EARTH Study Update
(Evaluating and Assessing Radon Testing in Housing)

US EPA Workshop: Indicators, Tracers, and Surrogates (ITS)
AEHS East Coast Conference | October 22, 2019 | Amherst, MA
Kyle Hoylman, ESC Chair, Standards Consortium

Overview

Three-year HUD-funded research project evaluating radon testing policies and standards in multifamily buildings

Authority / Standard	Requirement
Federal National Mortgage Association (FANNIE MAE)	10% GC residential only, no upper level
Federal Home Loan Mortgage Corporation (FREDDIE MAC)	10% GC residential only, no upper level
US Department of Housing and Urban Development (HUD)	25% GC residential / non-residential, 10% upper level residential
ANSI-AARST MAMF 2017 – Multifamily Buildings	100% GC residential / non-residential, 10% upper level residential
Note: some states require 100% ground contact testing – IA, IL, KY, ME, MN, OH	

Data Requirements

- Ground contact testing results for 100% of residential units in buildings
- Total ground contact residential units: 5 to 20+ per building
- Seeking approximately 30 buildings of each size or 59 buildings per category, multiple climate zones included
- Data collection anticipated to be complete in 12/2019
- Calculations based on hypergeometric distribution and proportion of buildings based on real data

Category Distribution

GC Units / Building Category	Total Buildings
5-6 GC Residential Units / Building	88
7-8 GC Residential Units / Building	99
9-10 GC Residential Units / Building	42
11-12 GC Residential Units / Building	47
13-14 GC Residential Units / Building	20
15-16 GC Residential Units / Building	23
17-18 GC Residential Units / Building	11
19-20 GC Residential Units / Building	10
20+ GC Residential Units / Building	29

> 350 buildings currently in research project

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Data Analysis

GC Units / Building	p=25%	p=20%	p=15%	p=10%	p=5%
5	3	5	5	5	5
6	4	5	6	6	6
7	5	5	6	7	7
8	6	6	6	8	8
9	6	6	6	9	9
10	6	7	7	10	10
11	6	7	8	10	11
12	6	7	8	10	11
13	6	7	9	10	12
14	6	7	9	10	13
15	6	8	9	10	14
16	7	8	9	11	15
17	7	8	9	12	16
18	7	8	10	12	17
19	7	8	10	13	18
20	7	9	11	14	19
21	7	9	11	14	19
22	7	9	11	14	19

How many ground contact units with radon concentrations below 4.0 pCi/L need to be measured so there is confidence that fewer than X% of the units are above 4.0 pCi/L?

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Data Analysis

Expected percentage of buildings containing radon concentrations ≥ 4.0 pCi/L that would fail to be identified at 10%-75% ground contact unit testing

(Requirement = building with at least one unit with radon ≥ 4.0 pCi/L)

