Woomera Annex to the Hangar 5 Radon and Radon Daughters
Monitoring report

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Monitoring Summary:

Radon monitoring by the RDS Passive Radon Monitor that is based on the nuclear track detector film Kodak-LR115

Radiation Detection Systems (RDS) used the Passive Radon Monitor (PRM) to measure long-term average radon activity concentration (RnAC) in air in 6 outdoor locations and 22 indoor ones. The 5 month average outdoor and indoor RnAC was measured as 16.4 Bq/m3 and 54.3 Bq/m3 respectively. Whilst the average indoor RnAC has been elevated above the outdoor natural radiation background all measured RnACs were found to be below the ARPANSA's radon reference level of 200 Bq/m3 for private dwellings.

The RnAC result summary is in the attached file "PRM-Report1".

Monitoring of the Potential Alpha Energy Concentration (PAEC) of Radon Daughters by the RDS Environmental Radon Daughter Monitor (ERDM)

The ERDM has been developed by RDS for the monitoring of the alpha radiation that is emitted by radon decay products. Air with radon daughters is sucked through the glass fibre filter (the average flow rate of 0.35 L/min is used) and the alpha radiation emitted by radon daughters on the filter is detected by the ZnS(Ag) scintillation foil that is coupled with a photomultiplier tube. The alpha count of radon daughters was logged in 1 hour counting windows. The alpha count is multiplied by a calibration constant that was confirmed by exposing the ERDM to the known PAEC of radon daughters inside the SA EPA's Radon Calibration Chamber.

Four ERDMs were used. The ERDMs 1, 2 and 3 were used for the indoor radon daughter monitoring. The ERDM 1 was affixed near the ground level inside a gap between 2 rows of drums. The ERDM 2 was affixed above the ERDM 1 approximately 1.2 m above the floor and the ERDM 3 was placed near the top of drums above the ERDM 2.

The ERDM 4 was placed inside of an enclosure that was affixed onto the external face of the sliding door of the ANEX near the three ERDMs above.

The ERDM 4 data were downloaded during the 7th of August visit. The second download occurred on 6 November 2018 (file "CSIRO-ERDM4b-6Nov2018").

The ERDM1, 2 and 3 data were downloaded on 6 November 2018 (files: “CSIRO-ERDM1-6Nov2018”; “CSIRO-ERDM2b-6Nov2018”; and “CSIRO-ERDM3-6Nov2018”).

The filter coupled to air samplers of the ERDM 1 and 2 became clogged with fine dust during July. This must be due to more airborne dust being at the floor level. Consequently, only June data were used to compare data of all four ERDMs. The ERDM 3 that was running at the lop level of drums and the outside unit ERDM 4 provided useful monitoring results during the entire sampling period of 152 days. The average PAECs measured by the ERDM 3 and 4 were 0.029 and 0.040 microJ/m3 respectively.

In order to compare trends of the PAEC of radon daughters measured by all 4 ERDMs June data were used (file “CSIRO-ERDM1,2,3,4-June2018”). All 4 monitors show similar diurnal variations of the PAEC of radon daughters even though the ERDM 1 data log shows the beginning of the air sampler failure during the last few days of June.

E-monitoring of RnAC

Two Continuous Radon Monitors (CRM-FTc and CRM-D) coupled with the E-monitoring interface were installed on 6 November 2018 near ERDMs 1,2 and 3. The E-monitoring interface includes the Telstra SIM and is using the Telstra 3G/4G mobile network. Both units were designed to send 10 min data to the RDS monitoring platform so J. Baxter, D. Mallants and M. Leviton could access data remotely. Dr. Mallants may grant access to the platform to additional personnel if it is required.

On 6 November the second solar panel was installed to support 4 ERDMs and 2 CRMs. It was noticed that the CRM-FTc that requires more power than other monitors stopped sending data on 8 November at 4am. I asked M. Leviton to disconnect this monitor in order to maintain reliable charging of the battery (note that the Annex front wall with the solar panels faces north-west and is only exposed to direct sunlight in summer well in afternoons. In winter it receives direct sunlight in the day). After the CRM-FTc was disconnected the battery looked to be fully charged at the end of every day.

Internal dose assessment from inhaled Radon Daughters

The average PAEC of radon daughter that was measured by ERDM is approximately 0.03 microJ/m3. Provided an employee is exposed to such PAEC for 100 hours his/her radon daughter exposure (PAEE) would be 3 micro J h/m3 and the corresponding effective dose equivalent could be calculated as 3 x 1.41 = 4.2 microSv.

(The PAEE to the effective dose equivalent conversion factor of “1μJh/m3=1.4μSv” was considered).

References:

RDS PRM

(See the conference presentation below and the list of papers of the first author used in the extended abstract)

J. KVASNICKA & H. STEEGER; “RADON MONITORING IN THE SOIL AIR WITH NUCLEAR TRACK DETECTORS: URANIUM EXPLORATION METHOD” URAM 2018, IAEA, 25-29 June 2018, Vienna.

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Exposure Result Sheet June - November 2018

Monitoring report

Client: **CSIRO/Jacobs**

Sample type: Indoor/outdoor radon activity concentration
Place of sampling: WP
Date of sampling: 1 June – 6 November 2018
Radon monitor: Passive Radon Monitor (RDS)
Date of calibration: July 2015
Calibration source: Radon Calibration Chamber SA EPA

CSIRO-PRMs	1June-6Nov 2018	RnAC
Monitor Number	PRM Location	(Bq/m3)
C18-1/1	IN-taped to ERDM1 (bottom)	98.4
C18-1/2	IN-taped to ERDM2 (mid drums)	53.9
C18-1/3	IN-taped to ERDM3 (top drums)	62.1
C18-1/4	Out-next to ERDM4 (on doors)	38.6
C18-1/5	OD-Perimeter fence	12.1
C18-1/6	OD-Perimeter fence	8.4
C18-1/7	OD-Perimeter fence	11.2
C18-1/8	OD-Perimeter fence	15.0
C18-1/9	OD-Perimeter fence	12.8
C18-1/10	IN-DT	31.6
C18-1/11	IN/TOP	77.3
C18-1/12	IN/TOP	25.0
C18-1/13	IN/TOP	61.3
C18-1/14	IN/Floor	38.2
C18-1/15	IN/Floor	37.1
C18-1/16	IN/TOP	37.8
C18-1/17	IN/MID	51.4
C18-1/18	IN/TOP	52.5
C18-1/19	IN/MID	40.4
C18-1/20	IN/TOP	*
C18-1/21	IN/MID	77.8
C18-1/22	IN/MID	63.5
C18-1/23	IN/MID	56.9
C18-1/24	IN/Floor	62.4
C18-1/25	IN/MID	74.5
C18-1/26	IN/MID	39.6
C18-1/27	IN/Floor	43.3
C18-1/28	IN/TOP	45.2
C18-1/29	IN/TOP	63.5
C18-1/30		*

Monitor placement:- IN/TOP-pallet top; IN/MID-pallet mid; IN/Floor-floor level.
Note: One relative standard deviation is better than about +/-30% for OD placements and better than +/- 25% for indoor monitors. *) Denotes missing PRMs. Monitor No. 4 was exposed between 7 August and 6 November ie for 91 days.

12 November 2018 Dr. Jiri Kvasnicka