

## Vapor Intrusion: Involved-Stakeholder Awareness of the Uncertainty (and Multiple Benefits of Controls)

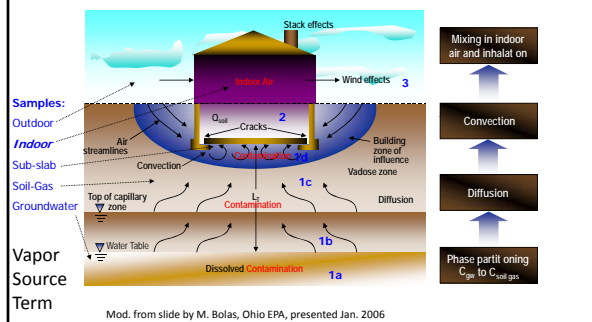
Henry Schuver & Lenny Siegel  
Open Time Session  
Community Involvement Training Conference  
Crystal City, VA  
July, 20, 2011

### In this Session we will discuss:

- How the intrusion of Volatile Organic Compounds (VOCs +) (and naturally-occurring Radon) into homes gives impacted residents an:
- **Unusual opportunity** to launch their **own environmental investigation and response**
- An approach that trained Community Engagement specialists could assist them with

+ = and other hazardous-vapor forming chemicals, e.g., mercury, etc.

### Simple conceptual model of the vapor intrusion exposure pathway



### Extent of Impacts



Slide by Enviro-Group, Ltd.

### Vapor Intrusion (VI)

- VI involves unavoidable contamination in personal spaces (e.g., residential) indoor air
- Raises significant concern in communities overlying volatile contamination

### Involved-Stakeholders have ...

- An Opportunity to see the:
  - Uncertainties in typical-chemical-based Assessments
  - Multiple Benefits of intrusion Controls
- To be a **key** to the solution to this problem

### Numerous Challenges in Traditional Chemical-based VI Assessment

- VI is characterized by **Variability**
  - Across:
    - Space
    - Time
- Assessing VI (indoor) chemical **Exposures** is Difficult, Disruptive, & Costly
  - Thus, typically involves a limited number of short-term samples from some locations/buildings

### Other constituents in soil-gas

- Moisture/mold, Radon, Methane, CO<sub>2</sub>, ...
  - Typically these do not improve indoor air quality
- Radon is:
  - Naturally-occurring in all soil-gas
  - Measureable concentrations in most soil-gas
  - In indoor air it is a **general tracer of soil-gas entry**
    - If radon is getting in, so could VI (spilled) chemicals in soil-gas

### RADON

FIGURE 1  
Generalized Geologic Radon Potential of the United States by the US Geological Survey

**EPA's Perspective on Risks from Residential Radon Exposure**  
 "Indoor radon ... the most serious environmental carcinogen which the EPA must address for the general public" Puskin 1989

Human Health-based studies (2005) required: **1 yr-long** samples to enter

Risk\* ~ 2.3000% (4pCi/L)  
**20,000 Lung\* Cancers/yr**  
 But: Complacency & Costs  
 Jalbert, 2004  
 \* adult cancer

Geologic Radon Potential (Predicted Average Screening Measurement)  
 Low (<2 pCi/L)  
 Moderate/Volatile (2-4 pCi/L)  
 High (>4 pCi/L)

Zones Based on indoor air & geology

The same VI pathway  
 Real 'background' for chemical VI  
 With chemical VI you get BOTH

From Frumkin, H. et al. CA Cancer J Clin 2001;51:337-344.  
 Copyright ©2001 American Cancer Society

### Cost & Practicality of Monitoring

Differences between VOCs & radon

- Significantly less cost for radon collection & analyses
  - Than for chemical-contaminants
- Simple passive sorbent (e.g., charcoal canisters)
  - ~\$10/sample for 2 to 14 days (used for real-estate transfers)
- **Continuous digital monitors (like Smoke & CO detectors)**
  - Models **designed for homeowner use** (dual channel)
  - ~\$130, 2-day running avg., and continuous avg. since plugged in
    - (e.g., Safety Siren Pro Series 3 model)
- Long-term (>90 d) practical & affordable
  - Several existing technologies for accurate 90+ day samples
    - (Alpha-track, Electret, Glass, ...)