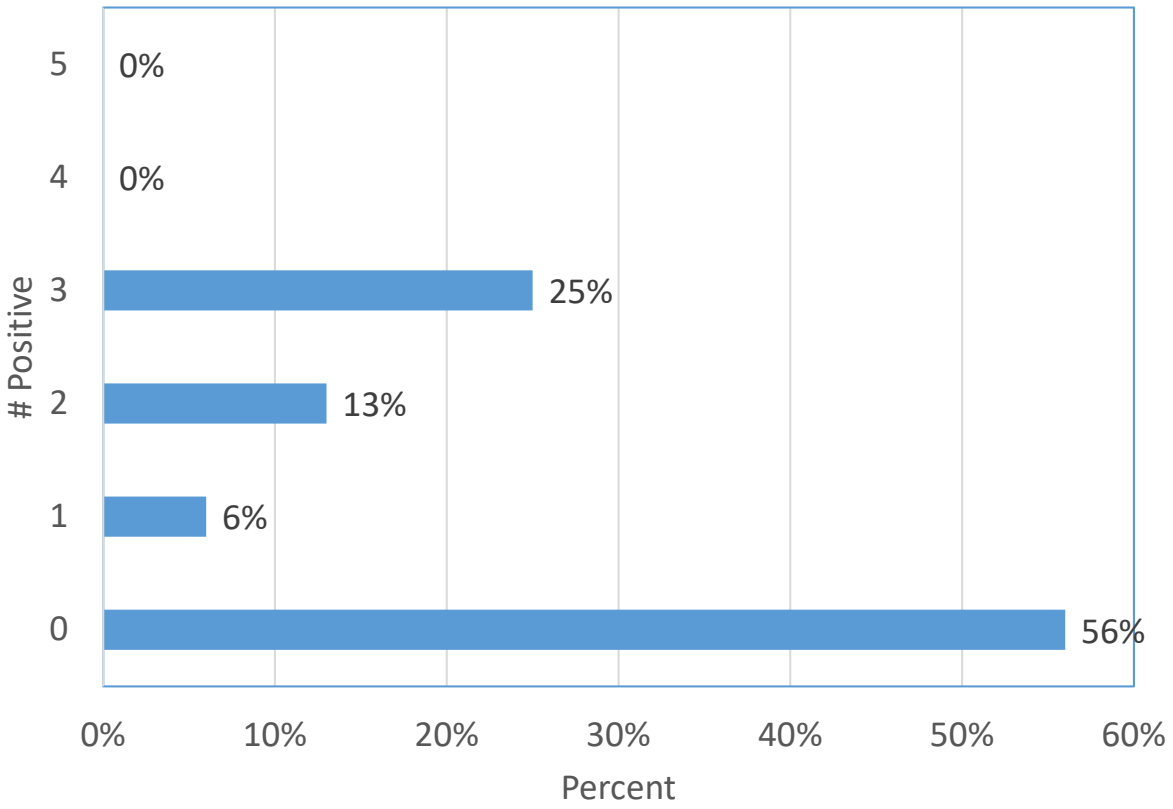
		10% Tested		25% Tested		50% Tested		75% Tested	
# GC Units	N	Mean Probability	IQR	Mean Probability	IQR	Mean Probability	IQR	Mean Probability	IQR
5-6	40	62%	45%-83%	38%	15%-67%	23%	3%-50%	6%	0%-17%
7-8	66	57%	38%-75%	37%	11%-54%	16%	0%-21%	5%	0%-4%
9-10	36	63%	44%-90%	34%	5%-70%	20%	0%-50%	7%	0%-20%
11-12	30	52%	23%-82%	42%	9%-73%	21%	0%-45%	8%	0%-18%
13-20	44	53%	23%-83%	34%	4%-62%	17%	0%-35%	6%	0%-13%

IQR = Interquartile Range (25th percentile – 75th percentile)

