

## Residential Radon Mitigation Course NEHA-NRPP Minimum Criteria

- I. Objectives of the Course (0.25 hr.)
  - A. Individuals holding the residential mitigation service provider certification have demonstrated knowledge of radon mitigation techniques as applied to residential structures.
  - B. To prepare potential radon mitigation providers with the basic knowledge in preparation for taking the radon mitigation exam.

- II. Canadian National Radon Proficiency Program (0.25 hr.)
  - A. Overview
  - B. Specifics
    - 1. Explanation of the Program
    - 2. Benefits
    - 3. NEHA Policies
      - a) *Certification*
      - b) *Decertification*
- III. Introduction to Radiation and Radioactivity (0.5 hr.)
  - A. Atomic Structure
    - 1. Electrons, Neutrons, Protons
    - 2. Periodic Table
    - 3. Isotopes
  - B. Radiation
    - 1. Radiation versus Radioactivity
    - 2. Types
      - a) *Alpha*
      - b) *Beta*
      - c) *Gamma*
    - 3. Ionization
    - 4. Penetrating Ability
    - 5. Radioactive Decay
    - 6. Half-Life
    - 7. Background Radiation
      - a) *Natural*
      - b) *Man-Made*
- IV. Health Effects and Risk Assessment (1.0 hr.)
  - A. Damage to the Body
  - B. Studies
    - 1. Miners
    - 2. Residential
    - 3. Animal
  - C. Comparison to Other Life and Health Risks
  - D. Hazard Communications {reference Health Canada and EPA Publications: Radon a Guide for Canadian Homeowners, Guide for Radon Measurement in Dwellings (Homes), Guide for Radon Measurements in Public Buildings }
- V. Radon, Radon Decay Chain, and Radon Behavior (2.0 hrs.)
  - A. Radon Gas versus Radon Decay Products
  - B. Radon Decay Chain
    - 1. Types of Radiation Emitted

- 2. Half-Life Significance
  - 3. Decay Chain
  - C. Equilibrium Ratio
  - D. Radon Entry into Occupied Areas
    - 1. Radon Source and Concentration
    - 2. Transport Mechanisms
      - a) *Differential Air Pressure*
      - b) *Differential Concentrations*
      - c) *Well Water*
      - d) *Building Materials*
  - E. Indoor Radon Concentration
    - 1. Daily and Seasonal Variations in Radon Concentrations
      - a) *Reasons for Fluctuations*
      - b) *Causes of Abnormal Fluctuations*
        - (1) *Fans*
        - (2) *Tampering*
        - (3) *Other*
    - 2. Ventilation Rates and Radon Concentration
      - a) *Ventilation Rates*
      - b) *Stack Effect*
    - 3. Differential Pressure Effects
    - 4. Differential Temperature Effects
    - 5. Wind Effects
    - 6. Other Environmental Factors (Precipitation)
    - 7. Importance of Closed House Conditions
- VI. Introduction to Radon Measurement (1.0 hr.)
- A. Overview
  - B. Introduction to Measurement Devices
    - 1. Device Types
      - a) *Alpha Track*
      - b) *Electret Ion Chamber*
        - (1) Short Term
        - (2) Long Term
      - c) *Activated Charcoal*
        - (1) Open-Face
        - (2) Diffusion Barrier
        - (3) Bags
        - (4) Vials – Liquid Scintillation
      - d) *Continuous Radon Monitor*
        - (1) Scintillation Cell
        - (2) Solid State
        - (3) Ionization Chamber
      - e) *Introduction to Continuous Working Level Monitors*

2. Theory of Operation for Each Device Type
3. Advantages and Disadvantages of Measurement Devices

VII. Measurement Protocols (2.0 hrs.)

A. Overview

1. Measurement Units
  - a) *SI Units*
  - b) *Working Level*
  - c) *Conversion: Bq/m<sup>3</sup> and WL*
  - d) *PicoCuries per Liter*
2. Health Canada Publications
  - a) *Radon a Guide for Canadian Homeowners*
  - b) *Guide for Radon Measurement in Dwellings (Homes)*
  - c) *Guide for Radon Measurements in Public buildings (Schools, Hospitals, Care facilities, Detention Centres)*

- B. Introduction to Performing Measurements
  - 1. Routine Measurements
    - a) *Normal Testing*
    - b) *Pre and Post-Mitigation Testing*
    - c) *Homeowner Testing*
  - 2. House Conditions
    - a) *Short-Term Test*
    - b) *Long-Term Test*
  - 3. Measurement Location
  - 4. Measurement Strategy
  - 5. Factors Affecting Reproducible Test Results
    - a) *Explanation*
    - b) *Factors Involved*
      - (1) Environmental
      - (2) Protocols
      - (3) Tampering
      - (4) Location
- C. Interpretation of Results
  - 1. Less than 200Bq/m<sup>3</sup>
  - 2. Results between 200 - 600Bq/m<sup>3</sup>
  - 3. Greater than 600 Bq/m<sup>3</sup>

## VIII. Mitigation

(21.0 hrs.)

