Houses from Heck

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What Makes a Building Difficult to Mitigate?

- Construction details
- Multiple foundations
- Layout
- Pipe routes
- Compact or tight soils
- Finished areas
- Inaccessible crawlspaces
- HVAC parameters
- Building size
- Height of structure
- Radon levels
- Fixing previous bad work
- Geology – Karst or gravel beds
- Pathways not accessible
- Difficult to achieve PFE
- Depressurization sources: bath fans, hoods, house fans, appliances
- Weather – precipitation, wind, outside temps
- Difficult clients
- Distance from home
- Phone bid too low

So What is a House from Heck?

- When you've applied the building science and the radon levels are still high
- PFE under all the foundation zones – at all times
  - Around foundations in some cases
- There's some unknown thing that's causing the issue
  - Adjacent slabs
  - Unaddressed or unidentified pathways into structure
  - Emanation
  - Radon in water contributing to the airborne issue
  - Detached radon sources

Prior Houses from Heck Discussions at Radon Symposiums

- Old “abandoned” plumbing
- Unknown elevated radon areas feeding the rest of the building
- Garage and adjacent slabs
- Atmospheric pressure triggers
- Large air voids under or around foundations
- Indoor wells
- Electrical Conduit
- Elevator Shafts
- Others

Two Topics for Consideration

- Out of the ordinary foundations – Are they HfH?
  - They are considered by some
    - City CAP agencies
    - Inexperienced contractors
    - Code officials
- Having adequate PFE at all times
  - Not just when you are there
  - When the CRM says the radon is bad

How do you Fix this?
Is this a House from Heck?





Wood Foundations





Work the Diagnostic Steps

- Come prepared with tools and material
  - Diagnostic tools and equipment
    - Micromanometer
    - Smoke/Air Puffer*
  - Various sealing materials
    - Foams
    - Caulks
  - Assortment of radon fans, or
  - EC fan(s)



Investigation Leads to a Plan

- ID air leaks and seal what we reasonably can
- Conduct diagnostics from a potential suction point away from leaks
- Dial in fan to what is needed
- Install the rest of the system and retest for radon

Not a House from Heck

- Didn’t tear up floor and pour a new slab
- Didn’t install a new gas furnace, AC, and ductwork
- Didn’t install an ERV

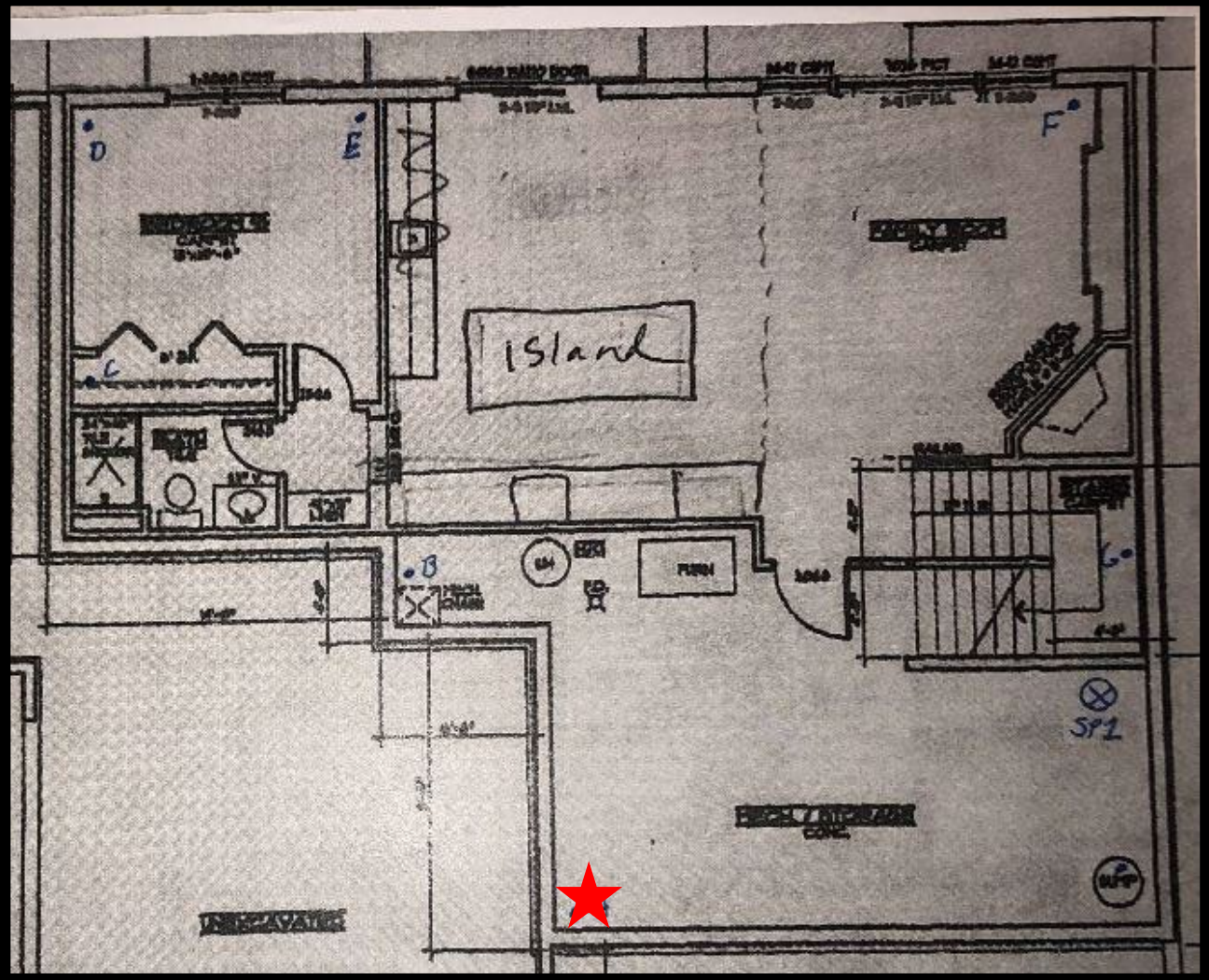
- Installed centralized suction point away from air leaks
- Dialed EC fan to 40% to just wiggle the foundation edges
  - Moving less than 40 CFM
  - Saving $100s annually in total system operating costs
  - Radon levels <0.3 pCi/L