Data Analysis

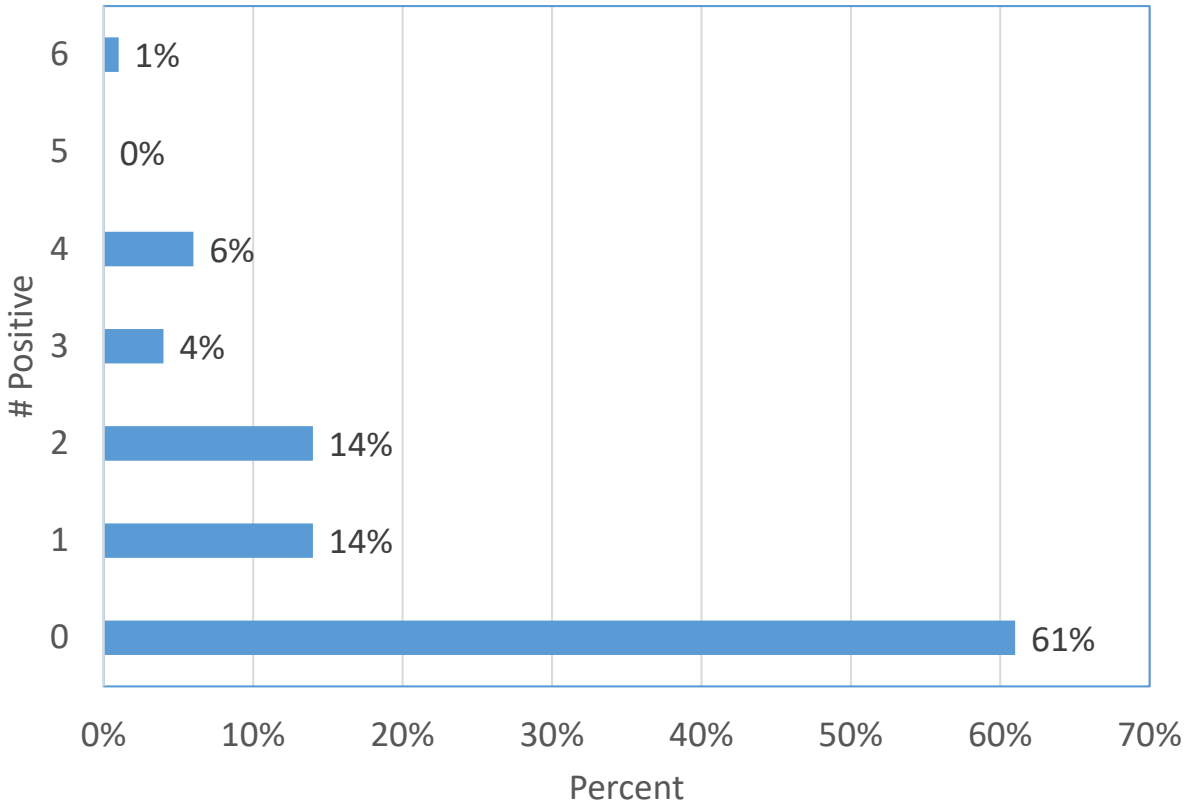
Percentage of buildings containing radon concentrations ≥ 4.0 pCi/L (5-6 ground contact units)

Fig 1. Five Ground floor units (n=16 buildings)



7/16 buildings with units with radon > 4.0 pCi/L

Fig 2. Six Ground floor units (n=72 buildings)

