Vapor Intrusion Evaluation and Mitigation Systems

ENVIRONMENTAL OPERATIONS, INC.

PRESENTED AT
MECC CONFERENCE
APRIL 22-24, 2019

Environmental Operations, Inc.
CLEARING THE WAY

Agenda

- Vapor Sampling Methods
- Evaluating Vapor Intrusion Results
- Strategies for Dealing with Vapor Intrusion
- Vapor Intrusion Mitigation Systems
- Case Studies
- General Costs
- Reducing Overall Costs

VI Sampling Methods

- Subsurface Soil Gas (Soil Vapor)
  - **Install shallow soil gas wells outside of existing building, or if no buildings on site**
- Sub-Slab Vapor
  - **Collect beneath concrete building slab**
- Groundwater
  - **USEPA and most states have VI standards based on groundwater concentrations**

Soil Gas Sampling

- External subsurface soil gas sampling

- Sub-slab sampling

Advantages and Disadvantages

ADVANTAGES	DISADVANTAGES
Exterior Subsurface Soil Gas • Rapid • Cost effective • Can be used to evaluate multiple areas	Exterior Subsurface Soil Gas • Risk of ambient air breakthrough • Risk of groundwater interference
Sub-slab Vapor • More direct measurement (directly under building)	Sub-slab Vapor • Indoor source interference potential • Use of sub-slab data may over-estimate risk

VI Sampling Methods, cont.

- Indoor Air
  - **Document actual building conditions**
  - **Inventory potential sources of VOCs and remove if possible**
  - **Vacuum canister with flow controller (8 hr. or 24 hr.)**
- Crawlspace Air
  - **Sampling is similar to indoor air from crawlspace**

Indoor Air Sampling

- Concurrent indoor air and sub-slab sampling

- Crawlspace sampling

Advantages and Disadvantages, cont.

ADVANTAGES	DISADVANTAGES
Indoor Air • Direct data for exposure evaluation • Easiest sample collection method	Indoor Air • Indoor source interference potential • IA concentrations may fluctuate
Groundwater • May already have data from other investigations • Provides preliminary look	Groundwater • Not a direct indicator • Depth may preclude vapor migration

Evaluating VI Data

- First – do you have any volatiles?
- Compare sample results to look-up tables
  - **USEPA RSL tables or VISL on-line**
- Do you need additional sampling?
- Risk assessment
- Consider—
  - **Natural biodegradation/attenuation – BTEX, TPH**
- Remediation or mitigation?
  - **Pro-active mitigation is sometimes less costly**

Remediation or Mitigation?

- Can use combination of strategies to address VI
- Traditional remediation (excavation, treatment, thermal, biodegradation, MNA)
- Institutional controls
  - **Land use limitations (industrial/commercial)**
  - **Building location restrictions**
- Building control technologies
  - **Barriers/liners**
  - **Sub-slab/sub-membrane venting systems**
- Interim or permanent

