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

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$^3$ 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/m³
2. Results between 200 - 600Bq/m³
3. Greater than 600 Bq/m³

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 Date for Mitigation System Design and Troubleshooting System Failures
   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 Greivance 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

Guide for Radon Measurements in Residential Dwellings (Homes)
Health Canada
Guide for Radon Measurements in Public Buildings (Schools, Hospitals, Care Facilities, Detention Centres)
Health Canada

ASTM E 1465-08a
Standard Practice for Radon Control Options for the Design and Construction of New Low-Rise Residential Buildings ASTM E 1465-08a
Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential BuildingsASTMI 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-schl.gc.ca/b2c/b2c/init.do?language=en&shop=Z01EN&areaID=0000000016&productID=00000000160000000036