X-Ray technical talks:

A measured comparison of Cobalt to X-Ray solutions

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CIRMS 2026 — Need

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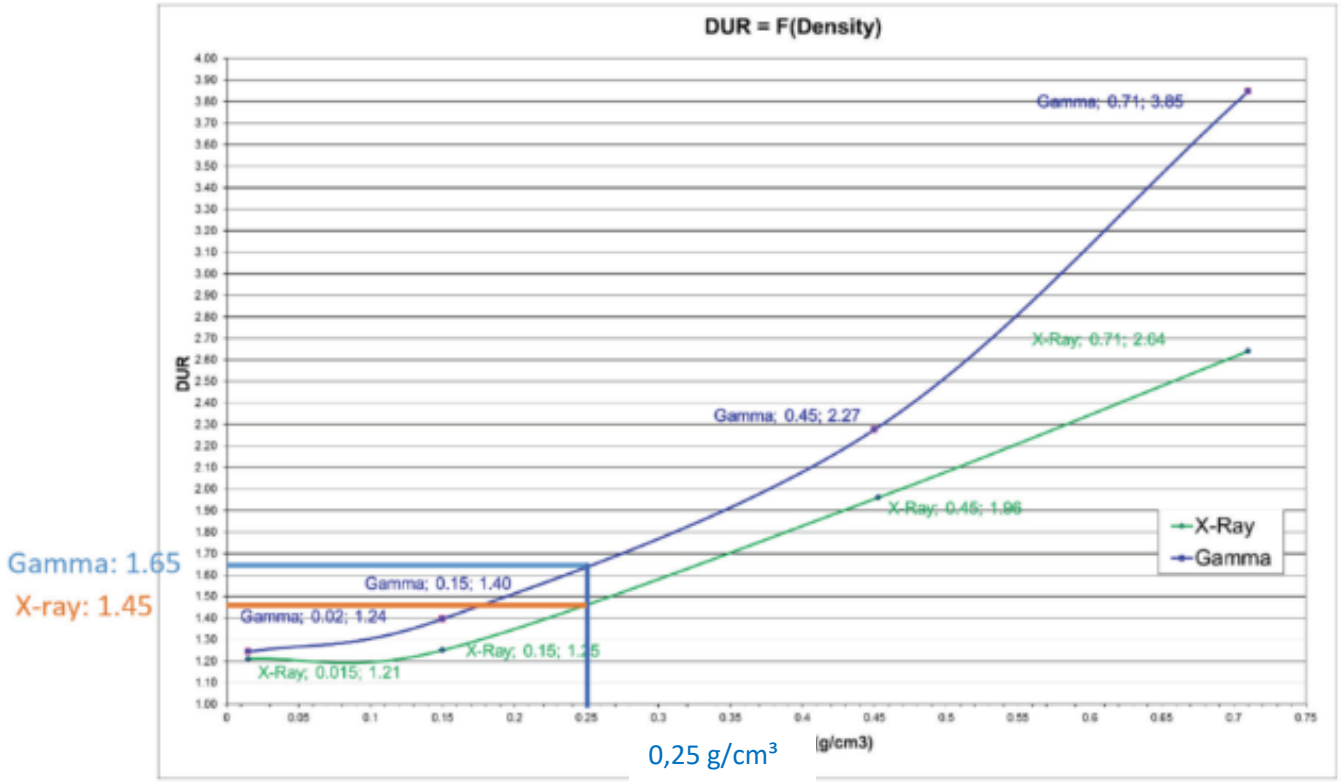
Progress in **X-ray radiation acceptance** is currently blocked because we lack **sufficient public data points**, which prevents **adoption of multiple irradiation modalities**.