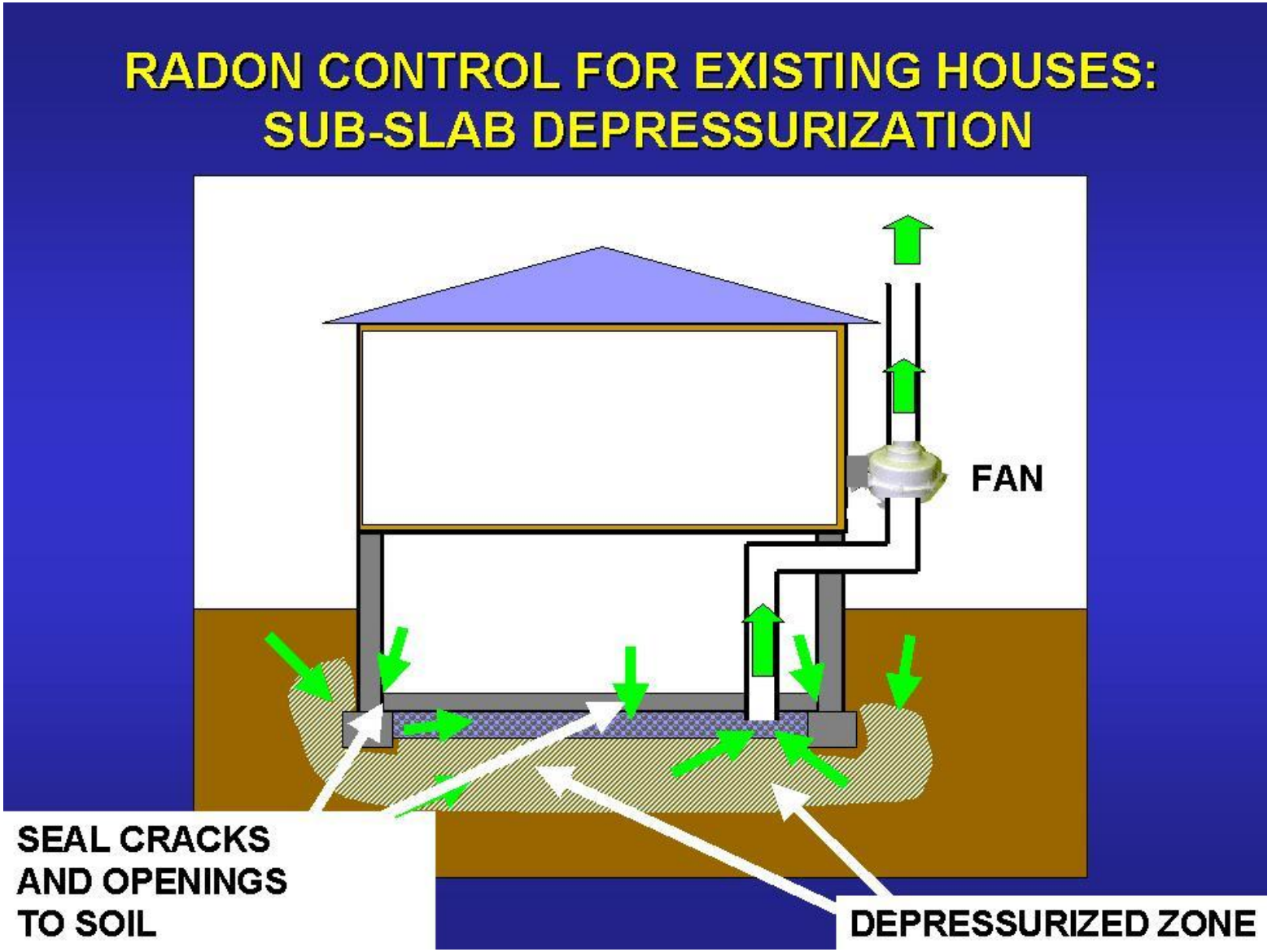
Types of Mitigation Systems

- Sub-slab depressurization or venting
- Impermeable barrier
  - **Chemical resistant**
  - **Installed during new building construction**
  - **Can be retro-fitted in some cases**

- Vented raised floors
  - **For new construction**

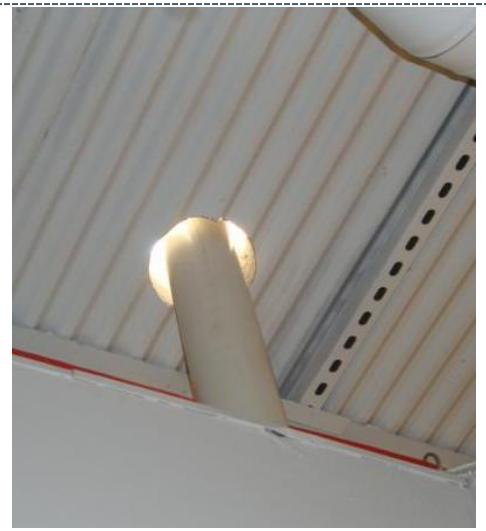
- Follow-up with indoor air sampling to verify