There are many examples of long-term continuous measurements for radon

### Temporal variation at the Example house

July 2003 to July 2005

Approx. Ranges  
 Days  
 0-16  
 1-13  
 1.5-11  
 3-8  
 4.3-5.0

Legend: Hourly Fin, Two day, Weekly, 90 day, annual average

EPA min. 2-day sample duration for Radon  
 Slide by Dr. Dan Steck, from AEHS March 2011

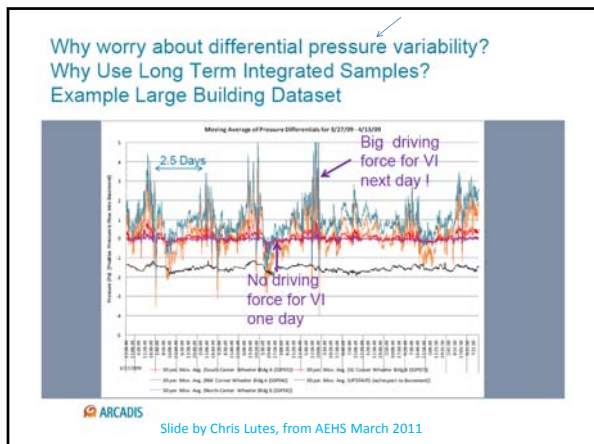
### TCE Indoor Air Concentrations

Non-random but irregular (complex, episodic), temporal variability observed in chemicals from VI in ASU's Sun Devil Manor.

There are very few examples of long-term continuous measurements for VI chemicals, but here is the one I know, for 5 and 30 days

See iavi.rti.org for Dr. P. Johnson's comments for regulators; including comments on need for real-time continuous chemical indoor air monitoring.

Similar to observations of radon.

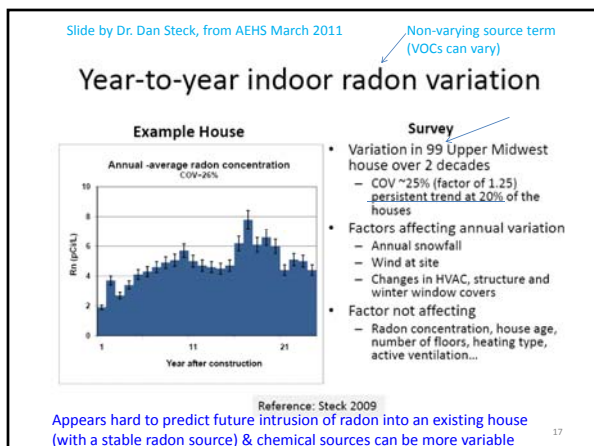
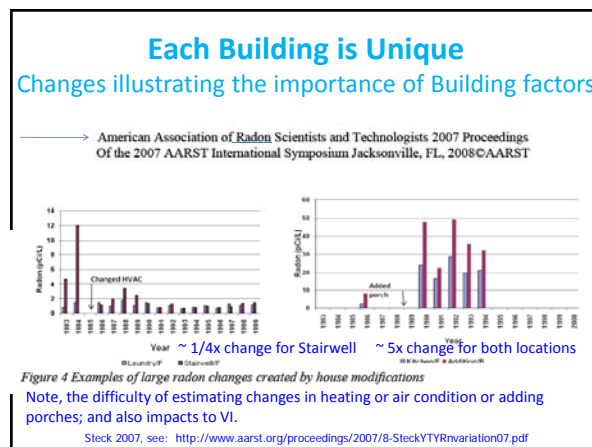
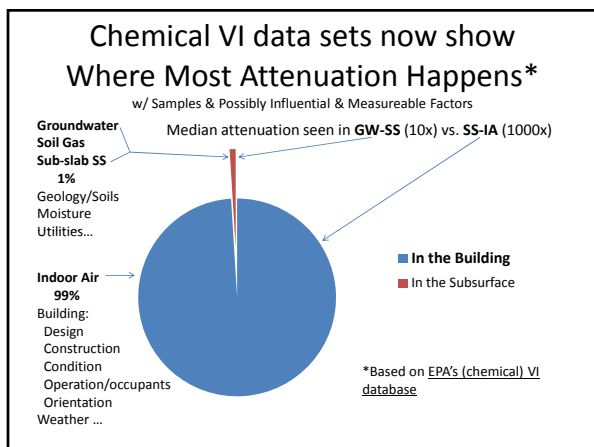


