples are not typically a requisite component of OM&M programs.

Indoor Air Testing

Indoor air data are used to evaluate whether the SSD system is effective at reducing indoor air contaminant concentrations to acceptable levels. The requisite frequency of indoor air testing can vary depending on the frequency of indirect performance monitoring activities (typically once every 1-5 years depending on site-specific circumstances). More frequent sampling is generally required upfront to ensure that the system is performing adequately. When conducting indoor air testing KDHE recommends performing a thorough inventory of potential indoor air sources of the contaminants of concern to avoid making inaccurate conclusions regarding the effectiveness of the SSD system. In addition, strong consideration should be given to collecting subslab and ambient air samples concurrently with indoor air sample collection.

Reporting

The results of all performance monitoring activities must be reported in a timely manner following each monitoring event. Any upset conditions must be reported to KDHE immediately and corrected within seven days of the inspection or as otherwise approved by KDHE. In addition to providing a written summary of the monitoring/inspection outcomes and recommendations, all field forms and notes, laboratory reports, and other ancillary documentation must be provided to KDHE. Monitoring reports should also provide any recommendations for improving the monitoring program.

Shutdown and Decommissioning

In general, it is KDHE's expectation that SSD systems continue operating until the source of indoor air contamination has been addressed. For most buildings, this means that OM&M activities will be ongoing until cleanup levels for soil and groundwater underlying and adjacent to the property have been achieved and the potential for continued migration from the source area (i.e., where the release occurred) towards the affected building is precluded. In many cases, KDHE will require confirmation subslab and indoor air testing once a SSD system has been deactivated for a short period of time (e.g., 30 days) to demonstrate that continued SSD operation is unnecessary.

In some cases, the SSD system may provide ancillary benefits to the property owner/resident through continued radon abatement. In such cases, it is in the best interests of all stakeholders to leave the system in place and operating; however, it should be explained to the property owner/resident that the primary reason for installing the system has been addressed and that it is being left in place to address naturally occurring radon impacts and will no longer be operated, maintained or monitored by the responsible party of KDHE. The decision regarding whether or not to leave a SSD system in place should be determined between the property owner and

responsible party and formally documented. It is KDHE's general expectation properties be restored to their pre-mitigation condition should an SSD system be removed.

References

ASTM, 2003, *Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings*, E2121-03, ASTM International, West Conshohocken, Pennsylvania.

DTSC, 2009, *Vapor Intrusion Mitigation Advisory*, Department of Toxic Substances Control, California Environmental Protection Agency, Sacramento, California, April.

EPA, 2008, *Engineering Issue – Indoor Air Vapor Intrusion Mitigation Approaches*, EPA/600/R-08-115, Office of Research and Development, National Risk Management Research Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio, October.

ITRC, 2007, *Vapor Intrusion Pathway: A Practical Guideline*, Interstate Technology and Regulatory Council, Washington, DC, January.

KDHE, 2007, *Kansas Vapor Intrusion Guidance*, Kansas Department of Health and Environment, Division of Environment, Bureau of Environmental Remediation, Topeka, Kansas, June.