RADON CONTROL FOR EXISTING HOUSES: SUB-SLAB DEPRESSURIZATION



Case Study 1 – Residential
Sub-Membrane Depressurization

Case Study 2 – Office
Sub-Slab Depressurization



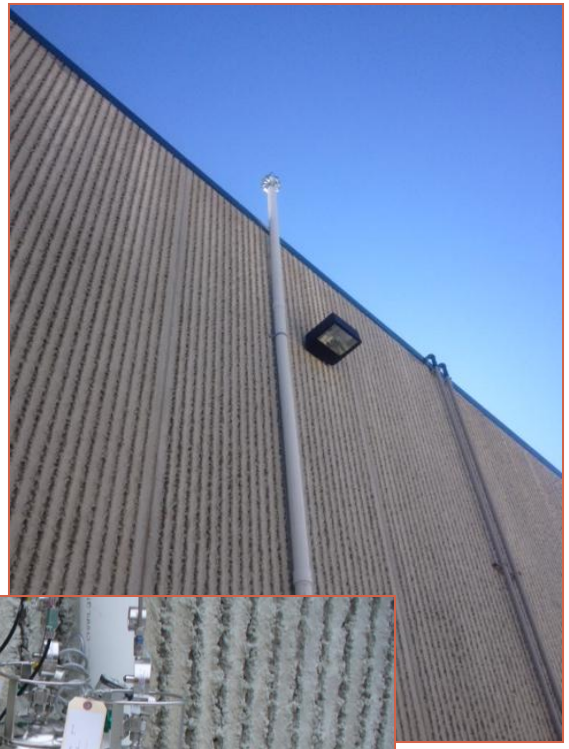
Case Study 3 – Impermeable Barrier with Passive Venting in New Construction

- Vapor vent installed below barrier
- Wind turbines on roof to promote vapor exhaust
- Installed performance monitoring system
- Can convert passive to active venting by installing fans

Case Study 3 – Venting and Performance Monitoring Systems

Case Study 3 – Barrier Installation

Case Study 3 – Venting and Performance Monitoring



General Costs for Mitigation Systems

- Sub-slab or sub-membrane depressurization – single unit:
  - **$1100-1500 for individual system**
  - **Electrical hook-up and roofing (if needed) extra**
  - **Electrical costs are minimal – about $65-130/year**
  - **O&M – periodic inspections, fan replacement**
- Impermeable barrier system:
  - **Multi-layered (new construction) - $2-4 per ft^2**
  - **Retro-fit (existing building) - $5-7 per ft^2**

Ways to Reduce Overall Costs

SAMPLING

- Reduce the list of analytes to known contaminants of concern
  - **E.g. BTEX instead of all VOCs if known contaminants are gasoline/petroleum products**
  - **For indoor air samples, ask lab to report known COCs, e.g. chlorinated VOCs for a former dry cleaning site**
  - **Analytical cost may not be lower but reduces reporting costs as well as avoiding potential "can of worms" issues**
- Skip directly to indoor air sampling to evaluate VI
  - **If soil/groundwater results are elevated**
  - **If building is vacant**

Ways to Reduce Overall Costs (cont.)

MITIGATION

- Institutional controls
  - **Consider land use restrictions**
    - Restrict building construction in areas of contamination
    - Restrict residential land use
- Proactive Mitigation
  - **Skip step-wise sampling events – plan to install mitigation system prior to closure or during construction**
    - If existing data show elevated concentrations in soil/groundwater
    - If complete remediation of soil/groundwater is too costly
    - Can be relatively inexpensive and satisfy regulators (get buy-in)
    - If time is critical to project closure

Questions?

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