

FIGARO dosereport

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E.L. Hansen, O.C. Lind, D.H. Oughton, B. Salbu. A framework for exposure characterization and gamma dosimetry at the NMBU FIGARO irradiation facility. International Journal of Radiation Biology, DoReMi special issue (2017, submitted).

To access the full dosimetry framework, please visit:

<https://github.com/lindbohansen/FIGARO>

NKS cosms

This project investigates the response of whole miniature freshwater ecosystems to four levels of dose at FIGARO.

Exposures started 2016-10-11 18:41:00 and ended 2016-11-01 08:32:00.

Participants

The following people participated in this project:

name	role	email	telephone
Tanya Helena Hevrøy	-	-	-
Anna-Lea Golz			
Li Xie	-	-	-
Elisabeth Lindbo Hansen	-	-	-
Clare Bradshaw	-	-	-
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Types of setups

The project used the following types of setups, where xcm refers to the width of the setup in the direction going outwards from the door; ycm refers to the height of the setup in the direction going upwards from the floor; and zcm refers to the depth of the setup along the central field axis going outwards from the source towards the back wall:

type	xcm	ycm	zcm	approximateshape	actualshape	materials
cosms	20	20	10	box	box	water-plexiglass

Positions

Setups were placed at the following positions in the field, where Xcm refers to the distance from the central field axis to the midpoint of the setup in the direction going outwards from the door; Ycm refers to the distance from the floor to the lowest point of the setup in the direction going upwards from the floor; and Zcm refers to the distance from the source focus to the front face of the setup in the direction going outwards from the source towards the backwall (this distance equals the distance from the exit face of the collimator to the setup front face plus 41.7 cm).

SSDL-defined field axis air kerma rates list the mean of air kerma rates free in air on the SSDL-defined field axis at the specified distances of Zcm to the source focus on the exposure start (2016-10-11 18:41:00) and end (2016-11-01 08:32:00) dates. Note that these are mean air kerma rates on the SSDL-defined field axis. Setups that are placed closer to the central field axis may receive slightly higher mean air kerma rates. Setups that are placed farther away from the central field axis than the SSDL-defined field axis, will generally receive lower mean air kerma rates.

type	position	Xcm	Ycm	Zcm	ssdlAxisAirKermaRateMGyPerh
cosms	1B	-10.60	65.0	196.2	22.1
cosms	1T	-10.60	87.6	196.2	22.1
cosms	2L	10.60	65.0	315.7	8.46
cosms	2R	32.05	65.0	315.7	8.46
cosms	3L	10.60	90.9	640.7	2.03
cosms	3LC	32.05	90.9	640.7	2.03
cosms	3R	74.95	90.9	640.7	2.03
cosms	3RC	53.50	90.9	640.7	2.03
cosms	4BC	32.05	134.0	1015.7	0.800
cosms	4BL	10.60	134.0	1015.7	0.800
cosms	4BR	53.50	134.0	1015.7	0.800
cosms	4TC	32.05	156.6	1015.7	0.800
cosms	4TL	10.60	156.6	1015.7	0.800
cosms	4TR	53.50	156.6	1015.7	0.800

Rotations and exposure times

There were a total of 4 rotations in this experiment. A rotation comprises the set of successive exposure times for which the whole setup remains exactly the same over the full exposure room.

rotation	rotationstart	rotationstop	rotationtime
10.10.	2016-10-11 16:41:00	2016-10-13	2545 mins

		14:14:00	
13.10.	2016-10-13 17:52:00	2016-10-20 14:02:00	9542 mins
20.10.	2016-10-20 17:45:00	2016-10-27 13:52:00	9514 mins
27.10.	2016-10-27 17:36:00	2016-11-01 07:32:00	6370 mins

Minimum, maximum and average absorbed dose rates and accumulated absorbed doses

Based on Monte Carlo radiation transport simulations of the FIGARO exposure hall, Co-60 source and microcosms experimental setups and logged exposure times, microcosms received the following accumulated absorbed doses (accumulated_Gy), at the following average (avg_mGyperh), minimum (min_mGyperh) and maximum (max_mGyperh) absorbed dose rates. The relative standard uncertainty on the absorbed dose rates is estimated to 8%.