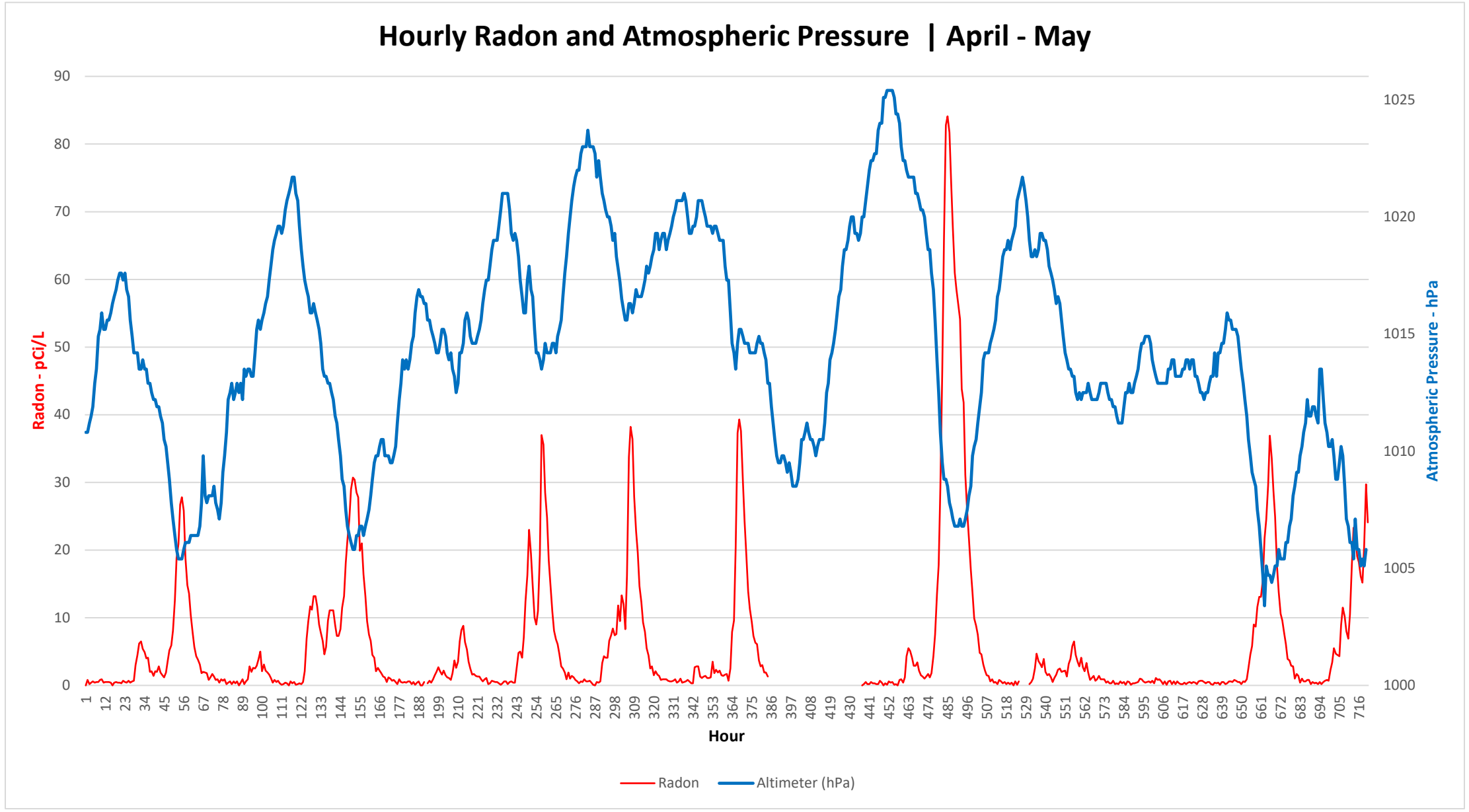
Houses from Heck on the Horizon

- As we tighten homes, diagnostics becomes more important
  - Timing of diagnostics is even more important
- If your radon tests fail, pinpoint when they fail
- Datalog your PFE if necessary

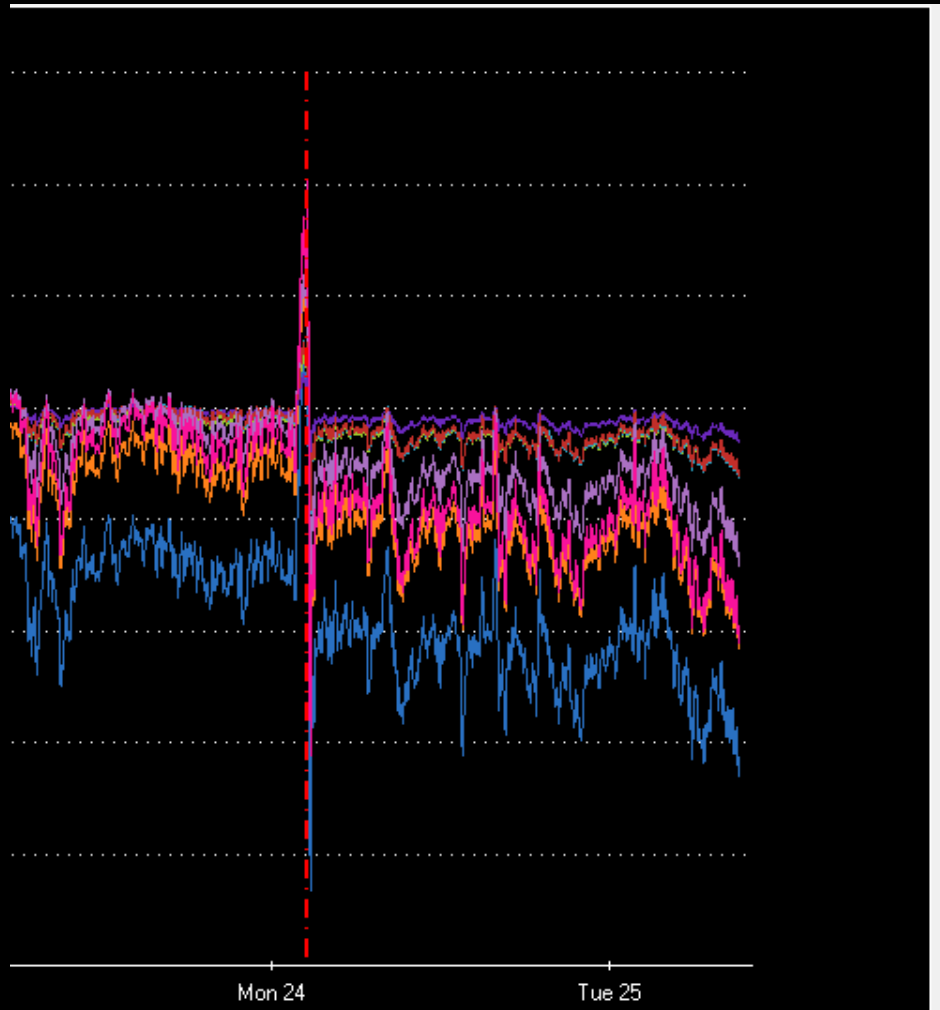
We Have PFE Everywhere

	Value
A	-25.6
B	-15.0
C	-3.9
D	-1.9
E	-3.8
F	-3.7
G	-8.9
Sump	-13.8




Hourly Radon and Atmospheric Pressure | April - May
Radon - pCi/L
Atmospheric Pressure - hPa
Hour
Radon
Altimeter (hPa)



