3° Πανελλήνιο Συνέδριο
Ιατρικής Φυσικής

27° Διαπανεπιστημιακό Συνέδριο
Ακτινολογίας

Computational Dosimetry and Shielding Assessment of Liquid Radioactive Waste Tanks in Healthcare Facilities

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ΠΑΝΕΠΙΣΤΗΜΙΟ ΘΕΣΣΑΛΙΑΣ
ΣΧΟΛΗ ΕΠΙΣΤΗΜΩΝ ΥΓΕΙΑΣ
- ΤΜΗΜΑ ΙΑΤΡΙΚΗΣ, ΛΑΡΙΣΑ

Οργάνωση

ΕΦΙΕ
Ένωση Φυσικών Ιατρικής Ελλάδος

ΕΛΛΗΝΙΚΟ ΚΟΛΛΕΓΙΟ ΑΚΤΙΝΟΛΟΓΙΑΣ

Introduction

Hazard Source

Healthcare activities generate low-to-medium level radioactive liquid waste, primarily from patient excreta and radiopharmaceutical preparation.

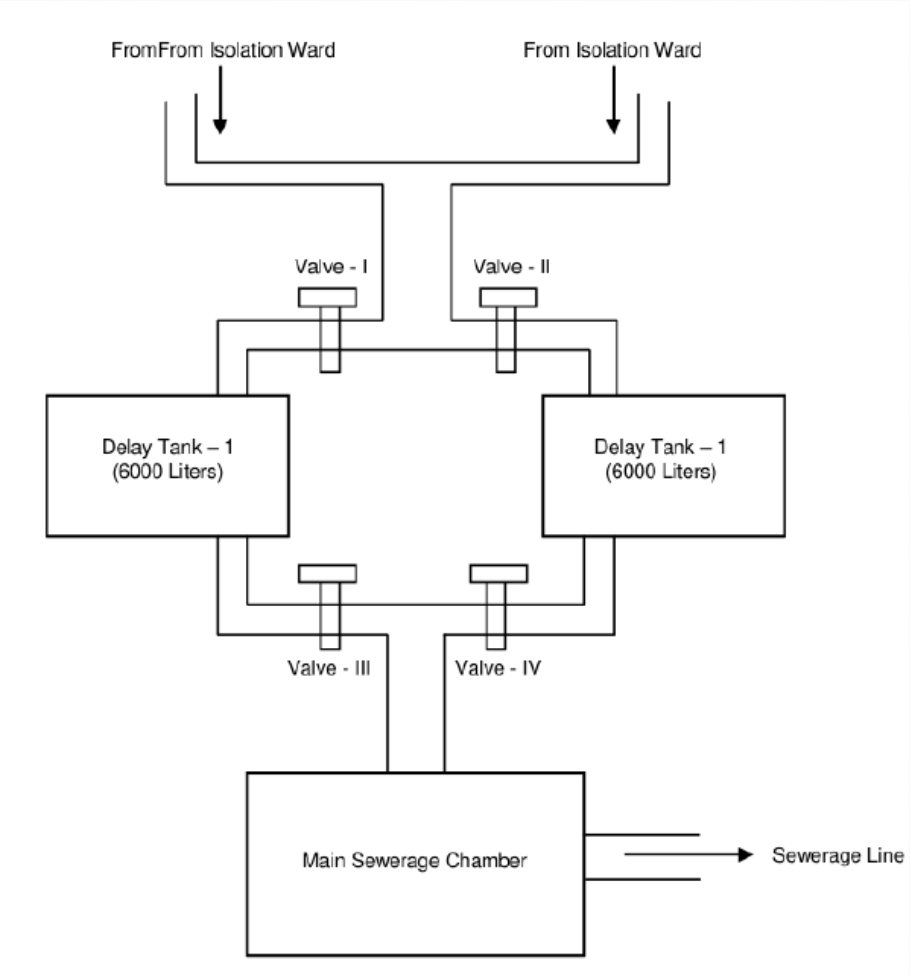
The Safety Gap

Handling and storage risks arise from inadequate shielding or record keeping. Regulatory limits require specific activity levels before discharge.

Research Goal

To investigate how different shielding materials and tank parameters (geometry, volume) affect dose rates in healthcare environments.

