

The New ANSTO Radon Detector at MLO

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The Australian Nuclear Science and Technology Organisation (ANSTO) CMDL radon program at the Mauna Loa Observatory, Hawaii (MLO) has been making continuous hourly observations of atmospheric radon concentrations since 1989. At 3397 m above sea level, appropriately selected observations from MLO are representative of the free troposphere, and corresponding radon observations are ideal to determine whether air masses have experienced recent terrestrial influence, a requirement of baseline observations. Soon after commencement of the program, it became evident that radon is indeed the best readily measured indicator of perturbation of air masses by contact with land beyond Hawaii. The original detector was replaced by a newer version in 1994 followed by a further-improved detector in 2003 (Figure 1). We have re-evaluated the performance of the 1994 detector using data from 1997 to 2003. A slow but steady degradation in performance due to the accumulation of Pb^{210} within the measurement head was identified resulting in the lower limit of detection increasing to 39 mBq m^{-3} . Also, the detector's sensitivity, approximately at $0.26 \text{ counts per second/Bq m}^{-3}$ in 1998, decreased by almost 10% in 2003. These changes in performance are significant given that the mean daily radon concentration at MLO typically varies from about 40 mBq m^{-3} to 650 mBq m^{-3} . In 2003 the manual calibration system was also replaced with an automatic unit (Figure 2), and a provision was made for the facilitation of instrument background checks. Specifications for the newest MLO radon detector are detailed in Table 1.

Table 1. Operational Specifications of the New Mauna Loa Radon Detector

Parameter	Value
Sampling height	40 m AGL
Flow rate	80 L min^{-1} ^a
Detector volume	1500 L
Lower limit of detection ^b	27 mBq m^{-3} ^e
Sensitivity	$0.35 \text{ cps / Bq m}^{-3}$ ^e
Sampling rate	30 minutes
Response time ^c	45 minutes
Thoron reduction factor ^d	98.2%

^aFrom May 2004.

^bThe radon concentration at which there is a counting error of 30% for a 1-hour count .

^cTime to reach 50% of maximum count rate after a step change in radon concentration.

^dBased on an intake tube 55-m long, 100-mm diameter, and flow rate of 80-L min^{-1} .

^eValues based on a single check of the detector during commissioning.



Figure 1. MLO radon detector commissioned in December 2003. The figure shows the 1500L delay volume of the new detector



Figure 2. Controlling PC and calibration unit containing a Rn-222 source traceable to a NIST standard. Automatic calibrations are scheduled every 28 days.