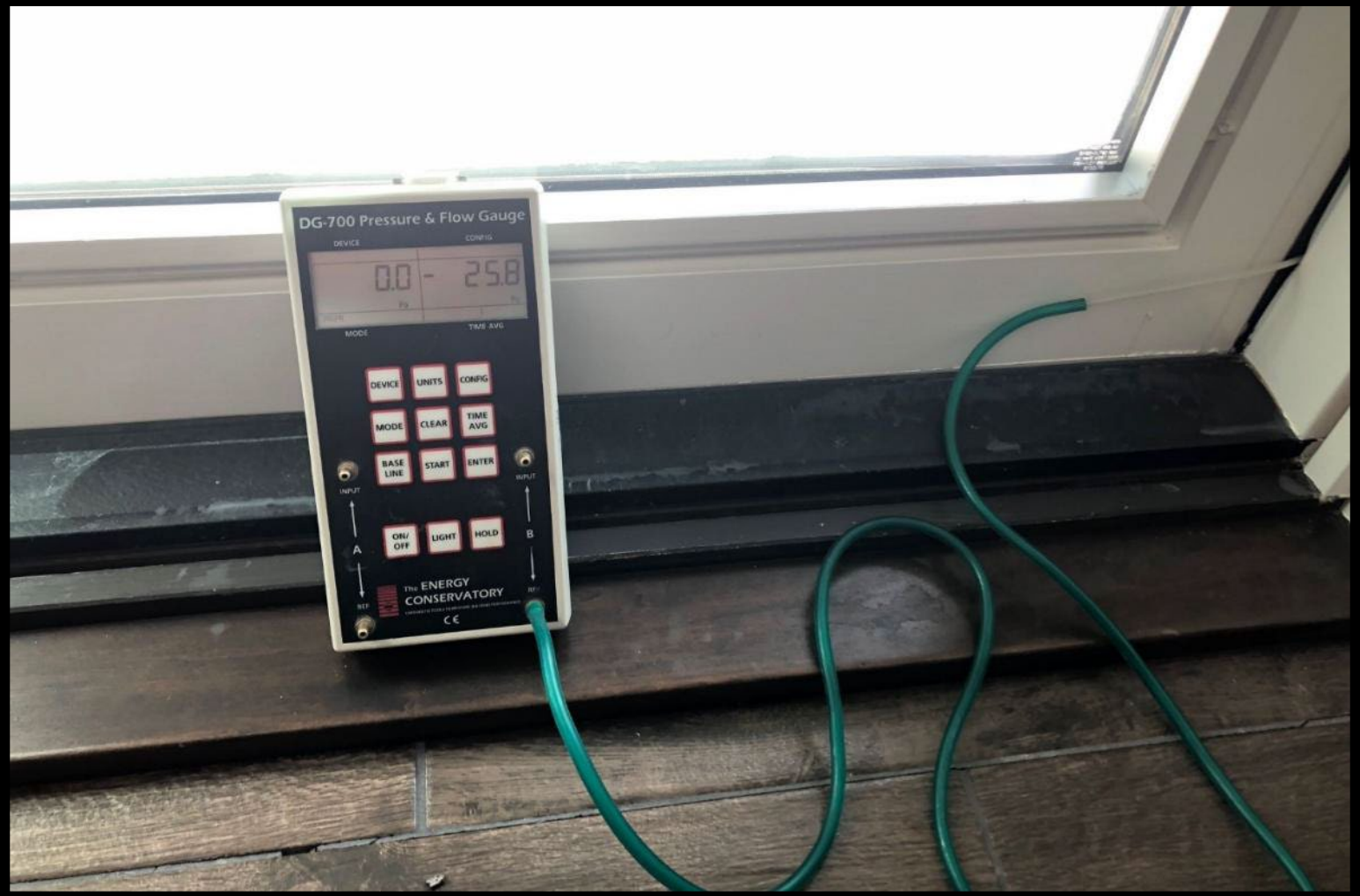


Jun 24 19 02:31:20.93
Obs #: 4641 of 6478

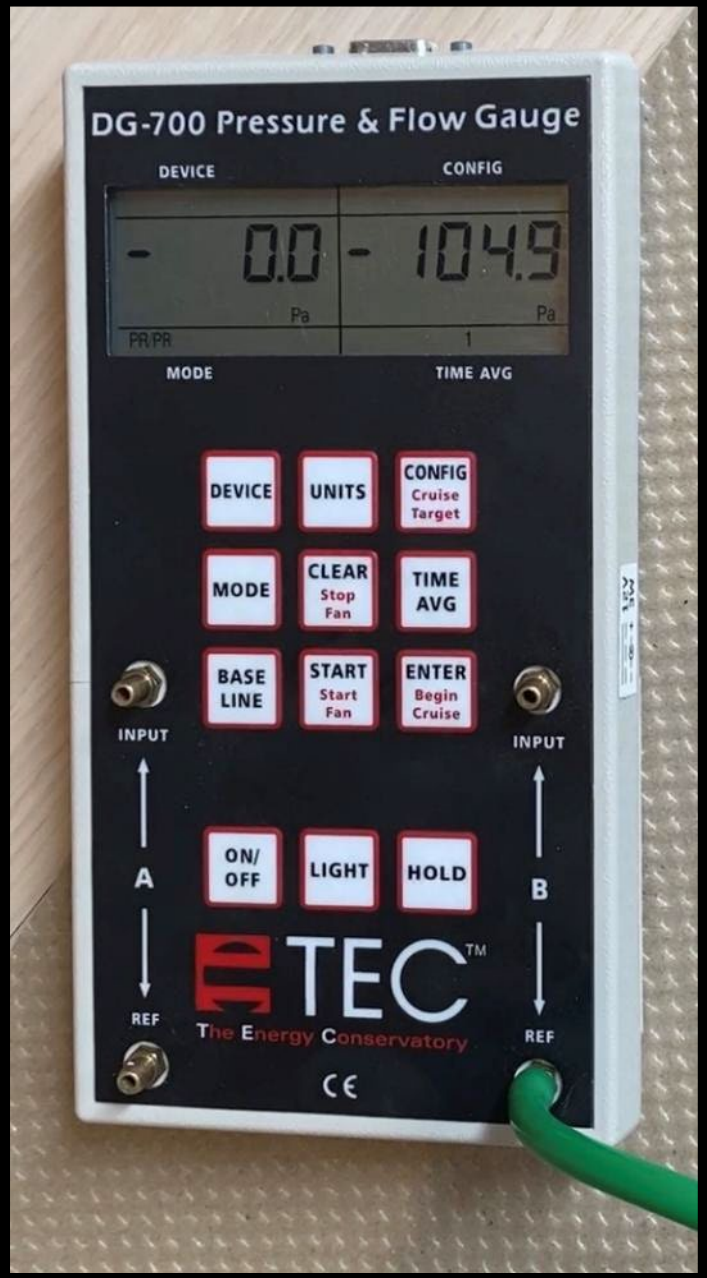
Viewing File:
Wilds Ridge 01 6-20-19

	Value
A	8.7
B	14.2
C	6.0
D	3.4
E	7.0
F	6.8
G	13.9
Sump	20.3

Houses are Only Getting Tighter…

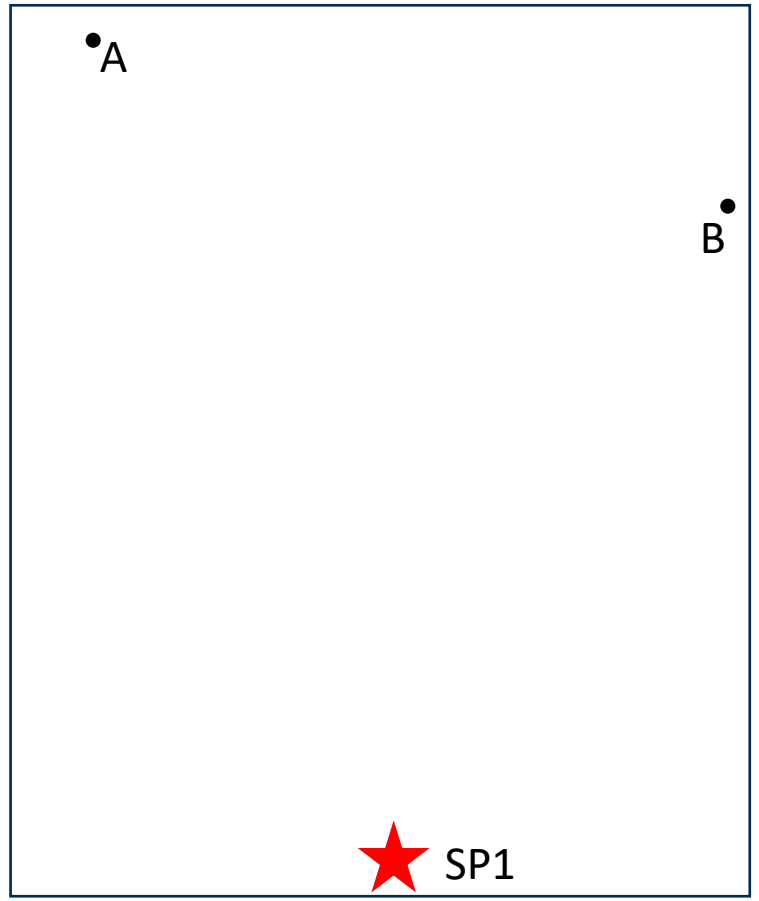


…And Tighter


DG-700 Pressure & Flow Gauge
DEVICE
CONFIG
- 0.0
Pa
- 104.9
Pa
PR PR
1
MODE
TIME AVG
DEVICE
UNITS
CONFIG
Cruise
Target
MODE
CLEAR
Stop
Fan
TIME
AVG
BASE
LINE
START
Start
Fan
ENTER
Begin
Cruise
INPUT
INPUT
A
B
ON/
OFF
LIGHT
HOLD
REF
REF
TEC
The Energy Conservatory
CE