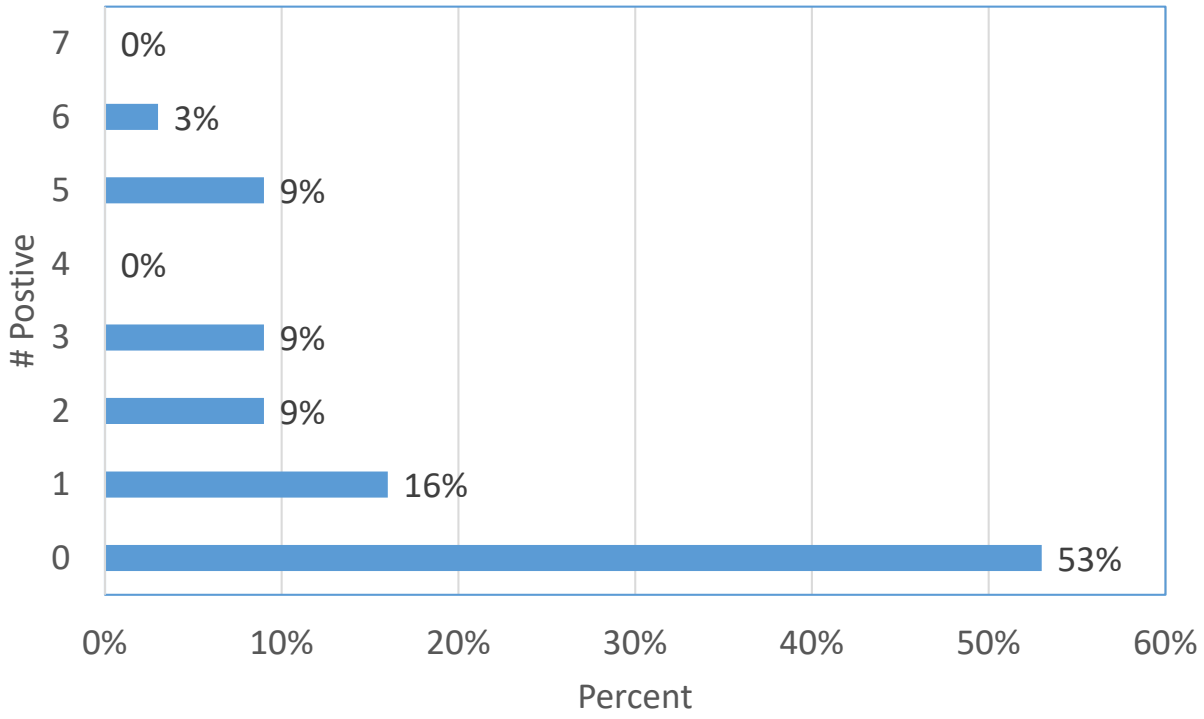


28/72 buildings have units with radon ≥ 4.0 pCi/L

Data Analysis

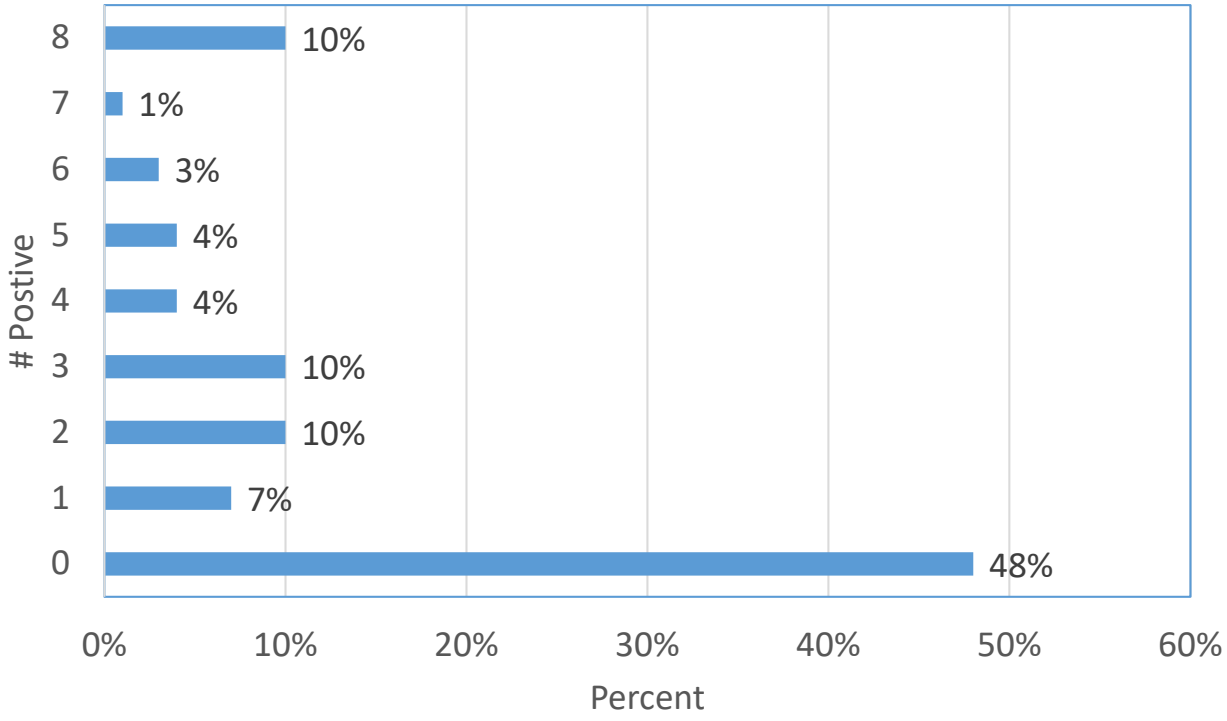
Percentage of buildings containing radon concentrations ≥ 4.0 pCi/L (7-8 ground contact units)

Fig 3. Seven Ground floor units (n=32 buildings)



15/32 buildings have units with radon ≥ 4.0 pCi/L

Fig 4. Eight Ground floor units (n=67 buildings)