Events between the blue dots

Radon workers have long focused on **building specific factors** interacting with environ. variables

## RADON

A Guide for Canadian Homeowners



- ### Involved-Stakeholders could see the uncertainties ...
- In Chemical-based Assessments involving:
    - A **limited number** of:
      - short-term samples
        - collected from
      - some locations/buildings
        - To estimate:
          - Current
          - Future
            - Vapor Intrusion

## Possible Alternative Approach

(If Building Occupant/Owners & PRP can decide together)

- Involved-Stakeholder's Intrusion Assessment
  - PRP offers stakeholder-community volunteers continuous soil-gas tracer monitors (e.g., radon)
    - Stakeholder-community volunteers are empowered
      - by having assessment-monitoring tool as good as or better than traditional low-number of short-term sample assessments
      - Can see their own building's variability/signature response to environmental changes through time
    - Continuous monitoring (of soil-gas tracers) provides fuller understanding of intrusion into their buildings through time, &
      - Can also show the variability between surrounding buildings

## Involved-Stakeholders May See

- Risks due to tracers (e.g., Radon) alone is:
  - > Health-based recommendations to prevent/control intrusion
    - or
  - > 100x the generic-screening high-end estimated (remote potential VI (95%)) chemical risk:
    - i.e., Chemical VI risks are estimated <1% of that from radon

## Involved-Stakeholders' may also See the Multiple Benefits of Controls

- Buildings overlying a source have a potential for VI
- Radon entry can show how soil-gas is entering
  - & VOCs could be entering as well (similarly, i.e., variably)
  - That is not easily assessed with limited number of short-term chemical samples
- Observed Radon levels may exceed health recommendation for controls – (e.g., for Rn alone)
  - Radon is the #1 carcinogen the EPA addresses for the public
    - If we also add (+/x) VI potential = recommend controls?
- **Only** mitigation (w/ on-going monitoring) **protects** for environmental and building changes with time

## Possible Alternate Decision Framework

(If Building Occupant/Owners & PRP can decide together)

- PRP offers 'Preemptive' (Radon) Mitigation where:
  - Radon levels (alone) exceed health-based recommendations to control VI, or
  - Radon (lung cancer) risks are > 100x the generic-screening high-end estimated (remote potential VI (95%)) chemical risk
  - Radon levels are such that EPA recommends controls should be considered (for Radon alone) and when combined with concerns for possible VI, controls may be desired, and/or
  - Costs to conduct a definitive chemical-based assessment are higher, and community prefers controlling intrusion
    - That reduces intrusion of both natural and any possible chemical gases/vapors in soil gas

## USEPA's developing 'Pre-emptive'\* mitigation guidance provides:

- An opportunity for stakeholders to become actively involved in their VI assessment to:
- **Improve** their understanding of:
  - Uncertainty in typical VI assessment/predictions,
    - and the
  - Multiple benefits of engineered intrusion controls to:
  - Confidently remove the uncertainty of potential chemical Vapor Intrusion,
    - as well as
  - Reduce other undesirable soil-gas constituents such as **Radon, moisture/mold, methane, CO<sub>2</sub>**, etc.
    - with **significant public health benefits** (due to radon alone)

\* Without conclusive proof of unacceptable current VI exposures

Lenny's (Siegel) perspective:

### Five kinds of people at VI/radon sites

- People who figure out how to investigate on their own
  - and are willing to pay for mitigation
- People who would mitigate, on their own dime
  - if someone figured it out for them
- People who would mitigate
  - if another pays.
- People who **do not** cooperate,
  - even if someone else is paying
- People who **not only do not** cooperate
  - but also try to discourage publicity

## Thank You

We look forward to your help in developing the guidance for this approach.

- Questions / Discussion