Extreme Example of House vs Radon System

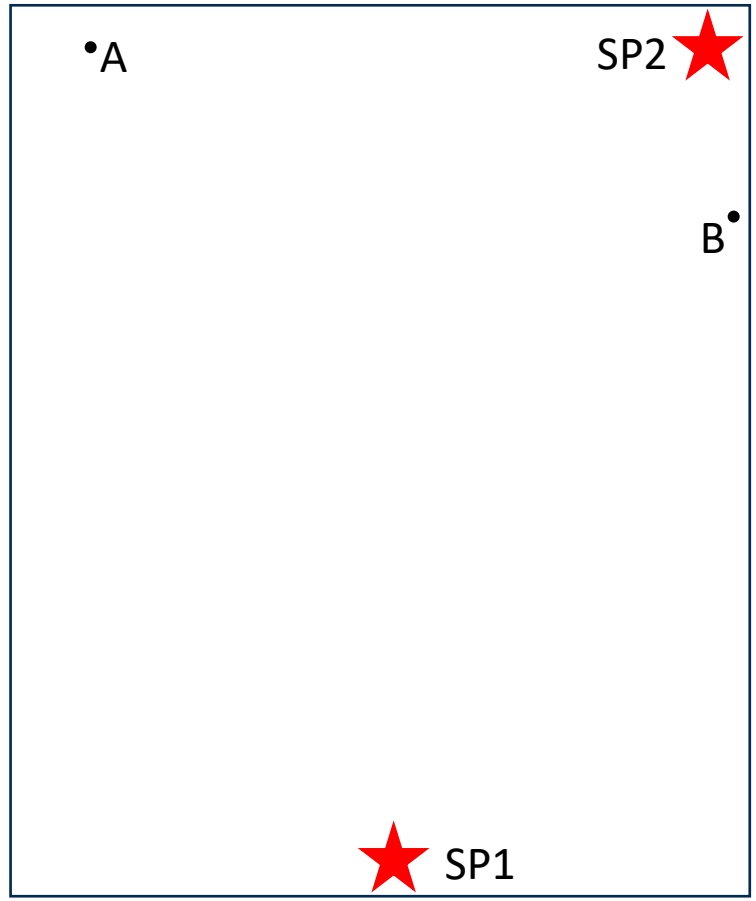
Radon Fan	Exhaust Fan	△P WRO (pascals)	A (pascals)	B (pascals)
Off	All off	-0.5	+/- 0.2	+/- 0.4
On	All off			
On	Bath 1 on			
On	Bath 2 on			
On	Bath 3 on			
On	Laundry on			
On	Kitchen on			



Adjust Your Pressures and Design Accordingly

- Don’t guess - measure it
- Move or add suction points
- Use more suitable fans and piping
- Beat the Target Pressure

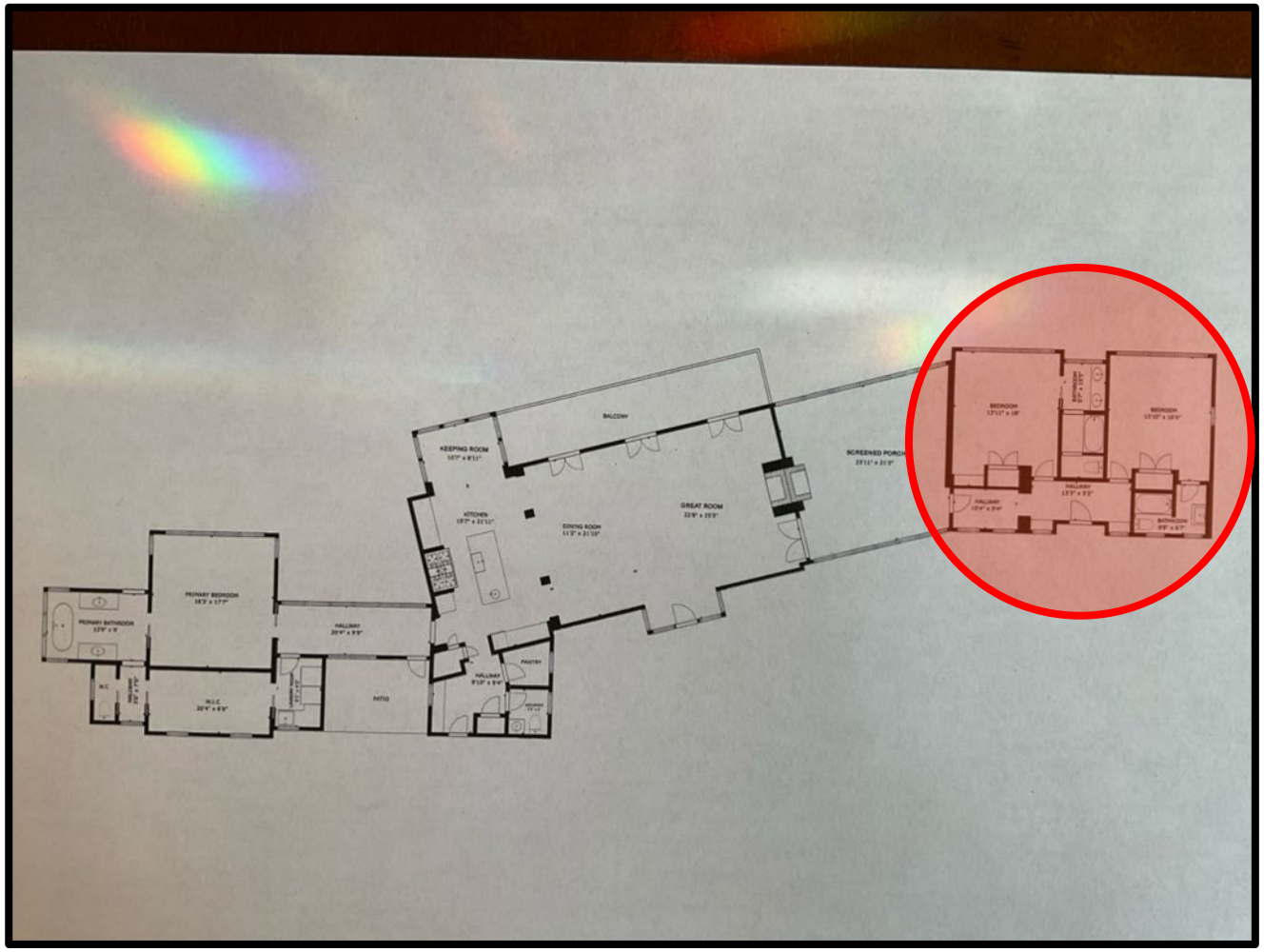
Radon Fan	Exhaust Fan	△P WRO (pascals)	A (pascals)	B (pascals)
Off	All off	-0.5	+/- 0.2	+/- 0.4
On	All off	-1.2	-30.5	-39.1
On	Bath 1 on	-8.8	-22.7	-31.7
On	Bath 2 on	-40.5	+6.0	-6.3
On	Bath 3 on	-52.7	+17.2	+2.1
On	Laundry on	-67.9	+32.4	+17.3
On	Kitchen on	-104.9	+69.1	+53.9