34/67 buildings have units with radon ≥ 4.0 pCi/L

Data Analysis

Percentage of buildings containing radon concentrations ≥ 4.0 pCi/L (10-12 ground contact units)

Fig 6. Ten Ground floor units (n=30 buildings)

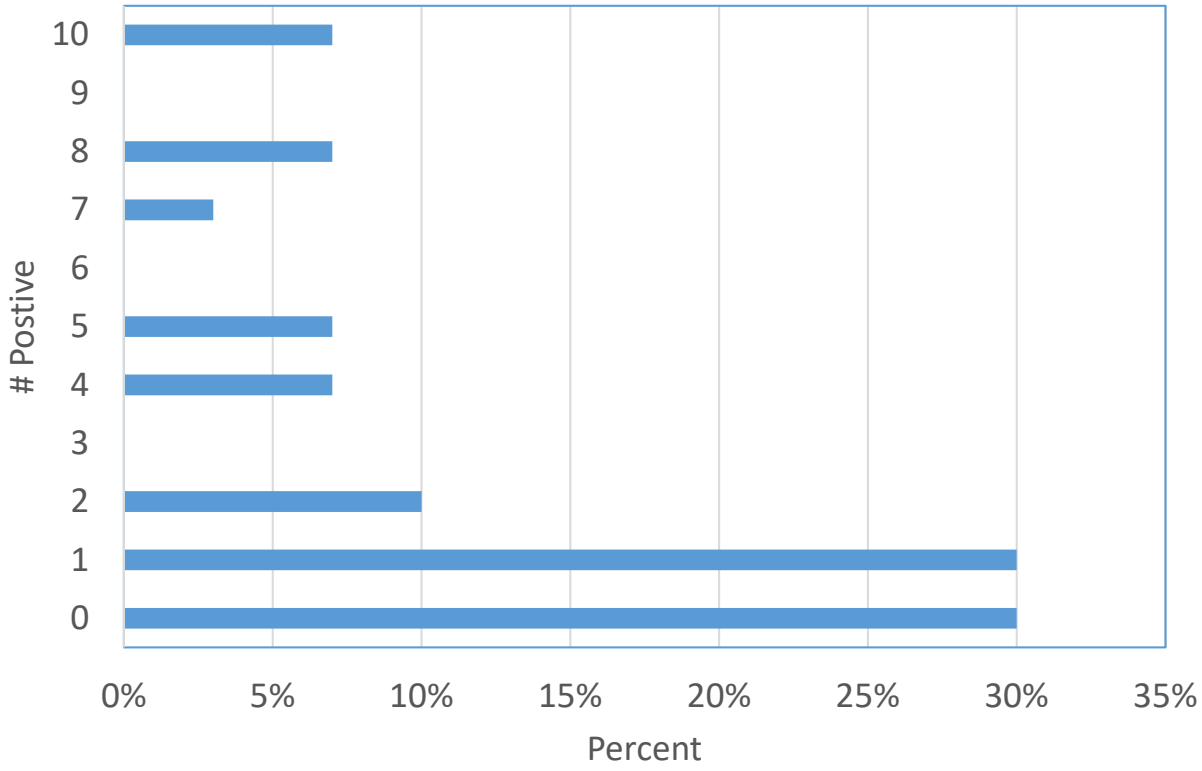
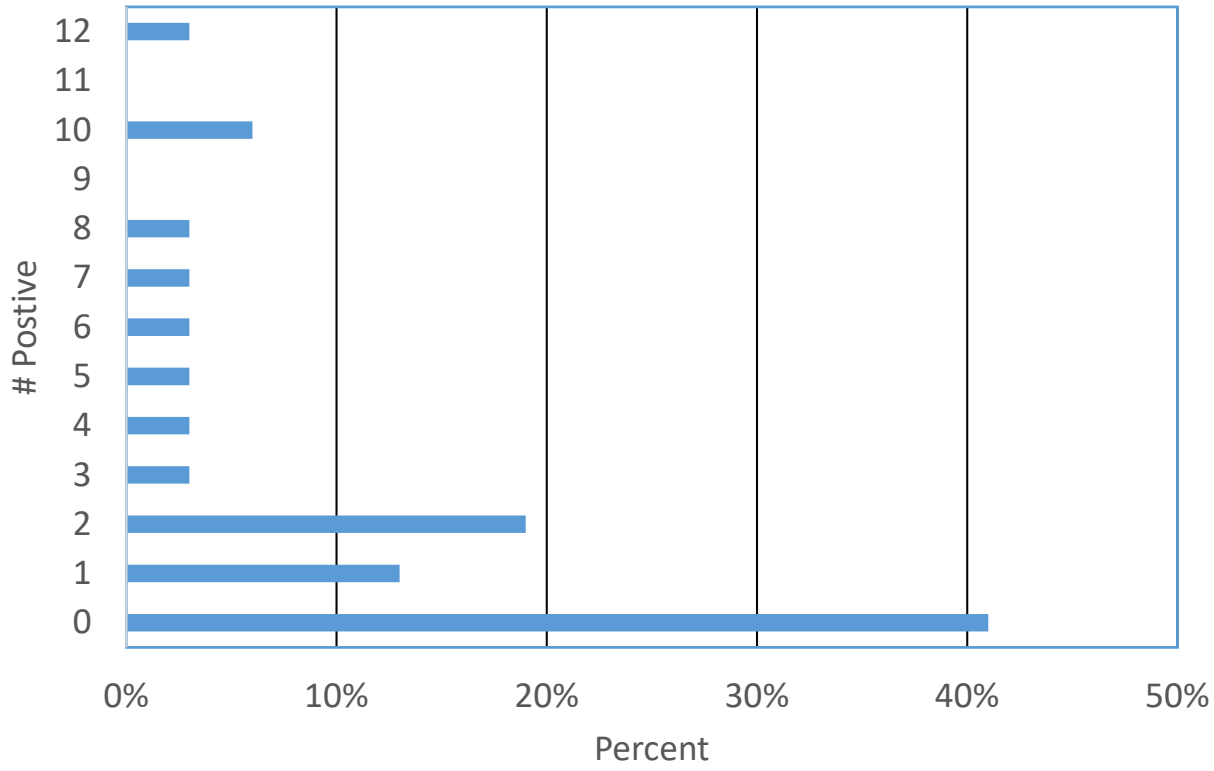


