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**Procedure outline for dose mapping/calibration and samples irradiation**

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1. **Dose mapping and calibration**
   1. Set an X-ray screen on the holder behind the target rail system.
   2. Set a dummy target (Aluminum block) with one X-ray screen behind it. Alternatively tape the X-ray screen to the rail.
   3. Set up four 75 mL target cells with dosimeter rods taped to the front are placed on the remaining seats.
   4. The target carousel (ITGM604) is operated to place the dummy target in front of the beam exit window
   5. Measure and tune the beam profile through the irradiation beamline using both Viewers and Harps
   6. Measure the beam energy and energy spread (8 MeV, Use MeV spectrometer line and harp701)
   7. Measure the beam current with Faraday Cup and Beam Current Monitor (100 nA)
   8. Energize either the solenoid or the raster
   9. Verify beam size at dummy target with X-ray screen (~50 mm diameter)
   10. Put Faraday cup in the beamline
   11. Move the 1st target cell in front of the beam exit window
   12. Deliver beam for 1 kGy dose, remove Faraday cup
   13. Record the beam current, irradiation start time and end time on the commissioning sheet.
   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
   15. Shut off beam
   16. PSS to Open
   17. Retrieve the rods from each target
   18. Replace sample holders with 60 mL sample holders with rods inside the water.
   19. PSS to Run
   20. Place dummy target in front of beamline exit window
   21. Verify beam profile and beam energy
   22. Deliver 1 kGy, 5 kGy, 10 kGy and 20 kGy to each target cell
   23. Shut off beam
   24. PSS to Open
   25. Retrieve rods from each target, measure dose and complete commissioning sheet
2. **Samples Irradiation**
   1. Fill each of the four target cells with DI water with 10 g/L 1,4-dioxane.
   2. Tape 2 dosimeter rods at the front at the outer most positions from commissioning.
   3. The 5th target is the solid aluminum dummy target with X-ray screen.
   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.
   5. Retrieve the samples, fill the VOA vials with the irradiated samples.
   6. Thoroughly rinse each target cell with DI water and wipe dry with nitrogen gun.
   7. Fill each of the four target cells with DI water with 100 g/L 1,4-dioxane.
   8. Follow steps 2.2 to 2.6
   9. Fill each of the four target cells with secondary effluent water with 10 g/L 1,4-dioxane.
   10. Follow steps 2.2 to 2.6
   11. Fill each of the four target cells with secondary effluent water with 100 g/L 1,4-dioxane.
   12. Follow steps 2.2 to 2.6.
   13. Fill one target cell with DI water with 10 g/L 1,4-dioxane, one with DI water with 100, g/L 1,4-dioxane, one with secondary effluent water with 10 g/L 1,4-dioxane and one with secondary effluent water with 100 g/L 1,4-dioxane.
   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 |