C-NRPP Residential Radon Measurement Course Criteria

Individuals holding the C-NRPP Residential Radon Measurement Course certification should demonstrate understanding of radon, its scientific properties and known health effects; current statistics of Canadian radon exposures; knowledge of Health Canada’s radon measurement protocols including placement and retrieval of radon measurement devices; understanding of C-NRPP approved devices; knowledge of the proper interpretation of results obtained in residential settings and some basic radon entry and mitigation concepts.

The course should cover the following topics and adequately prepare participants for taking the C-NRPP Radon Measurement Exam.

**Mechanics of the Exam:**
- 100 Multiple Choice Questions
- 2 Hours
- Pencil required; No electronic devices allowed accept for a simple calculator
- Learning Objectives and their percentage of the Final Exam:
  - Physics 14%
  - Measurement Protocols or Guidance 25%
  - Health Effects 11%
  - Quality Control 14%
  - Radon Entry 8%
  - Devices 20%
  - Mitigation 6%
  - Ethics 1%
I. OBJECTIVES OF THE COURSE
- proper outline should be given to students of course objectives

II. Canadian - National Radon Proficiency Program
A. Overview of the C-NRPP Certification Program
   1. Explanation of the Program
   2. Benefits
   3. Established Policies
      a) C-NRPP Policy Manual
      b) Steps for C-NRPP Certification (see Appendix I)
      b) Possibilities of and Consequence of Decertification

III. Introduction to Radiation and Radioactivity
A. Atomic Structure
   1. Periodic Table
   2. Electrons, Neutrons, Protons
   3. Isotopes

B. Radiation
   1. Radiation versus Radioactivity
   2. Types - Alpha, Beta, Gamma
   3. Ionization
   4. Penetrating Ability
   5. Radioactive Decay and Half-life and Becquerels
   6. Background Radiation
      - Natural and Man-made

IV. Health Effects and Risk Assessment
A. Biological Impact of Radon

B. Research and Case Studies
   1. Miners
   2. Residential
   3. Animal

C. Comparison to Other Life and Health Risks

D. Hazard Communications
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V. Radon, Radon Decay Chain, and Radon Behavior (2.0 hr)
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) Pathways into Living Spaces

E. Indoor Radon Concentration
   1. Daily and Seasonal Variations in Radon Concentrations
      a) Reasons for Fluctuations
      b) Causes of Abnormal Fluctuations
         - including Fans, Tampering and Other Miscellaneous Reasons
   2. Ventilation Rates and Radon Concentration
      a) Ventilation Rates
      b) Stack Effect
      c) Differential Pressure Effects
      d) Differential Temperature Effects
      e) Wind Effects
      f) Other Environmental Factors (Precipitation)
      g) Importance of Closed-House Conditions

VI. Introduction to Radon Measurement (1.0 hr.)

A. Overview

B. Introduction to Measurement Devices
   1. Device Types – All Devices listed on the C-NRPP Approved Device List
      a) Alpha Track
      b) Electret Ion Chamber
         (1) Short and 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

A. Overview
   1. Measurement Units
      a) SI Units
      b) Working Level
      c) Conversion: WL and Bq/m³ and Picocuries per Litre
   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. 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
         i) Environmental
         ii) Protocols
         iii) Tampering
         iv) Location

C. Interpretation of Results
   - including under 200 Bq/m³, between 200 and 600 Bq/m³, above 600 Bq/m³

D. Quality Assurance/Quality Control
   1. Terminology and Explanation
      a) Blanks, Duplicates, Spikes and Calibration
      b) Cross Checks, Intercomparisons and Background Measurements
      c) Concepts of Precision, Accuracy and Bias
      d) Control Charts and Record Keeping
      e) Corrective Actions
   2. Creating and Implementation of a Quality Assurance/Quality Control Plan
   3. Requirements for Certification

VIII. Introduction to Health and Safety

A. Introduction to Occupational Exposure

B. Introduction to Monitoring for Exposure
C. Introduction to Calculating Exposure

D. Introduction to Record Keeping

IX. Introduction to Radon in Water

A. Testing
   1. Devices
   2. Sampling

B. Guidance
   1. Conversion (10,000 to 1)
   2. Documents

X. Introduction to Mitigation

A. Overview
   1. Assessing the Need for a Mitigation System
   2. Designing a Mitigation System
   3. Installation of a Mitigation System

B. Types of Systems and Advantages/Disadvantages
   1. Active
      a) Depressurization
      b) Pressurization
      c) Ventilation
   2. Passive
      a) Sealing (not a recommended stand-alone action)
      b) Stack with No Fan Installed

XI. Industry Overview

A. Ethics
   1. C-NRPP’s Code of Ethics
   2. Grievance Procedures
   3. Fiduciary Issues
      a) Confidentiality and Canadian Federal and Provincial Privacy Act
      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
   c) Maintaining Records for Legal Purposes
d) Exposure Records
e) Electronic versus Paper Records

XII. Review and Questions

XIII. Student Evaluations
Required Documents:

1. Report of Radon Working Group
2. C-NRPP Approved Device List
5. Radon—A Guide for Canadian Homeowners, Canada Mortgage & Housing Corporation
6. Cross Canada Survey of Radon Concentrations in Homes – Health Canada
7. EPA Guidance on Quality Assurance – EPA
8. Smoker Radon Factsheet – Health Canada pamphlet
9. Radon is it in your Home – Health Canada pamphlet

Additional Reference Material:

1. Exposure to Atmospheric Radon, Daniel J Steck, R William Field, Charles F Lynch, Environmental Health Perspectives, Volume 107, Number 2, February 1999
5. 210Pb in Home Dust as a Possible Marker for Radon Exposure in Air, Chunsheng Li, Yong-Lai Feng, Jing Chen, Stephen Kiser, Weihuia Zhang, Jiping Zhu, Health Physics, 95(4): 436-439; 2008
6. Radon exposure: Can we make a difference?, Ray Copes, Jeff Scott, Canadian Medical Association Journal, November 6, 2007, 177(10) [http://www.cmaj.ca/cgi/reprint/177/10/1229](http://www.cmaj.ca/cgi/reprint/177/10/1229)
8. Estimated Risks of Radon-Induced Lung Cancer for different exposure profiles based on the new EPA model, Jing Chen, Health Physics, 88(4): 232-333; 2005