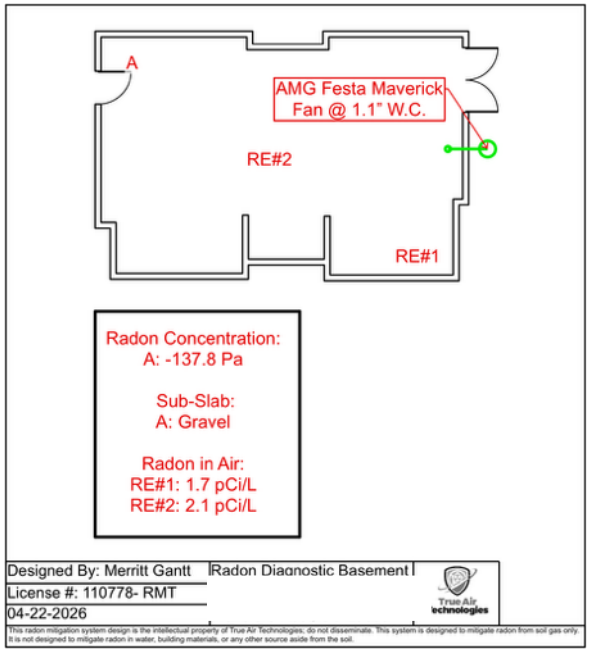


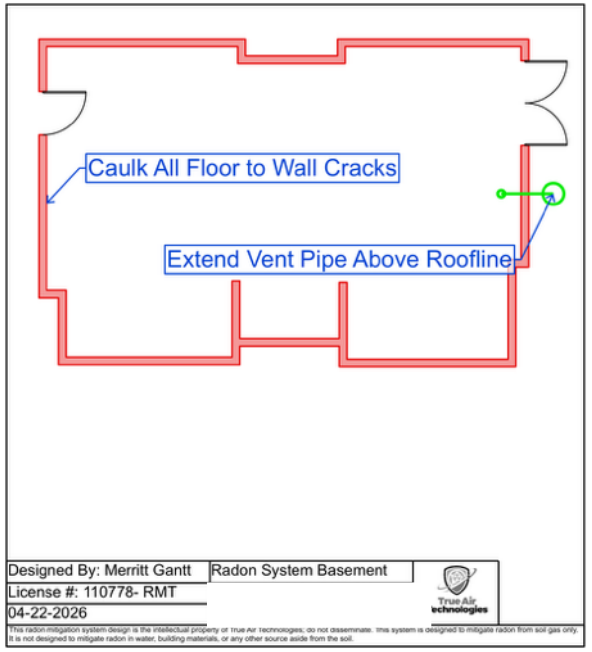
Case Study:



Mother-in-law Suite : Radon: 4.0 – 7.0 pCi/L







Mother-in-law Suite:





- Detached Wing of Home
- Separated From Rest of Home By Open Air Breezeway
- Unfinished Basement Below
- Poured Concrete Foundation Walls
- Full PFE on Slab (-138 Pa at Test Point)
- Build Quality Issues (Not Vented Above Roof, Not Sealed, No U-tube, etc.)

Mother-in-law Suite:



- We Corrected the Issues w/ Existing System
- Maintained PFE on Slab
- Homeowner Moved The Radon Monitor into The Mother-in-law Suite and Noticed High Radon
- Radon Was Spiking During the Middle of the Day







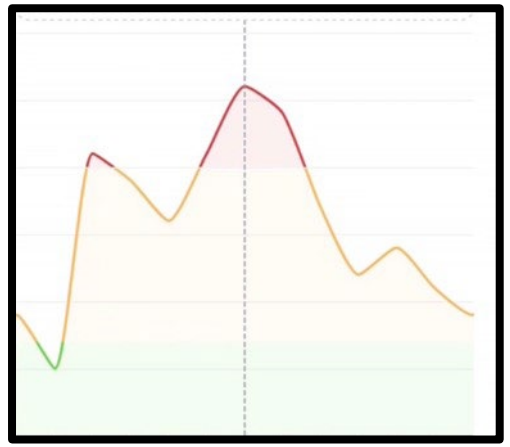
There was Full PFE (100%)… Where is the radon coming from?

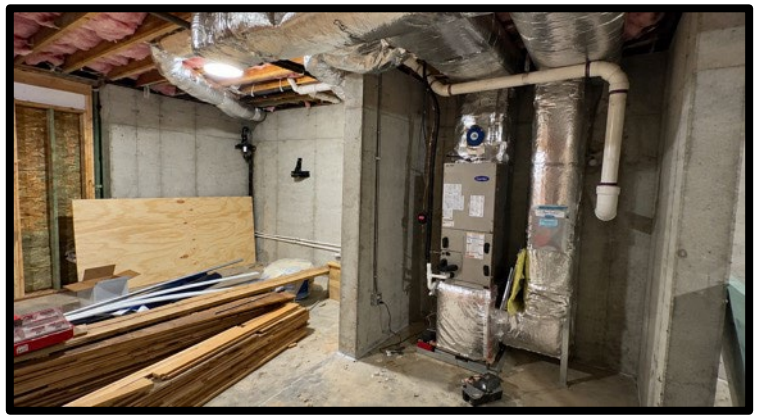
We Suspected Emanation From Concrete

Clue #1: The Radon Was Spiking During the Heat of the Day

Clue #2: The Basement Walls Were Poured Concrete and The Basement was Unventilated

