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# Preliminary Shielding Design Results for Sr-82/Rb-82 Generator Prototype Development

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## INTRODUCTION

Sr-82/Rb-82 generators have been widely used for the cardiac disease diagnostics using PET (Positron Emission Tomography) in the world. To meet increased worldwide demands, many large accelerator-based RI production facilities, such as IPF (Isotope Production Facility) of LANL (Los Alamos National Laboratory, USA) [1] and BLIP (Brookhaven Linac Isotope Producer) of BNL (Brookhaven National Laboratory, USA) [2], have been producing Sr-82. For the Sr-82/Rb-82 generator, two commercial generator products, CardioGen-82 [3] and Ruby-Fill [4] are supplied by Bracco Imaging and Jubilant Radiopharma.
The KOMAC (Korea Multi-Purpose Accelerator Complex) of KAERI (Korea Atomic Energy Research Institute) has been developing the Sr-82 production technology using the 100-MeV proton linear accelerator of the KOMAC and a Sr-82/Rb-82 generator with small activity Sr-82 for the animal testing. In this paper, the preliminary shielding design results of Sr-82/Rb-82 generator prototype are described.

## DESIGN AND DEFINITION

### ❖ Specifications of Sr-82/Rb-82 Generator

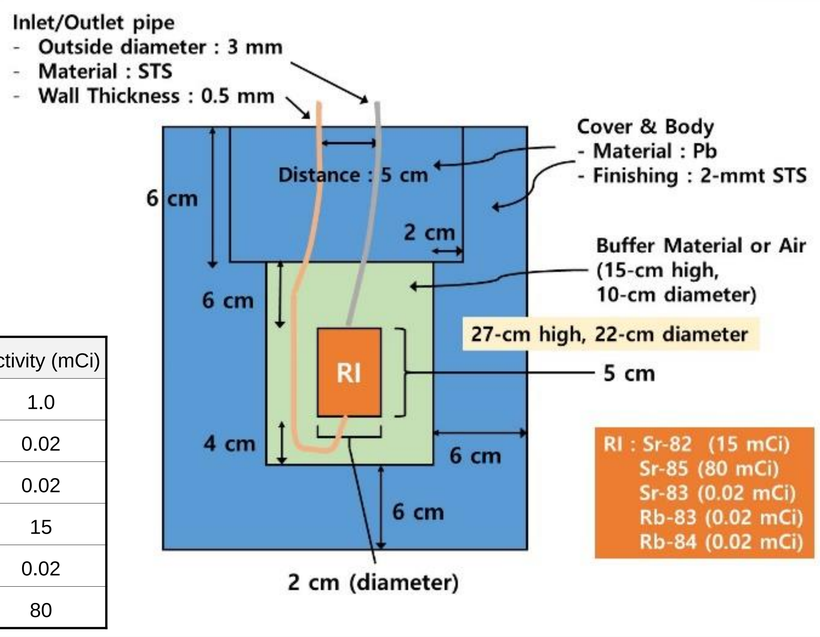
| Parameter | Commercial Products | KOMAC (Animal, Nonclinical) |
|---|---|---|
| - Sr-85/Sr-82 | ≤5 mCi/mCi | ≤10 mCi/mCi |
| - Sr-83/Sr-82 | ≤0.0015 mCi/mCi | ≤0.003 mCi/mCi |
| - Rb-83/Sr-82 | ≤0.0015 mCi/mCi | ≤0.003 mCi/mCi |
| - Rb-84/Sr-82 | ≤0.0015 mCi/mCi | ≤0.003 mCi/mCi |
| - Other Radionuclides | ≤0.01 | ≤0.05 |

### ❖ Source Definition for MCNP Code Simulation

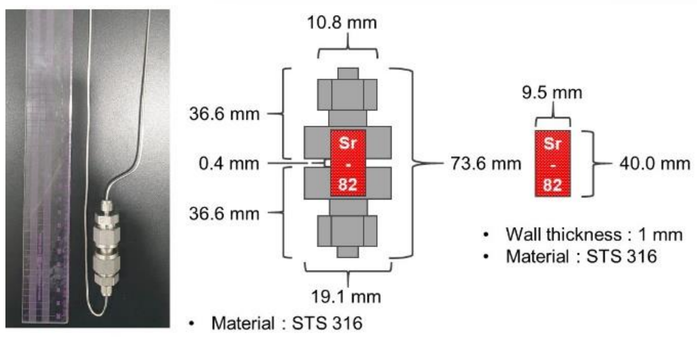
| Parameter | Sr-82 (BNL) | Sr-82 (KOMAC) |
|---|---|---|
| - Sr-82 | 100 mCi | 15 mCi |
| - Sr-85 | ≤500 mCi | ≤80 mCi |
| - Sr-83 | ≤0.15 mCi | ≤0.02 mCi |
| - Rb-82 | ≤0.15 mCi | ≤0.02 mCi |
| - Rb-84 | ≤0.15 mCi | ≤0.02 mCi |

| Isotope | Atomic Mass (u) | Half-life | Activity (mCi) |
|---|---|---|---|
| Rb-82 | 81.21449 | 1.2575m | 1.0 |
| Rb-83 | 82.20283 | 86.2d | 0.02 |
| Rb-84 | 83.19352 | 32.82d | 0.02 |
| Sr-82 | 81.21468 | 25.34d | 15 |
| Sr-83 | 82.20526 | 32.41h | 0.02 |
| Sr-85 | 84.18349 | 64.849d | 80 |

