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Procedure outline for dose mapping/calibration and samples irradiation

G. Ciovati, X. Li, M. McCaughan, J. Vennekate

1. Dose mapping and calibration

1.1. Set an X-ray screen on the holder behind the target rail system.
1.2. Set a dummy target (Aluminum block) with one X-ray screen behind it. Alternatively tape the X-ray screen to the rail.
1.3. Set up four 75 mL target cells with dosimeter rods taped to the front are placed on the remaining seats.
1.4. The target carousel (ITGM604) is operated to place the dummy target in front of the beam exit window
1.5. Measure and tune the beam profile through the irradiation beamline using both Viewers and Harps
1.6. Measure the beam energy and energy spread (8 MeV, Use MeV spectrometer line and harp701)
1.7. Measure the beam current with Faraday Cup and Beam Current Monitor (100 nA)
1.8. Energize either the solenoid or the raster
1.9. Verify beam size at dummy target with X-ray screen (~50 mm diameter)
1.10. Put Faraday cup in the beamline
1.11. Move the 1st target cell in front of the beam exit window
1.12. Deliver beam for 1 kGy dose, remove Faraday cup
1.13. Record the beam current, irradiation start time and end time on the commissioning sheet.
1.14. Repeat steps 1.10 – 1.14 to move each target in front of the beam exit window and deliver 5 kGy, 10 kGy and 20 kGy
1.15. Shut off beam
1.16. PSS to Open
1.17. Retrieve the rods from each target
1.18. Replace sample holders with 60 mL sample holders with rods inside the water.
1.19. PSS to Run
1.20. Place dummy target in front of beamline exit window
1.21. Verify beam profile and beam energy
1.22. Deliver 1 kGy, 5 kGy, 10 kGy and 20 kGy to each target cell
1.23. Shut off beam
1.24. PSS to Open
1.25. Retrieve rods from each target, measure dose and complete commissioning sheet

2. Samples Irradiation

2.1. Fill each of the four target cells with DI water with 10 µg/L 1,4-dioxane.
2.2. Tape 2 dosimeter rods at the front at the outer most positions from commissioning.
2.3. The 5th target is the solid aluminum dummy target with X-ray screen.
2.4. Follow steps 1.5 to 1.14 to irradiate one sample at 1 kGy, one at 5 kGy, one at 10 kGy and one at 20 kGy.
2.5. Retrieve the samples, fill the VOA vials with the irradiated samples.
2.6. Thoroughly rinse each target cell with DI water and wipe dry with nitrogen gun.
2.7. Fill each of the four target cells with DI water with 100 µg/L 1,4-dioxane.
2.8. Follow steps 2.2 to 2.6
2.9. Fill each of the four target cells with secondary effluent water with 10 µg/L 1,4-dioxane.
2.10. Follow steps 2.2 to 2.6
2.11. Fill each of the four target cells with secondary effluent water with 100 µg/L 1,4-dioxane.
2.12. Follow steps 2.2 to 2.6.
2.13. Fill one target cell with DI water with 10 µg/L 1,4-dioxane, one with DI water with 100, µg/L 1,4-dioxane, one with secondary effluent water with 10 µg/L 1,4-dioxane and one with secondary effluent water with 100 µg/L 1,4-dioxane.
2.14. Follow steps 2.2 to 2.6 but irradiate each sample with the same 2 kGy dose.

Steps 1 and 2 will be done with rastered beam first and with the solenoid sequentially.

Table 1: Irradiation time estimated with FLUKA simulation

	1kGy	5kGy	10 kGy	20 kGy
Time (mins) for solenoid	1	5	10	20
Time (mins) for raster	1.8	9	18	36

Scheduled day		Operators	target 1	target 2	target 3	target 4	total irradiation time (min)
11/11/2021	run 1	Matt	SRC_SPEC_08	SRC_SPEC_08	SRC_SPEC_08	SRC_SPEC_08	80
	run 2	Xi, Hannes	SRC_SPEC_08	SRC_SPEC_09	SRC_SPEC_09	SRC_SPEC_09	80
Estimated operator time: 5.5 h							
11/12/2021	run 3	Yan	SRC_SPEC_09	SRC_SPEC_09	SRC_SPEC_10	SRC_SPEC_10	80
	run 4	Xi, Hannes	SRC_SPEC_10	SRC_SPEC_10	SRC_SPEC_10	SRC_SPEC_07	64
Estimated operator time: 5.5 h							
11/13/2021	run 5	Matt	SE-10-0.5	SE-10-1	SE-10-2	SE-10-4	7.5
	run 6	Xi, Gigi	SE-10-tBuOH-0.5	SE-10-tBuOH-1	SE-10-tBuOH-2	SE-10-tBuOH-4	7.5
Estimated operator time: 2 h							
11/xx/2021	run 7		SRC_SPEC_07	SRC_SPEC_07	SRC_SPEC_07	SRC_SPEC_07	16
	run 8		SRC_SPEC_05	SRC_SPEC_05	SRC_SPEC_05	SRC_SPEC_05	80
Estimated operator time: 4 h							
11/xx/2021	run 9		SRC_SPEC_05	SRC_SPEC_04	SRC_SPEC_04	SRC_SPEC_04	32
	run 10		SRC_SPEC_04	SRC_SPEC_04			8
Estimated operator time: 2.5 h							

Schedule of irradiation tests from 11/01/2021 to 12/14/21

Description	Sample ID	vial size (mL)
SCE water with 10 ug/L 1,4 dioxane	SE-10-xx	40
SCE water with 10 ug/L 1,4 dioxane and t-BuOH	SE-10-tBuOH-xx	40
SCE water for PFAS analysis - Low dose (2 kGy, 4 min)	SRC_SPEC_04	275
SCE water for PFAS analysis - High dose (10 kGy, 20 min)	SRC_SPEC_05	275
SCE spiked with PFOA, PFOS, PFHxA - Low dose (2 kGy, 4 min)	SRC_SPEC_07	275
SCE spiked with PFOA, PFOS, PFHxA - High dose (10 kGy, 20 min)	SRC_SPEC_08	275
SCE spiked with PFOA - High dose (10 kGy, 20 min)	SRC_SPEC_09	275
SCE spiked with PFOS - High dose (10 kGy, 20 min)	SRC_SPEC_10	275
The following samples do not require irradiation:		
JLab DI water at point-of-use in Chem Room	SRC_SPEC_01	275
HRSD filed blank transferred through the sample holder	SRC_SPEC_02	275
SCE spiked with PFOA, PFOS, PFHxA transferred through the sample holder	SRC_SPEC_06	275
SCE poured through the sample holder	SRC_SPEC_03	275

3, 4, 5 兩大箱 ×75×3 =

6, 7, 8 兩大箱 500 ng/L ×75×3 =

2+2+1+1+1=7

⑨ 1大箱 500 ng/L

⑩ 1大箱 500 ng/L

⑤ 大1箱

6, 7, 8 兩大箱 500 ng/L