Clue #3: Full PFE
No Other Foundation Zones Attached







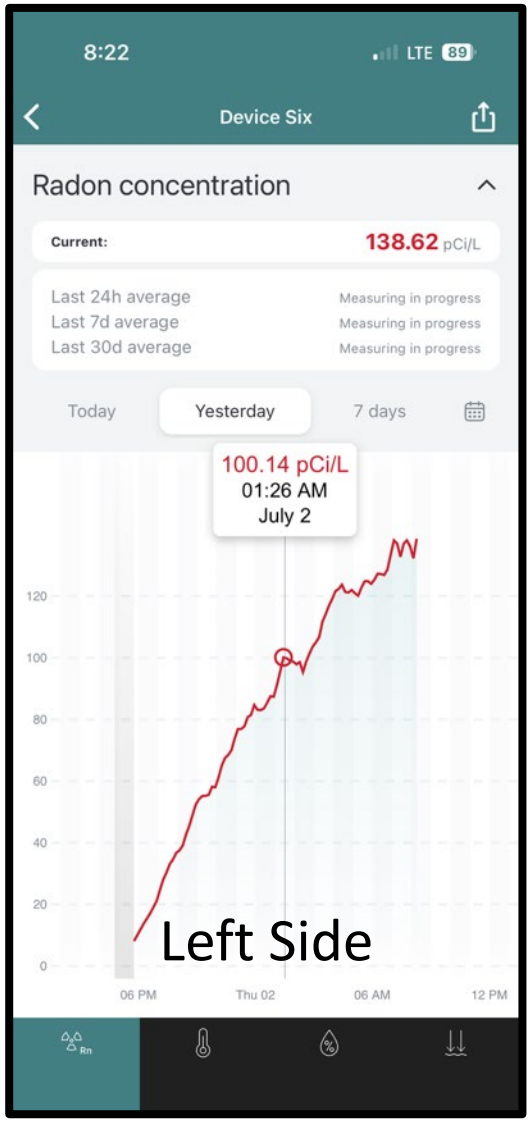


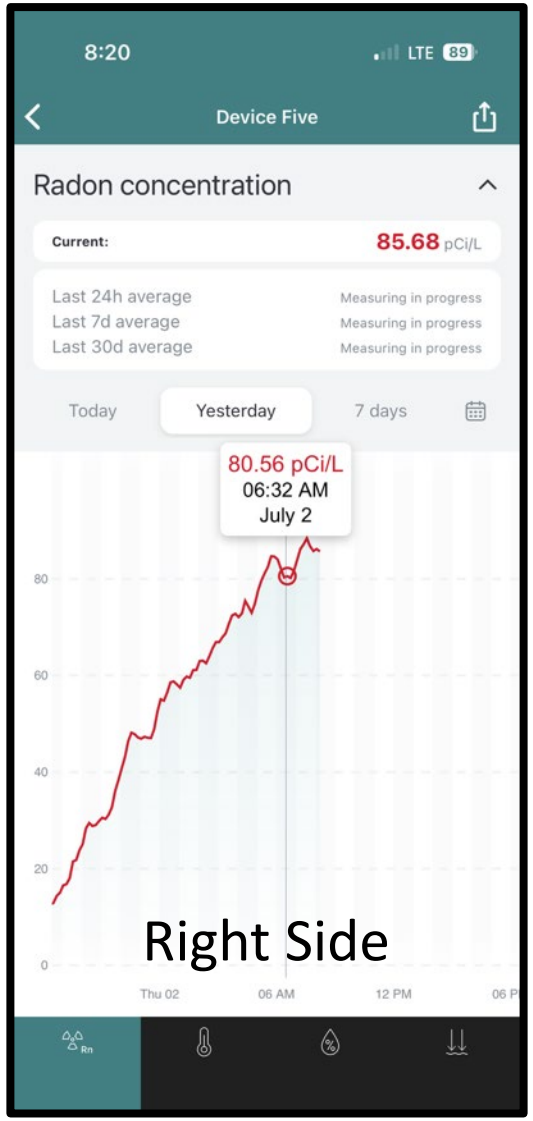
To Test The Theory…
We Sealed Metal Flux Buckets to The Concrete

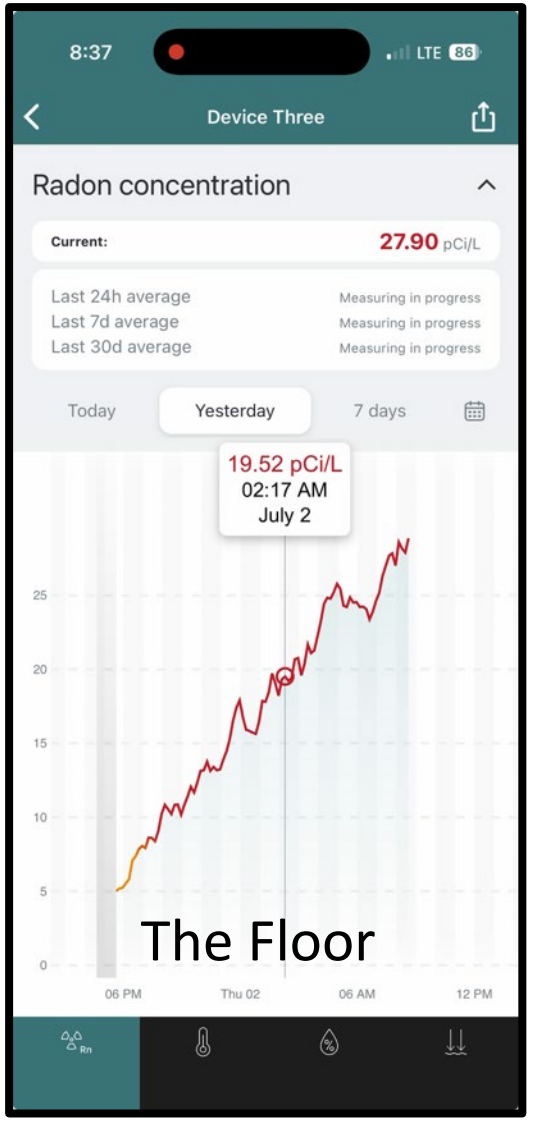




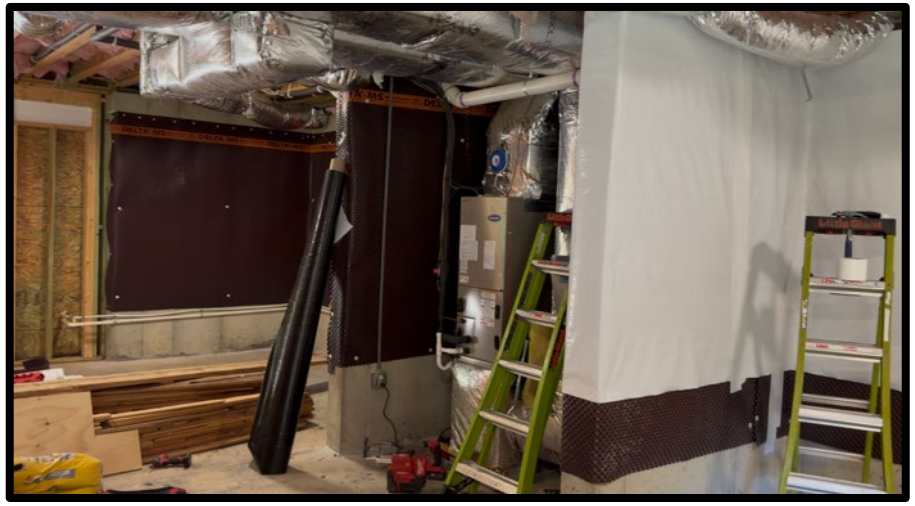
The Results:


8:22
LTE 89
Device Six
Radon concentration
Current: 138.62 pCi/L
Last 24h average Measuring in progress
Last 7d average Measuring in progress
Last 30d average Measuring in progress
Today Yesterday 7 days
100.14 pCi/L
01:26 AM
July 2
120
100
80
60
40
20
0
06 PM
Thu 02
06 AM
12 PM
Left Side


8:20
LTE 89
Device Five
Radon concentration
Current: 85.68 pCi/L
Last 24h average Measuring in progress
Last 7d average Measuring in progress
Last 30d average Measuring in progress
Today Yesterday 7 days
80.56 pCi/L
06:32 AM
July 2
80
60
40
20
0
Thu 02
06 AM
12 PM
Right Side


8:37
LTE 86
Device Three
Radon concentration
Current: 27.90 pCi/L
Last 24h average Measuring in progress
Last 7d average Measuring in progress
Last 30d average Measuring in progress
Today Yesterday 7 days
19.52 pCi/L
02:17 AM
July 2
25
20
15
10
5
0
06 PM
Thu 02
06 AM
12 PM
The Floor

The Fix:









Results and Observations:

- Radon was lowered to below 2.0 pCi/L
- Emanation more closely related to hot weather and lack of ventilation
  - No natural infiltration/exfiltration of air when it is hot
- Building tightness was not a factor
  - The structure was leaky and there were visible gaps and cracks in the sheathing



- Encapsulation and depressurization seemed effective in controlling the emanation from the concrete.

