Radon Review and Update: How Good is the Science
Mar 2010

EPA Office of Radiation and Indoor Air (ORIA)
Indoor Environments Division (IED)

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Radon as an Indoor Problem

• When:

• Where:

• How:

Radon as an Indoor Problem

• When: 1984

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• How:

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• How: Stanley Watras set off plant nuclear alarms
  Radon was coming from his home [2700 pCi/L]
Policy Setting Considerations

• Scientific Basis
Policy Setting Considerations

- Scientific Basis
- Best Available technology
- Cost-Benefit
- Legislation
EPA & Radon

- EPA has general **Regulatory Authority** to implement Title III of TSCA (i.e. IRA).
- Voluntary Program
  - Radon Outreach Effort
- EPA relies on others for Research/Science Development

Radon Risk in Perspective

- EPA and its Science Advisory Board
  - Radon among the top four Environmental risks to the Public
  - Radon ranked #1 risk in the Home

Radon Risk

- Second Leading cause of Lung Cancer
- Leading cause of Lung Cancer in Non-Smokers
Source of Radon Risk

Alpha Radiation

Epidemiology Study Designs

• Cohort
  – Identify populations based on exposure
  – Follow for disease occurrence

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• Case-Control
  – Identify individuals with disease & individuals without disease
  – Look at and compare exposures

EPA's Risk Assessments Based on Miner [Occupational] Studies

Radon Risks Are Significant and Supported By Strong Science

• National Academy of Science [NAS] BEIR VI Report
  - *The Health Effects of Exposure to Indoor Radon* (February, 1998)
• Serious public health problem

• Second-leading cause of lung cancer
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- No evidence of a threshold
- Effects of Radon & Smoking more powerful in combination
- Radon contributed to 15,000 or 22,000 US lung cancer deaths in 1995 [2,100 or 2,900 in never smokers].
- Reduction of Residential Radon levels above 4 pCi/L could prevent approx. 1/3 of the annual deaths

Summary of Miner Studies
Courtesy J. Lubin (NCI)

- Clear lung cancer dose-response in all cohort studies
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- BEIR VI miner-based risk models (11 studies)
- Continuing expansion of data (currently 15 studies)
  5,000+ cases, 2M person-yrs
- Cumulative exposures in miners overlap home exposures
Cohort Studies (15) of Radon-Exposed Miners
Courtesy J. Lubin (NCI)

EPA Assessment of Risks from Radon in Homes, by ORIA/Radiation Protection Division
(EPA 402-R-03-003, June 2003)

EPA Radon Assessment Results
– Modified & extended the NAS BEIR VI report
[consultation with SAB and NAS panel members]
**EPA Radon Assessment Results**

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- Current Risks at Action Level
  - Smokers 6/100
  - Never Smokers 7/1000

**EPA Action Level**

- 4 pCi/L
- Technology-based NOT Health-based
- Lower Levels are NOT Safe
- Risks @ Action Level
  - Smokers 6/100 [10^{-2}]
  - Never Smokers 7/1000 [10^{-3}]
Scope of the Radon Risk in Homes

• 100M 'should test' homes

• 6% (1:15) of homes ≥ 4 pCi/L
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- 6% (1:15) of homes ≥ 4 pCi/L
- As of 2008, 7.1M US homes still have elevated indoor radon levels

Strengths of Radon Risk Assessment

- Known Human Carcinogen
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• Extensive Epidemiological Studies

• Consistency in Magnitude of Risk
• Extensive Review by National and International Groups
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- Analysis of Dosimetry in Mines & Homes

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- Extensive Peer Review & Detailed Uncertainty Analysis

**International Consensus on Risk**

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**Miner to Residential Extrapolation**
Equivalent?

Radon Residential Case-Control Studies

- 22 worldwide residential case-control studies [19 show an assoc]
- Small study populations


- Continuing meetings of PIs after 1995

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Residential Case-Control Pooling

**European Pooling**
- 13 Studies from 9 Countries
  - Austria
  - Czech Republic
  - Finland (nationwide)
  - Finland (south)
  - France
  - Germany (eastern)
  - Germany (western)
  - Italy
  - Spain
  - Sweden (nationwide)
  - Sweden (never smoking)
  - Spain
  - United Kingdom
- Total 7,148 cases and 14,208 controls

**North American Pooling**
- 7 Studies from 2 countries:
  - New Jersey
  - Winnipeg
  - Missouri (non-smoking women)
  - Missouri II (smokers)
  - Iowa
  - Connecticut
  - Utah-South Dakota
- Total 3,622 cases and 4,966 controls

**Chinese Pooling**
- 2 Studies
  - Gansu
  - Shenyang
- Total 1050 cases and 1996 controls

North American, European and Chinese Residential Risk Pooling Studies

- Provide direct evidence

- Results:
  - Validate miner extrapolations
  - Directly demonstrate residential radon risks

![Graph of Radon Concentration vs. Odds Ratio](image)

**Results of All Radon Studies of Lung Cancer**

Courtesy of Jay Lubin, NCI

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- New Residential Pooling Results

US Radiation Exposure

- Radon Largest Source of Radiation Exposure [Exclud. Med]
- Outdoor Radon Natural Pollutant
- Radon in Homes is NOT
Comparative US Cancer Death Rates in 2005
Courtesy of Bill Field (U of Iowa)

Comparing Radon Related Cancer to Other Cancer Types

- Lung Cancer (radon)
- Liver Cancer
- Brain Cancer
- Stomach Cancer
- Melanoma
- Oral Cancer
- Gallbladder Cancer
- Bone Cancer

US Surgeon General’s National Health Advisory on Radon
Issued January 13, 2005

- “Indoor radon is the second-leading cause of lung cancer in the United States”
- “breathing it over prolonged periods can present a significant health risk”
- “Radon can be”
  - “detected with a simple test”
  - “fixed through well-established venting techniques”

Public Service Campaign
U.S. Surgeon General

TV, Print (Magazine, Newspaper), Radio

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WHO International RN Project [IRP]

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• First Global Call-to-Action on indoor RN

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WHO Handbook on Indoor Radon

- Consensus document
- Almost complete agreement with US positions
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- Almost complete agreement with US positions
- Recommended a reference level of 2.7 pCi/L

New Reference Level Will Not Affect EPA’s Action Level of 4 pCi/L

- EPA’s recommends:
  Consider fixing homes testing 2-4 pCi/L since No Safe Level
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- WHO Handbook recommends countries reduce reference level only after improving their testing and fixing rates

Why Not Just Expand Non-Smoking Programs

- Radon is a communal not an individual risk
**Why Not Just Expand Non-Smoking Programs**

- Radon is a communal not an individual risk
- US has had 50+ years of non-smoking programs
- Most US households don’t allow smoking
- Need to address the source of the Radon exposure
Other Recent Developments

• Presidents Cancer Panel invited speakers on radon to its Dec 2008 Environmental Cancer Meeting.
  – Interim Reports released in Dec 2009 & Jan 2010
  – Final Report in April 2010

• Health Physics Society came out with a new Position Paper on radon
  – Released in Oct 2009
  – Endorses EPA’s Action Level of 4 pCi/L
  – Endorses EPA Rec. to consider fixing between 2 and 4 pCi/L

Rn Program has accomplished a lot...
More than 6,000 Lives Saved

We still have much to do…

EPA Policy Position on Radon

• Because Radon:
  - Constitutes Substantial Risk
  - Is Largely Preventable
  - Is Easy to Control

• Reduction of Risk from Radon Exposure is Prudent Public Policy