### ❖ Geometry of Sr-82/Rb-82 Generator for Calculation



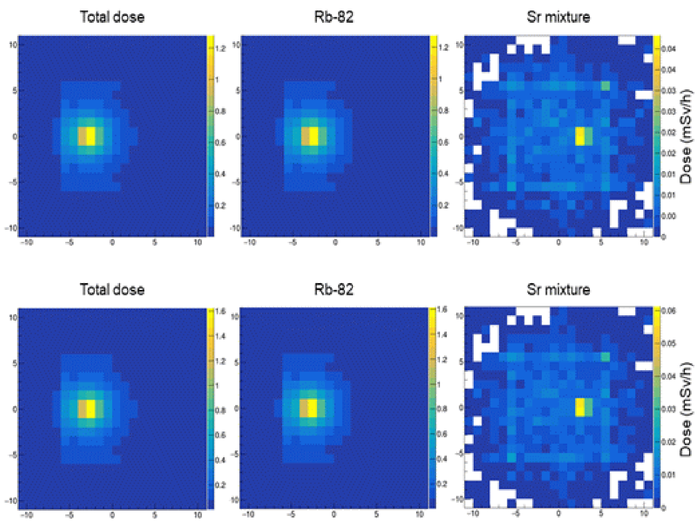

▪ **Column Loaded to Generator**

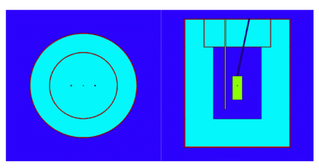



## RESULTS

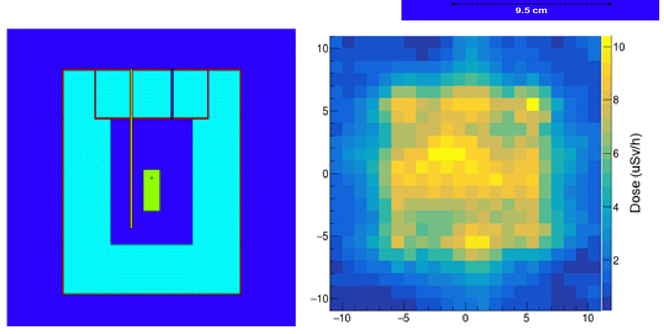
### ❖ MCNPX Calculation

▪ **The 1st Calculation Results**

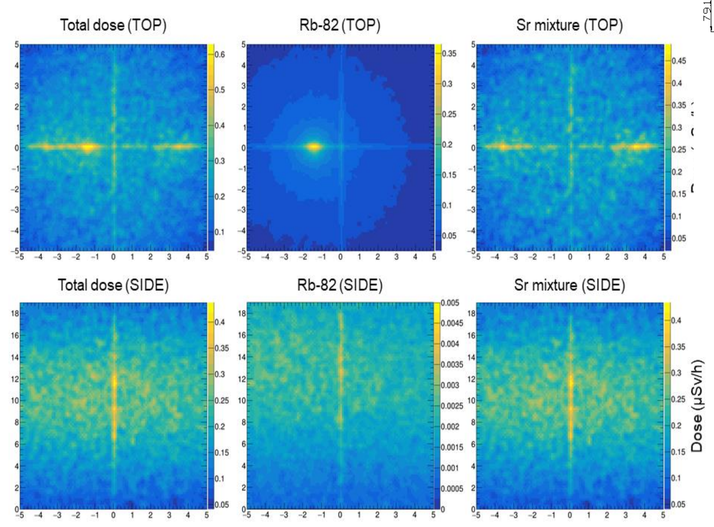


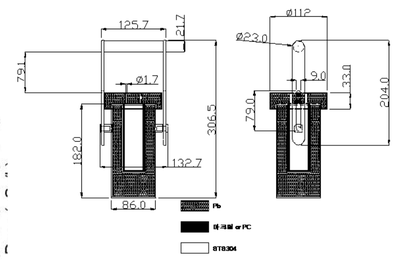
- **Inlet / outlet line routing**
- **Wall thickness optimization**

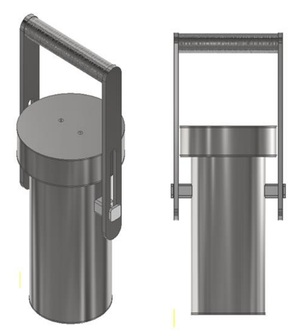



▪ **After Modification**




### ❖ Shielding Design



## SUMMRY

The preliminary shielding design and calculation of shielding capacity for Sr-82/Rb-82 generator prototype of KOMAC was performed. The 6 cm-thick lead shielding wall can shield the radiation from the column filled with Sr-82 and other radioisotope mixture too enough except the inlet pipe opening. The results told us that we have to be careful for the inlet pipe routing inside the generator. According to the regulations, the radiation dose 10 cm apart from the surface have to be less than 2 mSv/hr. So, we recalculate the shielding capacity with 3-cm Pb wall thickness. Reflecting the calculation results, the wall thickness reduced to 2.5 cm and additional plastic shielding was included in the final design.

## REFERENCES

[1] https://lansce.lanl.gov/facilities/ipf/index.php
[2] https://www.bnl.gov/BLIP/
[3] https://imaging.bracco.com/us-en/products/nuclear-medicine-radiopharmaceuticals/cardiogen-82.
[4] https://www.draximage.com/products/USA/ruby-fill-(rubidium-rb-82-generator)-and-elution-system.

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