Fig 8. Twelve Ground floor units (n=32 buildings)



As number of ground contact units increase, the probability of having a unit with radon ≥ 4.0 pCi/L increases

Data Analysis

Percentage of buildings containing any units with radon concentrations ≥ 4.0 pCi/L when all units included in testing event are < 2.0 pCi/L

(Requirement = building with at least as manty values with radon < 2.0 pCi/L as the number tested)

	25% Tested			50% Tested			75% Tested			90% Tested		
# GC Units	N	Probability	90% CI	N	Probability	90% CI	N	Probability	90% CI	N	Probability	90% CI
5-6	87	23%	(16%,31%)	70	13%	(8%,21%)	56	5%	(2%,13%)	41	0%	NA(1)
7-8	111	28%	(22%,35%)	95	21%	(15%,29%)	70	6%	(3%,12%)	51	0%	NA(1)
9-10	52	31%	(21%,42%)	44	23%	(14%,35%)	30	3%	(1%,14%)	27	0%	NA(1)
11-12	60	28%	(20%,39%)	51	18%	(11%,28%)	45	13%	(7%,24%)	34	9%	(4%,20%)
13-16	41	20%	(11%,31%)	36	11%	(5%,23%)	28	7%	(2%,19%)	23	0%	(0%,11%)
17-20	29	48%	(34%,63%)	22	32%	(18%,49%)	16	13%	(4%,32%)	11	0%	(0%,20%)

(1) All ground contact units tested, probability = 0%

Data Analysis

Percentage of buildings containing any units with radon concentrations ≥ 4.0 pCi/L when all units included in testing event are < 4.0 pCi/L

(Requirement = building with at least as manty values with radon < 4.0 pCi/L as the number tested)