"Smelly ~~Shitty~~ Situations"

From the New York Times Best Selling Series
"Radon Detective Diarrheas" Diaries



1) The Case of the Stinky Basement

- Full Basement
- Full PFE
- PFE All the Time
- No Adjacent Slabs
- RN Concentrations Spike When Outside Temperature Goes Below Inside Temperature

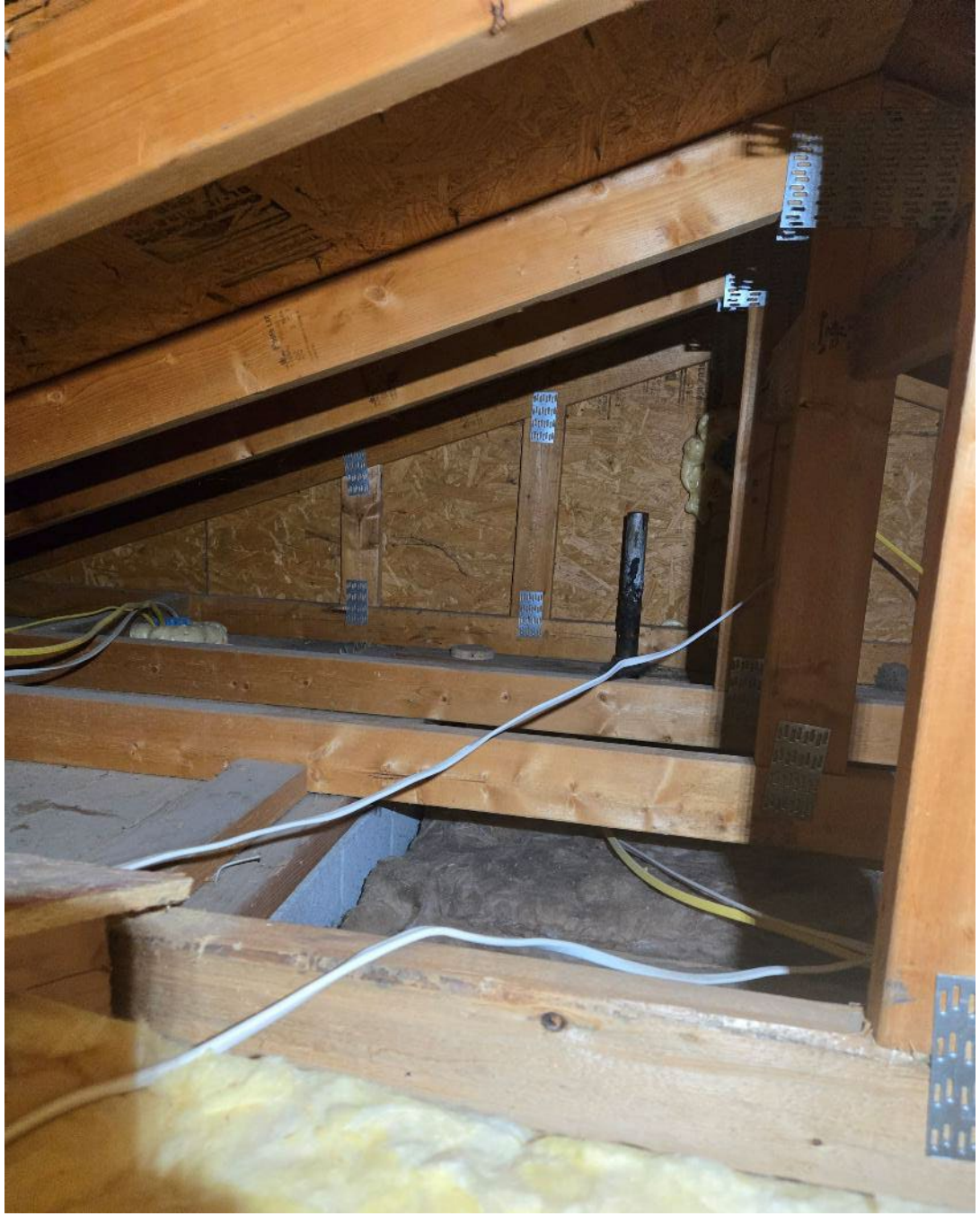
The Case of the Stinky Basement



2) The Case of the Stinky Bathroom

- Full Slab on Grade but Back of House is Buried 2ft and has a Block Wall
- Full PFE
- PFE All the Time
- PFE into Adjacent Garage
- RN Concentrations Spike When Outside Temperature Goes Below Inside Temperature

The Case of the Stinky Bathroom



The Case of the Stinky Bathroom



The Case of the Stinky Bathroom



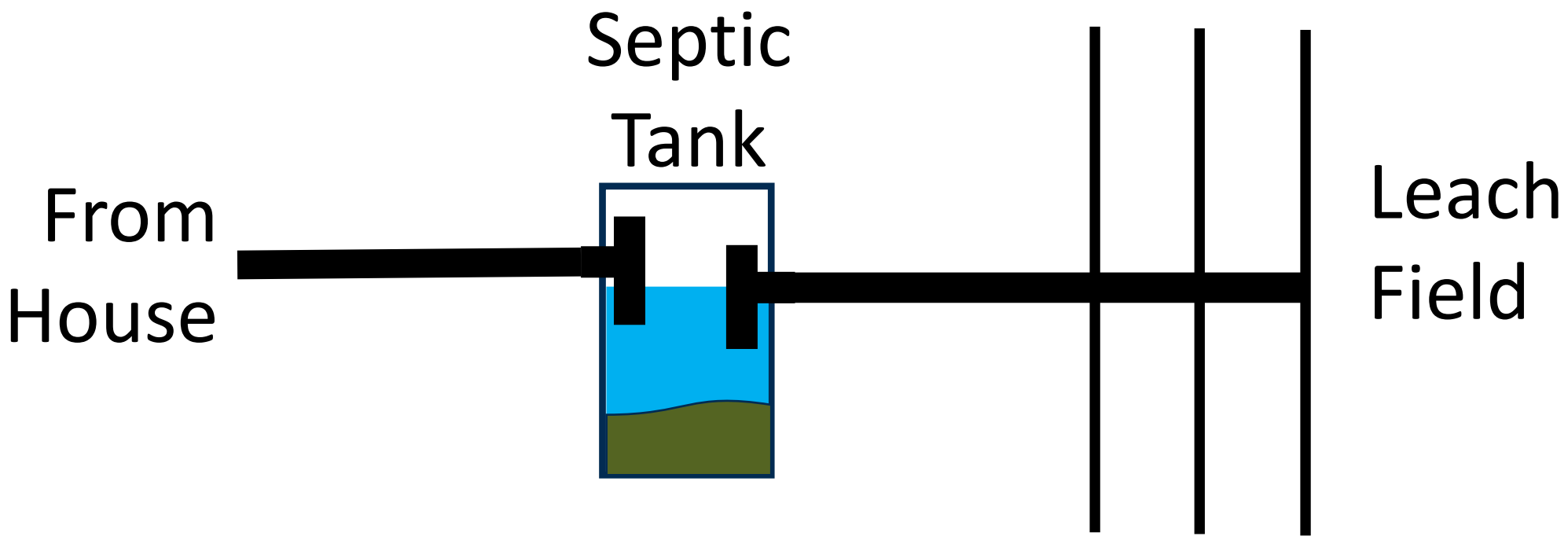
The Case of the Stinky Bathroom



Lessons Learned

- Both houses had sewer smells
- Both houses were on septic sewer systems

Lessons Learned



Lessons Learned

- In the last year we have seen 4 other houses with sewer-based radon problems
- Two of these houses were not on septic systems but they were in the midst of a remodel
- These two houses were older (pre 1960 i.e. likely rusted cast iron pipes)
- The driving force in one was wind, the driving force in the other was an attic fan.







What the HECK?!?

Wes Hodgden • 2026 IEA Symposium





Incorrect & noncompliant discharge locations continue to plague our industry…
























Damage to other building materials is one reason for the ANSI/AARST requirement for discharging above the roofline.





