# Big Bang Theory: Evaluation of Sub-Slab Methane at Large Warehouse Sites

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**Background/Objectives.** Methane vapor intrusion is a well documented explosive risk. Building explosions have been reported associated with methane migration from landfills, leaking natural gas lines, leaking oil and gas production wells, naturally-occurring gas seeps, and large deposits of buried organic material. However, few guidance documents address methane vapor intrusion risk and the available guidance is generally less specific than many guidance documents that address toxic chemical vapor intrusion.

**Approach/Activities.** We have evaluated the occurrence of sub-slab methane and associated explosion risk at a number of recently constructed large warehouse buildings. Investigation activities included measurement of methane concentrations in indoor air and sub-slab, measurement of methane mass discharge in sub-slab vapor extraction systems, and additional investigations to identify possible methane sources.

**Results/Lessons Learned.** Fill soil used for construction of slab foundations commonly contains low amounts (0.5% to 2%) of natural organic material. When these soils are isolated from the atmosphere below a large slab-on-grade foundation, the soil environment quickly becomes anaerobic allowing naturally-occurring methanogenic bacteria to degrade this organic material resulting in methane formation. Sub-slab investigations may show:

- Increasing methane concentrations in soil gas in the months after initial warehouse construction
- Methane concentrations in soil gas well above the LEL of 5% by volume
- Lower than expected carbon dioxide concentrations due to reaction of carbon dioxide with lime or limestone in the fill material

Soil, itself, cannot explode regardless of methane concentration. As a result, the explosive risk depends on the potential for explosive levels of methane to accumulate inside the building structure. This potential is a function of methane generation rates rather than methane concentration in the subsurface. Subsurface methane concentrations greater than 90% do not pose a risk if the methane generation rate is insufficient to generate explosive concentrations of methane within a structure.

The published literature does not present any examples of methane explosions associate with methane generation in normal fill material below a building. As a result, evaluation of methane risk should focus on determining the presence or absence of an additional source of methane beyond the fill material. If the possible presence of an additional source cannot be ruled out, then methods to quantify the methane generation rate can be used to evaluate the potential for an explosive risk.