MEDICIS Board:
Tb155Productions @ Arronax in 2019

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Tilted target with graphite foils

3 Gd foils 25µm thickness between 2 graphite foils 500µm thickness in copper body

Water cooling

Graphite foils

Irradiation: JUL 02 2019
Proton beam 2h30– E=55MeV – 20µA– 50 µA*h integrated

No change in gadolinium foil aspect
No change in graphite foil aspect

Target used for Tb 155 production
Two irradiations and shipping to CERN

JUL 30 2019 and AUG 27 2019

Gd in MEDICIS #671 M Re target and shipping to CERN

Gd in MEDICIS #645 M W target and shipping to CERN
Produced Activities

Good estimations of Tb 153, Tb 155, Tb 156 production with MCNPX in our conditions

<table>
<thead>
<tr>
<th>Radionuclide</th>
<th>Half-life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tb151</td>
<td>17.6 h</td>
</tr>
<tr>
<td>Tb152</td>
<td>17.5 h</td>
</tr>
<tr>
<td>Tb153</td>
<td>2.34 j</td>
</tr>
<tr>
<td>Tb154</td>
<td>21  h</td>
</tr>
<tr>
<td>Tb155</td>
<td>5.32 j</td>
</tr>
<tr>
<td>Tb156</td>
<td>5.35 j</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Radionuclides</th>
<th>Tb153</th>
<th>Tb155</th>
<th>Tb156</th>
</tr>
</thead>
<tbody>
<tr>
<td>Produced activities in MBq</td>
<td>228</td>
<td>154</td>
<td>79</td>
</tr>
</tbody>
</table>
Dose rate values

EOB + 3 days:
package shipping

Mean dose rate value at contact \(\sim 1\) mSV/h

maximum authorized value for shipping 2 mSV/h
Conclusion

- Production of 150 MBq of Tb 155 at ARRONAX and shipping to CERN
- Dose rate value at contact of the package around 1mSV/h
- The activity can be multiply by two in the current setup
- Separation Gd/Tb in progress
Gd/Tb separation

Separation done after dissolution of the irradiated target, solution S0 with aim:

![Tb and Gd symbols](image)

- LN (TRISKEM) resin washed with UP water + HNO₃ 8M
- conditioning with HNO₃ 0.75M at 1mL/min
- S0 in head column
- Rinsing of beaker: 2*1mL HNO₃ 0.75M
- Rinsing of the column: 8*1mL HNO₃ 0.75M
- Rinsing of the column: 30*1mL HNO₃ 2M
Gd/Tb separation

Possibility to separate 90% of the Gd from the solution

Repeating the elution 4 fold to reach 1: 100 (Tb: Gd)

Optimization of the protocol ongoing
Possibility to really increase activity by shipping solution after radiochemistry in a vial inside a lead container and type A package.
Five irradiations @ ARRONAX

• Irradiation n°1 : 06 MAI 2019 EOB 15h15
  • Proton beam - 4h47– E=35MeV – 50µA – 250.52µA*h integrated
  • Target : 3 Gd foils of 25µm thickness+ aluminium 2mm + in stainless steel cap
• Irradiation n°2 : 28 MAI 2019 EOB 10h13
  • Proton beam – 15 mn– E=60MeV – 20µA– 5µA*h integrated
  • Target : 3 Gd foils of 25µm thickness between two copper plates in 15 ° tilted rabbit IBA12
• Irradiation n°3 : 02 JUL 2019 EOB 15h55
  • Proton beam – 2h30– E=55MeV – 20µA– 43.03µA*h integrated
  • Target : 3 Gd foils 25µm thickness between two graphite foils of 500 µm thickness in copper plates into 15 ° tilted rabbit IBA12
• Irradiation n°4 : 30 JUL 2019 EOB 16h58 - IBA12 en P3
  • Proton beam 7h – E=55MeV – 10µA– 70.20µA*h integrated
  • Target : 3 Gd foils 25µm thickness between two graphite foils of 500 µm thickness in copper plates into 15 ° tilted rabbit IBA12
• Irradiation n°5 : 27 AOU 2019 EOB 15h47 – IBA12 en P3
  • Proton beam 7h – E=55MeV – 10µA– 70.20µA*h integrated
  • Target : 3 Gd foils 25µm thickness between two graphite foils of 500 µm thickness in copper plates into 15 ° tilted rabbit IBA12
Target improvement

1\textsuperscript{st} irradiation has been done with encapsulated Gd foils
Cooling issue with this system

Irradiation: MAY 06 2019

Proton beam 5h– E=35MeV – 50µA on target – 250  µA*h integrated

Window deformation
Bad thermal contact
Melting of the target
New design with tilted target

Second irradiation with Gd foils in copper body

Water cooling

Irradiation: MAY 28 2019 proton beam 15mn – E=60MeV – 20µA sur cible – 5µA*h integrated

- White traces on Gd: redox reactions under beam between Cu and Gd?

→ Addition of a graphite sheet between Gd and Cu to avoid interaction.