

# Field experience with Direct Radon and Thoron Progeny Sensors (DRPS/DTPS) results being distributed in the Balkan Region

Rosaline Mishra<sup>1</sup>, Zora S. Zunic<sup>2</sup>, Zdenka Stojanovska<sup>3</sup>, Zoran Curguz<sup>4</sup>, Ljiljana Gulan<sup>5</sup>, Janja Vaupotic<sup>6</sup>, Nenad Veselinovic<sup>2</sup>, Predrag Kolarz<sup>7</sup>, Gordana Milic<sup>5</sup>, Balvindar.K.Sapra<sup>1</sup>, Shinji Tokonami<sup>8</sup>

<sup>1</sup>Radiological Physics and Advisory Division, Bhabha Atomic Research Centre (BARC), Mumbai, India

<sup>2</sup>University of Belgrade, Vinca Institute of Nuclear Sciences, P.O.Box 522, 11000 Belgrade, Serbia

<sup>3</sup>Faculty of Medical Sciences, Goce Delcev University, P. O. Box.201, 2000 Stip, Republic of Macedonia

<sup>4</sup>University of East Sarajevo, Faculty of Transport, Doboj, Republic of Srpska

<sup>5</sup>Faculty of Natural Sciences, University of Priština, Kosovska Mitrovica, Serbia

<sup>6</sup>Radon Center, Department of Environmental Sciences, Jožef Stefan Institute, Jamovacesta 39, 1000 Ljubljana, Slovenia

<sup>7</sup>University of Belgrade, Institute of Physics, 11080, Belgrade, Serbia

<sup>8</sup>Department of Radiation Physics, Institute of Radiation Emergency Medicine, Hirosaki University, Aomori Prefecture, Japan

**Purpose:** This paper reports the results of the international collaboration on direct measurements of radon ( $^{222}\text{Rn}$ ) and thoron ( $^{220}\text{Rn}$ ) progeny in indoor environments (dwellings and schools) in some parts of the whole of Balkan region (Serbia with Kosovo, Republic of Srpska, Slovenia and Republic of Macedonia).

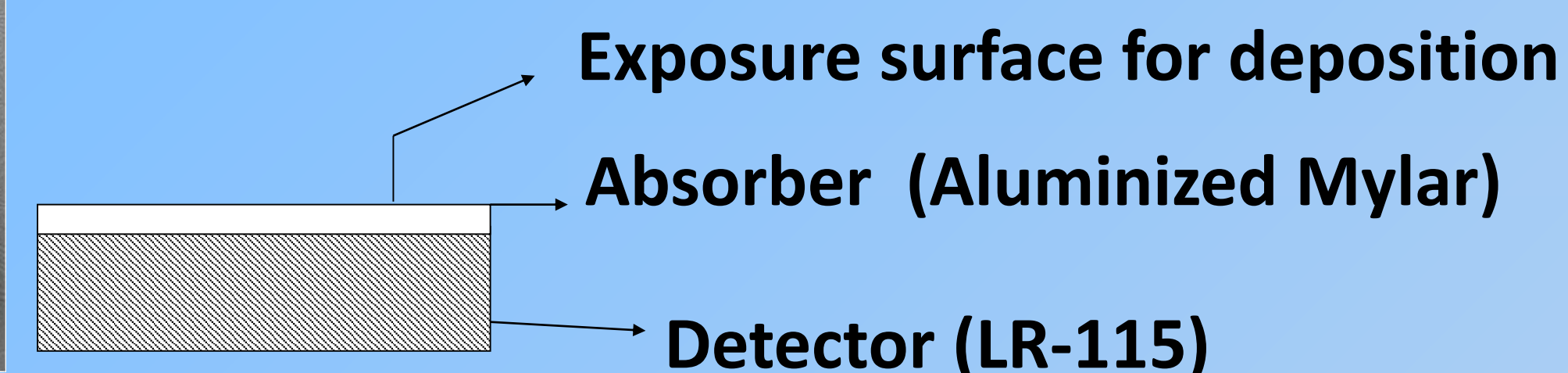
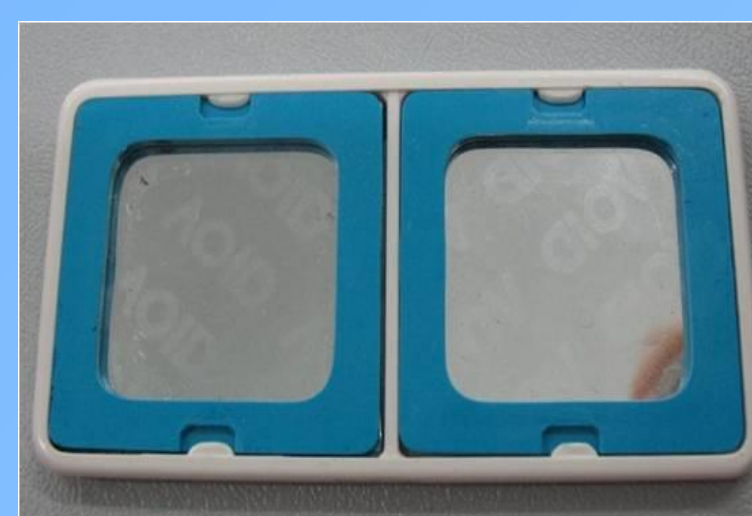
**Instruments used:** Passive deposition based  $^{222}\text{Rn}$  and  $^{220}\text{Rn}$  Progeny sensors