- A. Overview
- B. Mitigation Standards
  - 1. ASTM International Mitigation Standards E 2121 and E1465
  - 2. Reducing Radon levels in existing Homes; A Canadian Guide for Professional contractors
- C. Types of Systems
  - 1. Depressurization
    - a) *Sub-Slab*
    - b) *Drain-Tile*
    - c) *Block-Wall*
    - d) *Sub-Membrane (crawl spaces and dirt floors)*
  - 2. Pressurization
    - a) *Basement*
    - b) *Beneath the Concrete Floor*
  - 3. Passive
  - 4. Sealing (not a recommended stand-alone action)
- D. Assessing the Need for a Mitigation System
  - 1. Radon Test Results
  - 2. Diagnostic Radon Tests
  - 3. Inspection of the Residential Structure
- E. Designing a Mitigation System

- F. Installation of a Mitigation System
- G. Evaluating the Mitigation System
- H. Radon-Resistant New Construction
  - 1. Construction Techniques
  - 2. Passive System
  - 3. Active System
- I. Products and Equipment
  - 1. Commonly Used Products
  - 2. Commonly Used Equipment
  - 3. Where to Purchase Products and Equipment
- J. Hands-On Training/In-Classroom Demonstration
  - 1. Evaluate Radon Test Results for Determining Action
  - 2. Identify Radon Entry Routes by Visual Inspection of Structure and Physical Testing to Provide Data for Mitigation System Design and Troubleshooting System Failures
  - 3. Select Mitigation Strategy by Reviewing Industry Standards, Practices and Mitigation Alternatives Along with Relevant Costs versus Benefits to Reduce Radon Levels
  - 4. Implement System Design by Installing Appropriate Equipment and by Making Structural Alterations and/or Repairs to Reduce Radon Levels
  - 5. Perform Appropriate Testing to Evaluate System Functioning

IX. Health and Safety (1.0 hr.)

- A. Occupational Radiation Exposure
- B. Monitoring for Radiation Exposure
- C. Calculating Radiation Exposure
- D. Record Keeping
- E. CCOHS Guidelines—Canadian Centre for Occupational Health and Safety
- F. Canadian Guidelines for Management of Naturally Occurring Radioactive Material

X. Introduction to Radon in Water (0.5 hr.)

- A. Testing
  - 1. Devices
  - 2. Sampling
- B. Guidance
  - 1. Conversion (10,000 to 1)
  - 2. Reference Documents
- C. Mitigation Methods
  - 1. Decay Storage
  - 2. Aeration
  - 3. Granular Activated Charcoal

XI. Industry Overview (1.0 hr.)

- A. Ethics
  - 1. NEHA's Code of Ethics
  - 2. NEHA Grievance Procedures
  - 3. Fiduciary Issues
    - a) Confidentiality
    - b) Contract Details
    - c) Test Results
- B. Professional Conduct
  - 1. Certification
  - 2. Continuing Education
  - 3. Professional Image
  - 4. Records Management
    - a) Need for Written Contracts
    - b) Reporting Results to Clients
    - c) Maintaining Records for Legal Purposes
    - d) Exposure Records
    - e) Electronic versus Paper Records
- C. Introduction to Quality Assurance/Quality Control

XII. Review and Questions (1.0 hr.)

Student Evaluations (0.5 hr.)

*Additional Reference Material for Canadian Radon Mitigation Exam*

*Canada Mortgage and Housing Corporation February 2008*

[https://www03.cmhc-schl.gc.ca/b2c/b2c/init.do?language=en&z\\_category=0/0000000142](https://www03.cmhc-schl.gc.ca/b2c/b2c/init.do?language=en&z_category=0/0000000142)

*Guide for Radon Measurements in Residential Dwellings (Homes)*

*Health Canada*

[http://www.hc-sc.gc.ca/ewh-semt/alt\\_formats/hecs-sesc/pdf/pubs/radiation/radon\\_homes-maisons/radon\\_homes-maisons-eng.pdf](http://www.hc-sc.gc.ca/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/radiation/radon_homes-maisons/radon_homes-maisons-eng.pdf)

*Guide for Radon Measurements in Public Buildings (Schools, Hospitals, Care Facilities, Detention Centres)*

Health Canada

[http://www.hc-sc.gc.ca/ewh-semt/alt\\_formats/hecs-sesc/pdf/pubs/radiation/radon\\_building-](http://www.hc-sc.gc.ca/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/radiation/radon_building-edifices/radon_building-edifices-eng.pdf)

[edifices/radon\\_building-edifices-eng.pdf](http://www.hc-sc.gc.ca/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/radiation/radon_building-edifices/radon_building-edifices-eng.pdf)

ASTMI E 1465-08a

*Standard Practice for Radon Control Options for the Design and Construction of New Low-Rise Residential Buildings ASTMI E 1465-08a*

*Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings ASTMI E 2121-08*

*Radon Mitigation: Alaska Experiences, Costs, Results*

RAD-0755

R D Seifert

*Energy and Building Specialist*

University of Alaska

Fairbanks

<http://www.uaf.edu/ces/publications-db/catalog/eeh/RAD-00755.pdf>

*Radon—A Guide for Canadian Homeowners, Canada Mortgage & Housing Corporation,*

[https://www03.cmhc-](https://www03.cmhc-schl.gc.ca/b2c/b2c/init.do?language=en&shop=Z01EN&areaID=0000000016&productID=00000000160000000036)

[schl.gc.ca/b2c/b2c/init.do?language=en&shop=Z01EN&areaID=0000000016&productID=00000000160000000036](https://www03.cmhc-schl.gc.ca/b2c/b2c/init.do?language=en&shop=Z01EN&areaID=0000000016&productID=00000000160000000036)

*Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM),*

ISBN0-662-29448-3

[http://www.hc-sc.gc.ca/ewh-semt/alt\\_formats/hecs-sesc/pdf/pubs/contaminants/norm-mrn/00ehd245.pdf](http://www.hc-sc.gc.ca/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/contaminants/norm-mrn/00ehd245.pdf)