Design and Development of a Radon Calibration Chamber for Canada

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- Founded in 1980 directly as a result of the Elliot lake uranium mine experience
- Operations began in Elliot lake, Ontario in January 1981
- Independent
- Not-for-profit
- Mission:
  - Prevention of cancer, occupational illness and injury from unacceptable exposure to radiation.
• C-NRPP launched in 2012 to fulfill need for certification program from Canadian Professionals
• Increasing numbers of radon measurement/mitigation professionals
• No certified radon test chamber in Canada
• Need arises for a reference atmosphere for standardized testing, under controlled conditions, of measuring instruments
• C-NRPP -> Calibration/Performance/Spike Testing
Traceability for Radon

Something to be measured → Measurement Device → Secondary Standard → Primary Standard

How radon enters a house:
- Soil
- Water
- Air

United States Environmental Protection Agency

Bowser Morner
Intercomparisons

Average within 10%
Individual within 25%
Components of a Rn Chamber

1. Equipment for producing radon
2. Equipment to contain it inside a volume
3. Equipment to monitor the radon inside
4. Equipment to control the concentration

How do we know this is accurate?!

- Reference Atmosphere
- Reference Instruments
- Radon Source
- Instrument Under Test
- Container
- Control Circuit
Controlling Radon Concentrations

\[ \rho_C = \frac{\epsilon \cdot A_0}{(V_C + Q_e / \lambda)} \]
Radon Injection

Radon Chamber Rn-222 Concentration

$T_R = 123 \text{ hrs}$

Radon Concentration (kBq/m³)

Time

Feb 06  Feb 10  Feb 14  Feb 18  Feb 22  Feb 26  Mar 01  Mar 05

RnC Data
Best Fit
$\pm 2\sigma$
Radon Chamber Rn-222 Concentration

Radon Concentration (kBq/m3)

Time

Mar 07  Mar 11  Mar 15  Mar 19

$T_F = 61$ hrs @ 0.15 l/min
Radon Chamber Rn-222 Concentration

Rn-222_{Ave} = 2,260 \text{ Bq/m}^3
Exposure = 29.4 \text{ kBq-h/m}^3
COV = 2.5\%
## Chamber Parameters

<table>
<thead>
<tr>
<th>Chamber Element</th>
<th>Description</th>
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<tbody>
<tr>
<td>Concentration</td>
<td>$148 \text{ Bq/m}^3 - 500 \text{ kBq/m}^3$</td>
</tr>
<tr>
<td>Size</td>
<td>12 cubic meters + small glove box for experiments</td>
</tr>
<tr>
<td>Reference Instrument</td>
<td>AlphaGuard DF2000</td>
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<tr>
<td>Traceability</td>
<td>4 Pylon 300A Cells at Bowser-Morner</td>
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</tbody>
</table>
• Radon chambers are required to maintain traceability in measurement
• RSIC with support from Health Canada have introduced first AARST-NRPP certified facility in Canada
Questions?