**Direct Thoron Progeny Sensor (DTPS):** (50 $\mu$  absorber)

Selectively detects  $^{212}\text{Po}$  (8.78 MeV) alpha particles

**Direct Radon progeny Sensor (DRPS):** (37 $\mu$  absorber)

Mainly detects  $^{214}\text{Po}$  (7.69 MeV) alpha particles



## Grand Table of Results

		Period of Exposure	EERC (Bq m <sup>-3</sup> )	EECT (Bq m <sup>-3</sup> )
<b>Kosovo</b>	50 indoors	Dec 2010-May2011	5.64-148.85(Range) 44.89 (Average)	0.79-4.08(Range) 1.91 (Average)
	50 indoors	May 2011-Dec2011	6.39-81.78(Range) 22.23 (Average)	0.54-4.34 (Range) 1.1 (Average)
<b>Serbia, Sokobanja</b> 45 (indoors)	Citluck	Feb-July2011	6.64-14.29 (Range) 10.98 (Average)	0.31-1.72 (Range) 0.73 (Average)
	Bogdinac		7.07-15.63(Range) 10.94(Average)	0.87-1.35 (Range) 1.0 (Average)
	Trubarevac		6.9-16.7(Range) 11.39(Average)	0.51-1.97 (Range) 1.09 (Average)
	Sokobanja		6.7-16.8(Range) 11.78(Average)	0.3-0.45 (Range) 0.4 (Average)
	Resnik		13.17-24.6(Range) 18.06(Average)	0.37-2.74 (Range) 1.44 (Average)
	Josanica		5.6-16.58(Range) 12.33(Average)	0.36-1.27 (Range) 0.83 (Average)
	Zuckovac		5.17-14.0(Range) 8.39(Average)	0.32-1.67(Range) 0.8 (Average)
	Belipotok		9.8-13.7(Range) 11.87(Average)	0.56-1.15 (Range) 0.82 (Average)
<b>Serbia, Sokobanja</b>	12 indoors	Oct2011-Oct2012	5.5-15.8(Range) 10.51(Average)	0.13-1.2 (Range) 0.59 (Average)
<b>Serbia, Josanica</b>	5 indoors	Oct2011-Oct2012	7.1-13.7(Range) 10.1(Average)	0.33-3.4 (Range) 1.03 (Average)
<b>Republic of Srpska,</b> Banja Luka	Homes (40 indoors)	Nov 2011-Dec 2012	6.34-14.4(Range) 9.5(Average)	0.1-1.1 (Range) 0.44 (Average)
	Schools (25 dosimeters)	Nov 2011-Dec 2012	6.79-16.84(Range) 11.43(Average)	0.1-1.16 (Range) 0.52 (Average)
<b>Serbia, Sokobanja</b> villages (60 dosimeters)	Muzinac	April 2012-April 2013	4.72-19.12(Range) 9.27(Average)	.54-1.57(Range) 0.96 (Average)
	Jezero	April 2012-April 2013	5.21-17.1(Range) 9.41(Average)	0.59-2.47 (Range) 1.43 (Average)
	Blendija	April 2012-April 2013	5.24-18.27(Range) 12.84(Average)	0.76-1.96 (Range) 1.17 (Average)
	Vrmdza	April 2012-April 2013	3.94-19.09(Range) 13.2(Average)	0.17-1.69 (Range) 0.88 (Average)
<b>Slovenia</b>	102 indoors	Nov 2011-July1012	4.1-19.93(Range) 11.31(Average)	0.11-1.36 (Range) 0.34 (Average)
<b>Republic of Macedonia</b>	82 dosimeters in schools	Feb-2012-May2012	8.09-51.29(Range) 28.65(Average)	0.1-6.1 (Range) 1.07 (Average)

**Conclusion:** The overall analysis of around 400 detectors deployed showed:

- Both EETC and EERC obtained using DTPS and DRPS respectively showed a *log normal distribution pattern*.
- The overall GM of EETC was obtained as 0.69 Bq/m<sup>3</sup> with a GSD of 2.0
- The GM of EERC was obtained as 11.02 Bq/m<sup>3</sup> with a GSD of 2.6