id	accumulated_Gy	absorbedDoseRateTo What	avg_mGype rh	min_mGype rh	max_mGype rh
19	9.3	water for plants at the midplane	20.	19.	21.
2	9.2	water for plants at the midplane	20.	19.	21.
4	3.8	water for plants at the midplane	8.2	8.0	8.4
9	3.8	water for plants at the midplane	8.2	8.0	8.4
13	0.84	water for plants at the midplane	1.8	1.6	1.8
22	0.83	water for plants at the midplane	1.8	1.6	1.8
14	0.81	water for plants at the midplane	1.7	1.6	1.8
5	0.81	water for plants at the midplane	1.7	1.6	1.8
15	0.35	water for plants at the midplane	0.76	0.74	0.77
18or8_b	0.35	water for plants at the midplane	0.76	0.73	0.77
11	0.35	water for plants at the midplane	0.75	0.73	0.76

20	0.35	water for plants at the midplane	0.75	0.73	0.77
6	0.35	water for plants at the midplane	0.74	0.73	0.76
18or8_a	0.34	water for plants at the midplane	0.74	0.73	0.76
19	6.6	water for plants at the surface	14.	8.9	18.
2	6.0	water for plants at the surface	13.	8.9	18.
4	3.2	water for plants at the surface	6.8	6.6	7.0
9	3.2	water for plants at the surface	6.8	6.6	7.0
19	8.8	water for the whole-microcosms	19.	17.	20.
2	8.6	water for the whole-microcosms	18.	17.	20.
4	3.7	water for the whole-microcosms	7.9	7.6	8.1
9	3.6	water for the whole-microcosms	7.8	7.6	8.1
13	0.81	water for the whole-microcosms	1.7	1.5	1.8
22	0.80	water for the whole-microcosms	1.7	1.5	1.8
14	0.78	water for the whole-microcosms	1.7	1.5	1.8
5	0.78	water for the whole-microcosms	1.7	1.5	1.8
11	0.34	water for the whole-microcosms	0.73	0.72	0.74
15	0.34	water for the whole-microcosms	0.73	0.72	0.75
18or8_b	0.34	water for the whole-microcosms	0.73	0.72	0.74
6	0.34	water for the whole-microcosms	0.72	0.70	0.74
18or8_a	0.33	water for the whole-microcosms	0.72	0.69	0.73

20	0.33	water for the whole-microcosms	0.72	0.69	0.75
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You can report information from this table in your work e.g. as:

Setup 19 received an accumulated absorbed dose to water for the whole-microcosms of 8.8 Gy over a net exposure time of 466 hours at an average beam-on absorbed dose rate of 19. mGy/h (range from 17. mGy/h to 20. mGy/h).

Measured air kerma rates

Setups were verified to be placed correctly in the field through measurements with Landauer nanoDots of air kerma rates across the front and back faces of empty microcosms (measured_mGyperh). Simulated air kerma rates (simulated_mGyperh) on the measurement dates were compared with the measured values to validate the simulations.

type	position	point	plane	measured_mGyperh	simulated_mGyperh	ssdlAxisAirKerma RatemGyperh
cosms	1B	center	back	20.1	20.0	22.0
cosms	1B	center	front	22.9	22.0	
cosms	1B	lowerleftcorner	back	19.8		
cosms	1B	lowerleftcorner	front	22.3		
cosms	1B	lowerrightcorner	back	19.4		
cosms	1B	lowerrightcorner	front	22.0		
cosms	1T	center	back	16.7	16.8	8.43
cosms	1T	center	front	18.7	18.1	
cosms	1T	upperleftcorner	back	12.3		
Cosms	1T	upperleftcorner	front	12.4		
cosms	1T	upperrightcorner	back	12.1		
cosms	1T	upperrightcorner	front	12.7		
cosms	2L	center	back	7.73	8.00	8.43
cosms	2L	center	front	8.37	8.39	
cosms	2R	center	back	7.41	7.93	
cosms	2R	center	front	8.40	8.39	
cosms	3L	center	back	2.06	1.94	2.02
cosms	3L	center	front	2.18	2.03	

cosms	3LC	center	back	1.97	1.86	
cosms	3LC	center	front	2.16	1.93	
cosms	3R	center	back	1.87	1.64	
cosms	3R	center	front	1.86	1.71	
cosms	3RC	center	back	2.01	1.92	
cosms	3RC	center	front	2.14	1.86	
cosms	4BC	center	front	0.794	0.744	0.796
cosms	4BL	center	front	0.751	0.751	
cosms	4BR	center	front	0.743	0.725	
cosms	4TC	center	front	0.688	0.685	
cosms	4TL	center	front	0.761	0.711	
cosms	4TR	center	front	0.730	0.745	