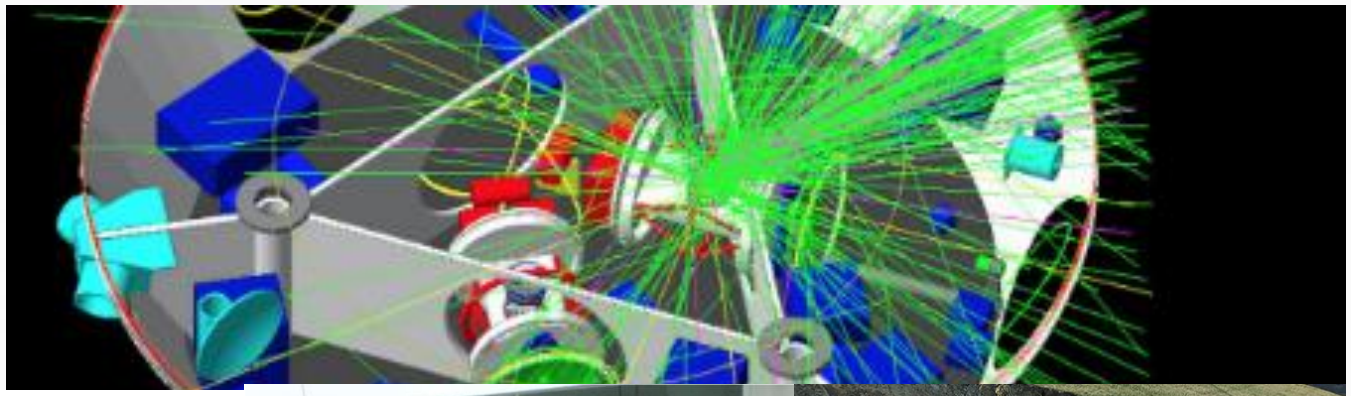
Delay tank system in a hospital



Materials & Methods

GEANT4 Framework

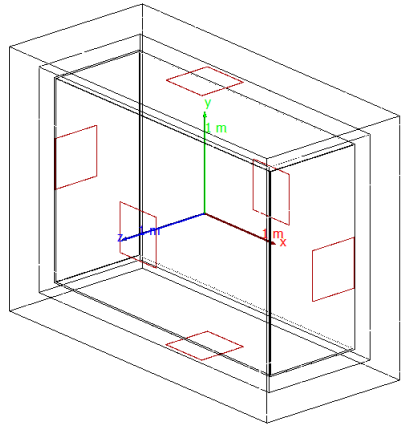
- Monte Carlo Simulations (10^8 events)
- QBBC Physics List & G4RadioactiveDecay
- Exact calculations of build-up factors
- Geometry: Parallelepiped & Cylindrical ($6m^3$ / $8m^3$)
- Different filling rates based on real data from hospitals
- Materials: Lead - Pb, Concrete, Stainless Steel, PVC, Air (different combinations and thicknesses)
- Radioactive waste isotopes: I-131 & Lu-177 (seperate or mixed 85%-15%)

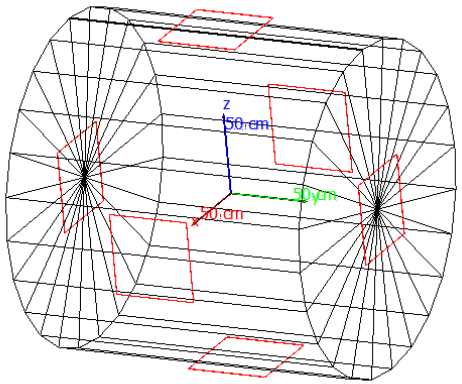












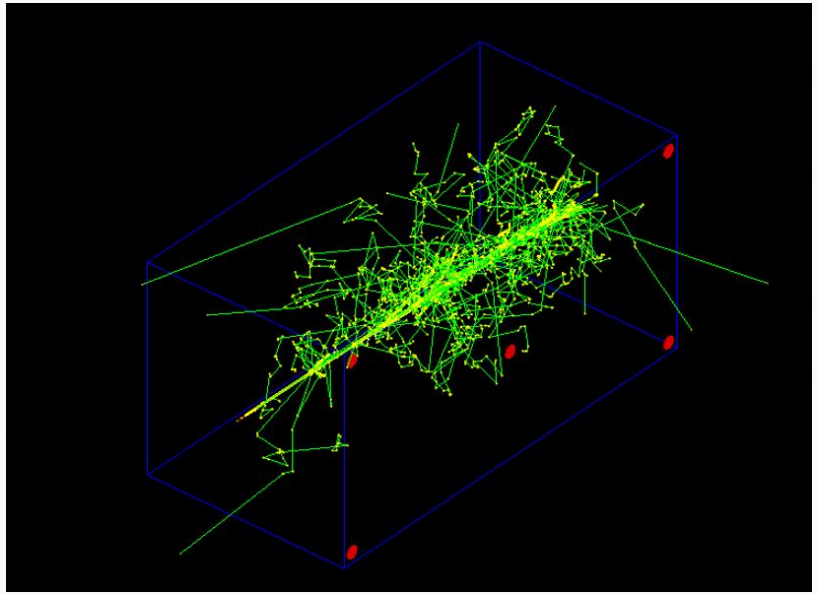
Results

1.5cm
Optimal Lead (Mixed sources)

19.0cm
Optimal Concrete (Mixed sources)

85%
Contribution of I-131 in dose

Geometry and flow dynamics significantly alter dose rate progression over time.



Dynamic relation of Dose with Filling Rate & Volume

Reduced 19%: In maximum Dose Rate when volume was expanded by $2m^3$.

Dose Rate: Reducing filling rate (from 100L to 40L) extends storing time, by increasing stacked activity of radioactive waste.

Conclusions

Shielding

Lead (1.5cm) or Concrete (19cm) identified as optimal for medical facilities.

Geometry

Cylindrical tanks exhibit complex filling dynamics. By changing the volume and the fill rate the dose rate change dramatically based on the new properties.

Optimization

Mix of I-131/Lu-177 requires 15% thicker shielding.

Automation

Basis for automated shielding parameter algorithms.

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