Context of limited shared data

- Very few data compares Cobalt & X-ray's performances



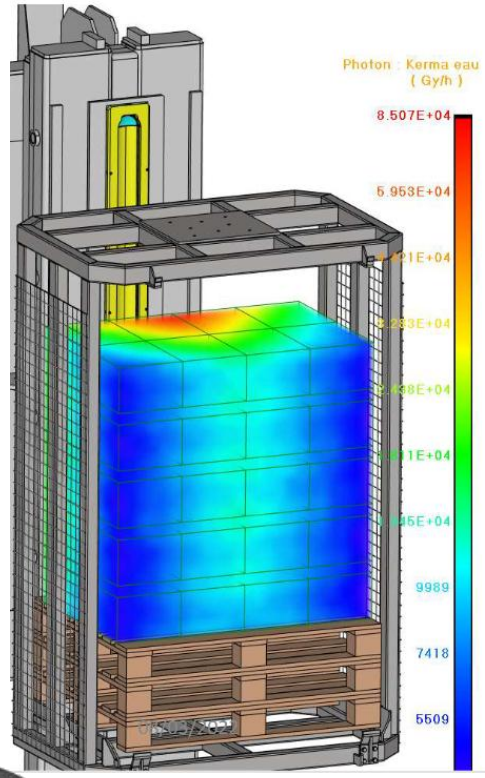
- Comparison by STERIS
- Däniken X-ray to Gamma pallet irradiator
- Limited to DUR comparison
- Published in AAMI journal[1]

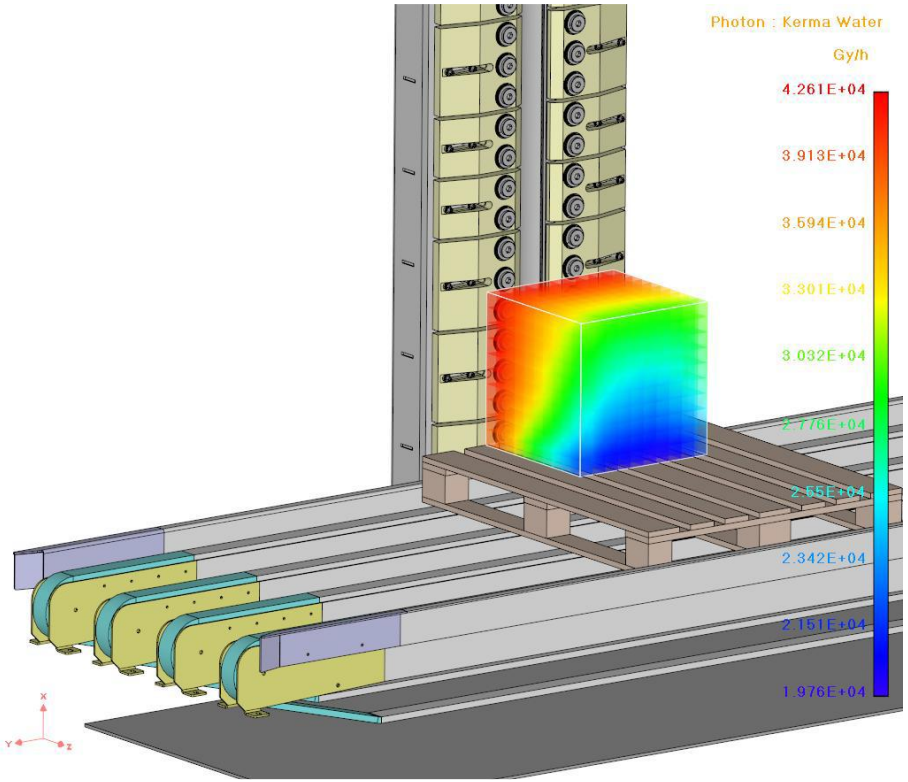
- Objective: Provide additional comparison ➔ Cobalt irradiator vs. IBA X-ray system.

Council on Ionizing Radiation Measurements & Standards

1. AAMI 2020, "X-ray : An effective Photon", B. McEvoy and all

Monte Carlo Simulations





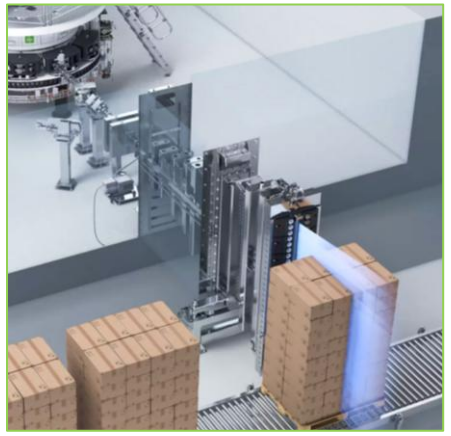
RayXpert

TRAD Tests & radiations a HEICO company

Data Collection

What we have done in lieu of public data:

