Vapor Intrusion Mitigation Using HVAC System Engineering Controls: Performance and Reliability Demonstration

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Background/Objectives. For some commercial and industrial buildings, prevention or mitigation of vapor intrusion (VI) of subsurface volatile organic compounds can be accomplished using the building heating, ventilating, and air conditioning (HVAC) systems. In such cases, the HVAC system serves as a VI engineering control, similar to other common VI mitigation methods, such as sub-slab depressurization (SSD). Typically, HVAC systems can control VI by pressurizing the building to keep VI out, and/or by providing sufficient outdoor air exchange to dilute VI effects. For any mechanical system employed as a VI engineering control, the long-term effectiveness and reliability depends on the consistency of relevant system operating parameters. However, for HVAC systems serving as engineering controls, there is a general lack of reported data and experience regarding the critical operating parameters and their connection to longer-term performance and reliability for VI mitigation. The purpose of this paper/presentation is to present data and information collected to evaluate and ensure the longer-term effectiveness and consistency of HVAC engineering controls for buildings that might otherwise be affected by VI.

Approach/Activities. The long-term effectiveness of HVAC systems for VI engineering control is predicated on maintaining the HVAC operating parameters (e.g., outside air damper position or flow rate) at conditions that sustain appropriate indoor air quality. If VI is mitigated under a specific set of HVAC operating parameters, then as long as those conditions are maintained, long-term protectiveness against VI should be assured. Mitigation performance can be compromised by numerous factors, including changes to HVAC operations due to equipment malfunction, inadequate maintenance, building modifications, among other factors. To demonstrate the connections among HVAC operations, VI mitigation, and indoor air quality, a program of real-time and long-term monitoring and sampling will be presented for two large campuses of commercial/industrial buildings. HVAC operational monitoring and building configuration/use checks have been coupled with various indoor air screening and sampling methods to assess the outlook for routine HVAC operational monitoring, in lieu of indoor air sampling alone, to assure long-term protectiveness against VI.

Results/Lessons Learned. When HVAC systems are being relied upon as an engineering control for VI mitigation, a thorough understanding of the factors that influence HVAC system operations must be achieved and controlled over the long term. Similar to other mechanical systems, such as an SSD system, as long as the critical operating conditions are maintained, the HVAC system should provide consistent, sustained performance for long-term VI mitigation. The indoor air and HVAC operations data from this demonstration project support the premise that the long-term success of HVAC engineering controls for VI mitigation is dependent on the strength and execution of a building-specific HVAC system operations, maintenance, and monitoring program. Where such strength and consistency are demonstrated, on-going indoor air sampling may be reduced or even eliminated, similar to long-term monitoring programs for many SSD systems.