	25% Tested			50% Tested			75% Tested			90% Tested		
# GC Units	N	Probability	90% CI	N	Probability	90% CI	N	Probability	90% CI	N	Probability	90% CI
5-6	108	36%	(29%,44%)	99	30%	(23%,38%)	82	16%	(10%,24%)	69	0%	NA(1)
7-8	139	41%	(34%,48%)	131	37%	(31%,45%)	106	23%	(17%,30%)	82	0%	NA(1)
9-10	67	45%	(35%,55%)	63	41%	(32%,52%)	55	33%	(23%,44%)	48	23%	(15%,34%)
11-12	69	38%	(29%,48%)	67	36%	(27%,46%)	60	28%	(20%,39%)	53	19%	(12%,29%)
13-16	56	36%	(26%,47%)	54	33%	(24%,44%)	48	25%	(16%,36%)	42	14%	(8%,25%)
17-20	30	50%	(36%,64%)	30	50%	(36%,64%)	29	48%	(34%,63%)	22	32%	(18%,49%)

(1) All ground contact units tested, probability = 0%

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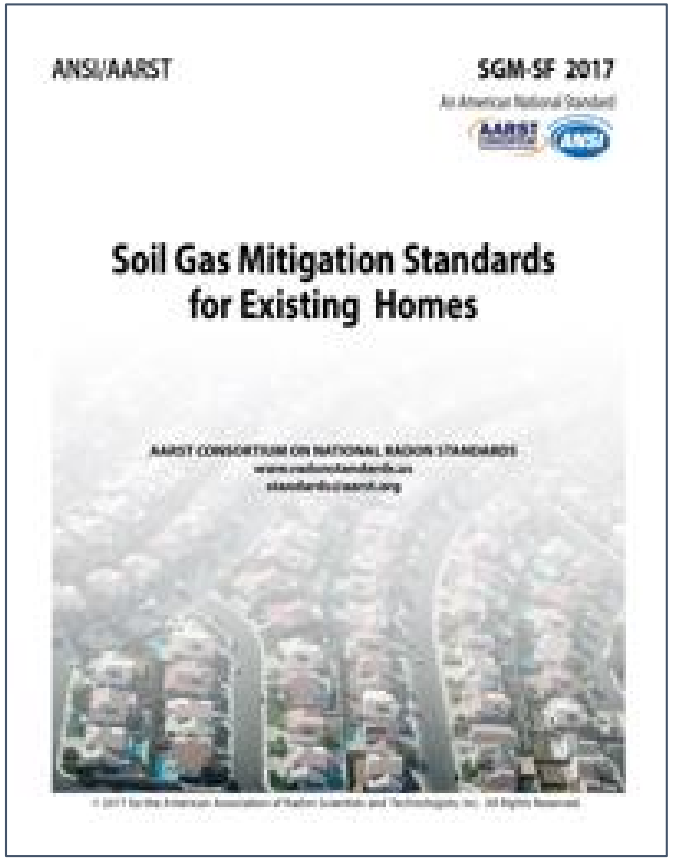
Conclusions

- Many multifamily buildings do not contain radon concentrations ≥ 4.0 pCi/L, but many also do
- As the number of ground contact units increase, the probability of buildings with radon concentrations ≥ 4.0 pCi/L increases
- Up to 10% of buildings with at least one ground contact unit containing radon concentrations ≥ 4.0 pCi/L would not be identified at 75% testing level
- In order to properly characterize a multifamily building for radon potential, 100% of ground contact units must be tested

ANSI-AARST Standards Update



- Recent EPA letter sent to states regarding measurement and mitigation standards
- National consensus standards for:
  - Radon measurement – soon to include Vapor Intrusion
  - Radon and Vapor Intrusion mitigation
  - Radon measurement QA – soon to include Vapor Intrusion
  - Long-term stewardship – radon and Vapor Intrusion

ANSI-AARST standards are developed and maintained through a consensus-based process that includes stakeholder groups representing EPA, HUD, state regulators, industry, and other stakeholder groups

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