- Monte Carlo Simulations
  - Simulation of X-ray solutions
  - Constraints of variables to help make apples to apples comparison
    - Method of conveyance (pallet conveyor)
    - Modeling of generic medical products
      - Product density
      - Product dimensions
      - Minimum dose required
- Calculated
  - Dose uniformity ratios (DUR)
  - Throughputs



X-Ray solutions with pallet processing

Double Level Pallet Conveyor

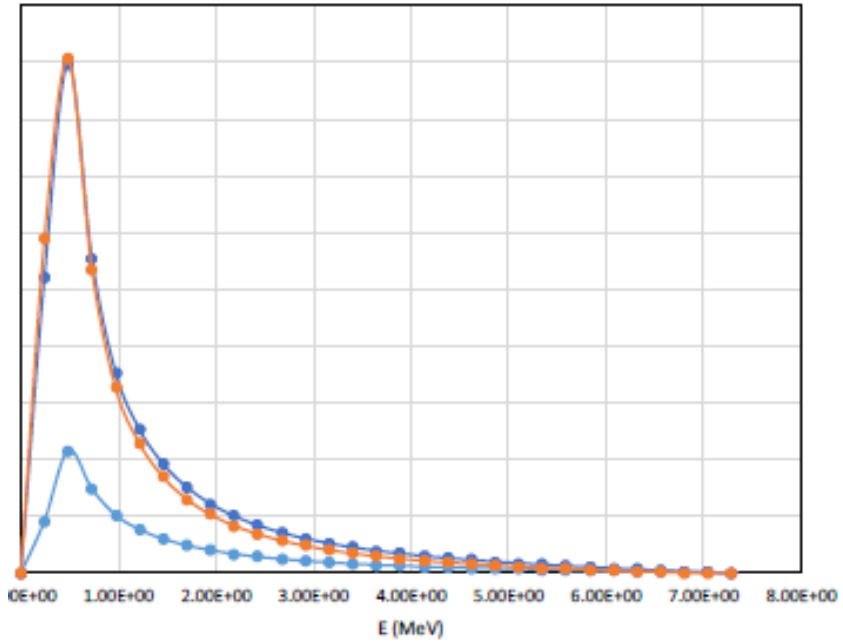
Parameters

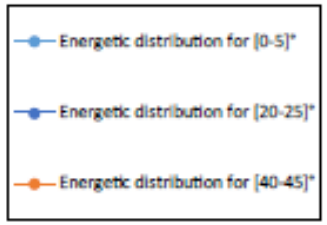
X-Ray solutions

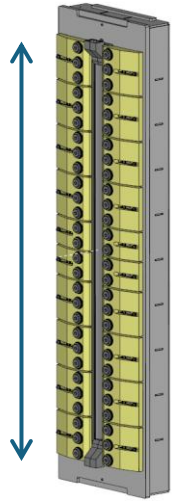
What X-ray parameters did we use for this comparison?