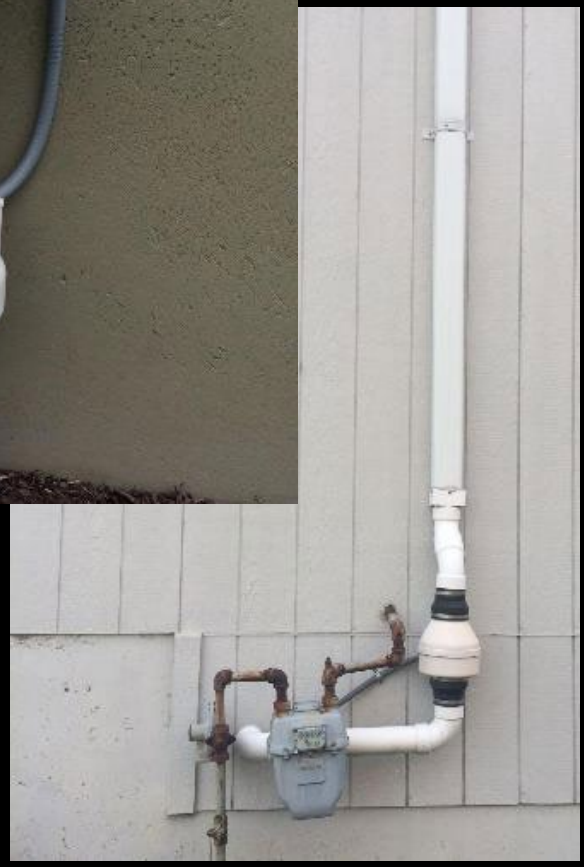


Natural Gas Meters. National Fuel Gas Code requires 3 feet clearance from meters and bleeder valves. *(NFPA 54 / ANSI Z223.1)*









Improper back slope is easy to prevent and can become a costly mistake.
















Ice, ice, baby…











Fans in basements



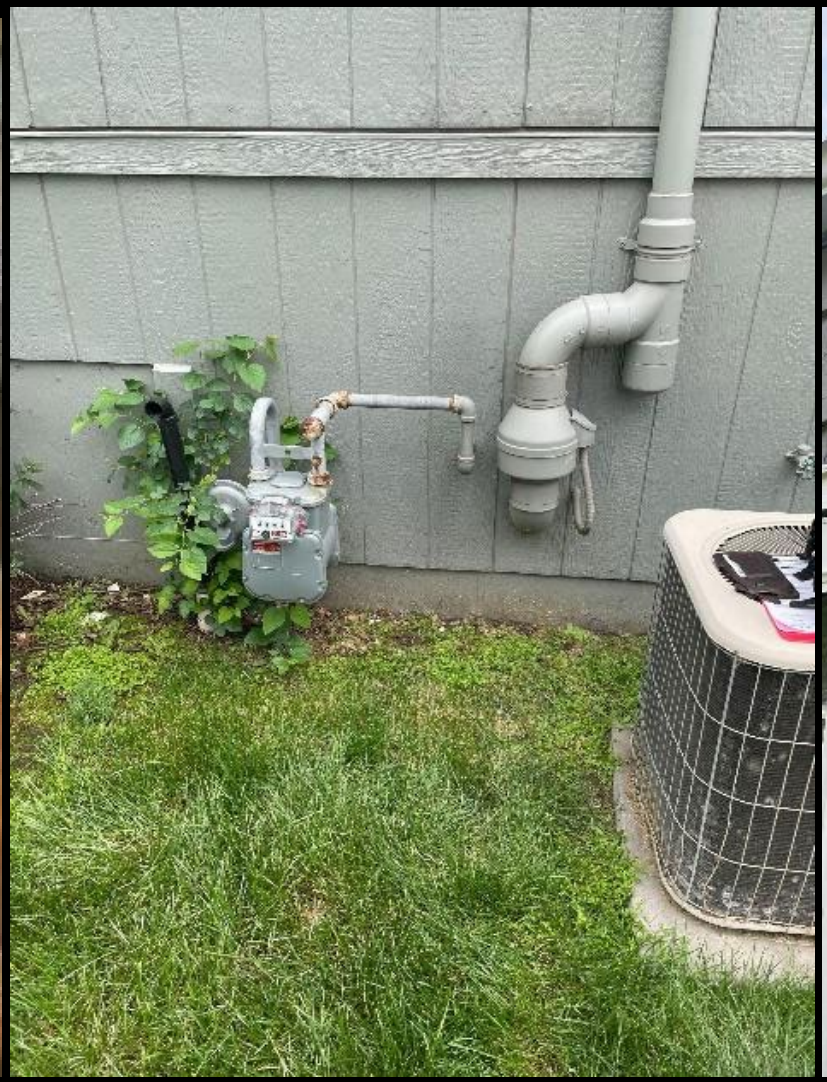
Nice try.





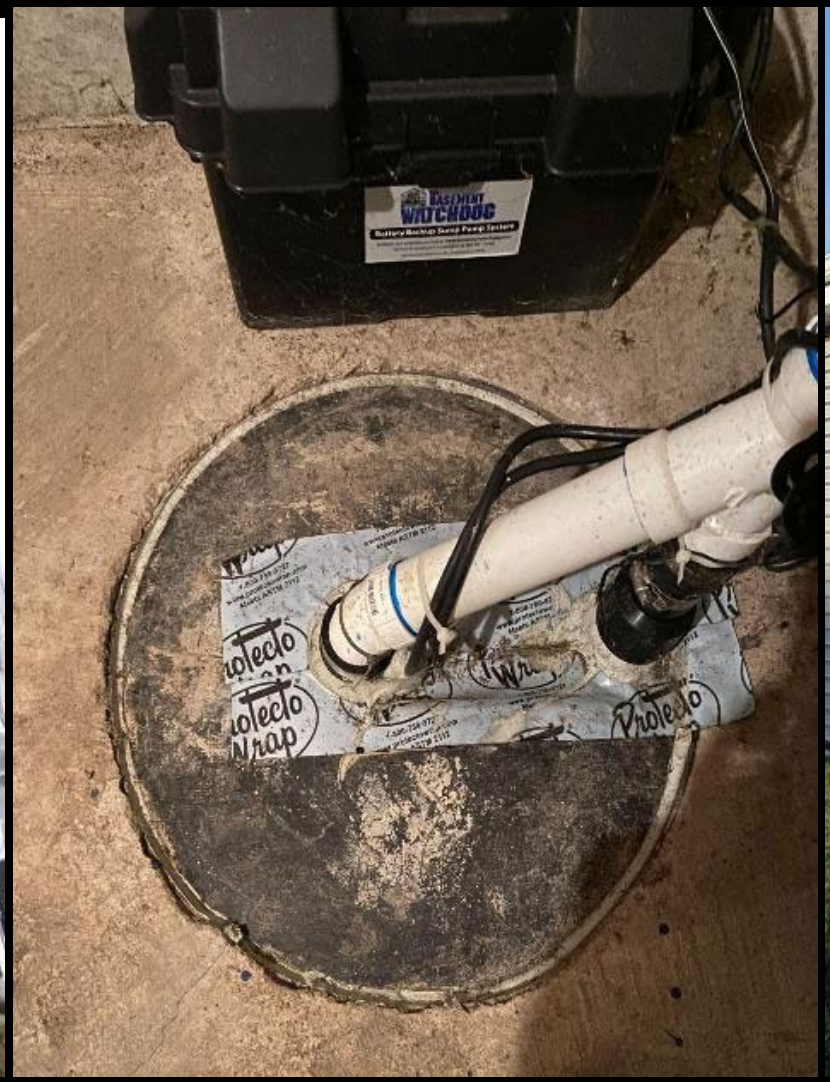
More “What in the actual HECK?!!?” moments.










WATCHDOG
Protecto
Wrap



Testing TOO????





WE CAN DO BETTER THAN THIS.

WE MUST DO BETTER THAN THIS.

Contact Information

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