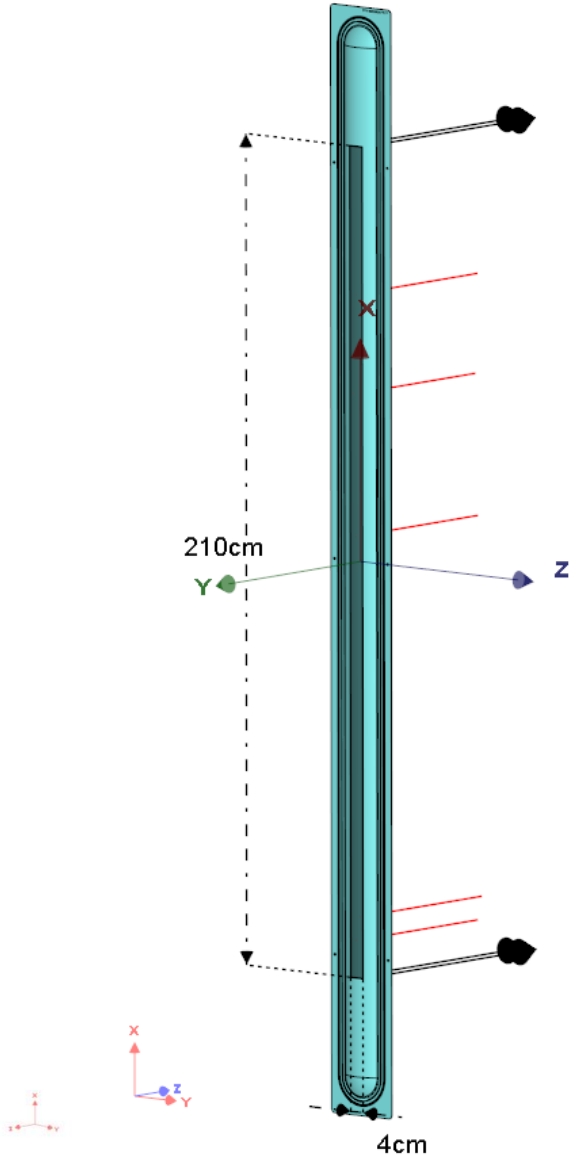
Beam source

- Extended source:
  - 2.1m x 4 cm
  - Energy-angle X-ray spectra computed using real X-ray horn geometry
  - Primary electron beam: 7.3 MeV, 80 mA





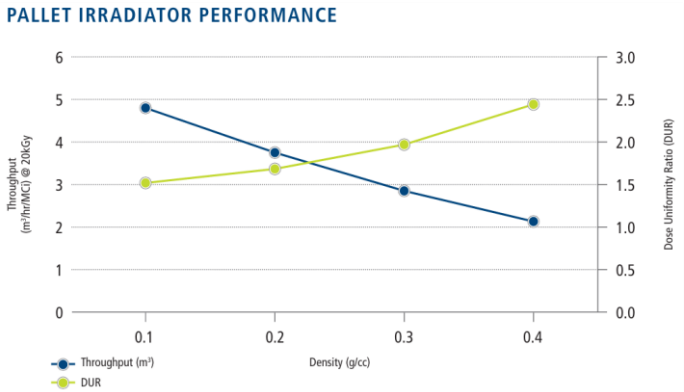


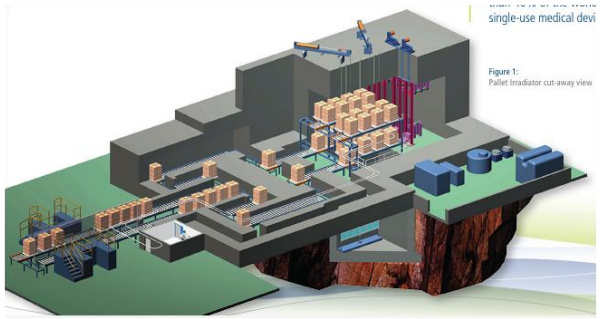


Method

Parallel Row Pallet Cobalt Irradiator:

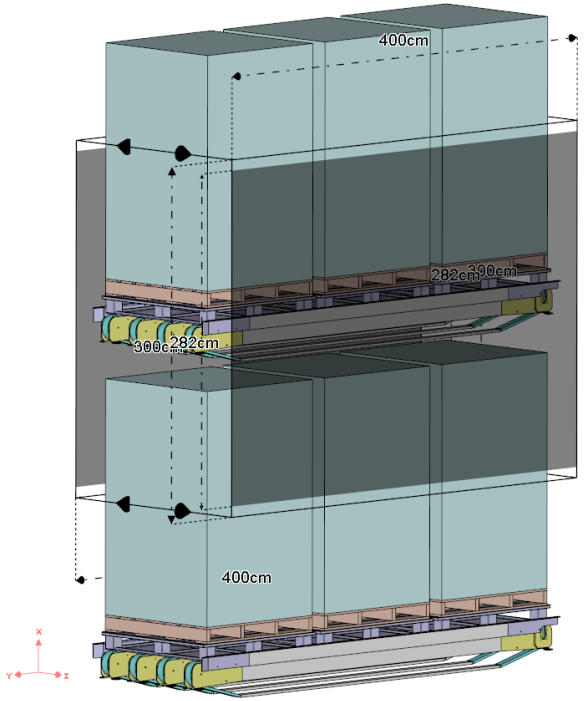
- 2-level roller conveyor
- Product : 48” x 48” x 72”, 0.1-0.4 g/cm³
- Performances from data sheet





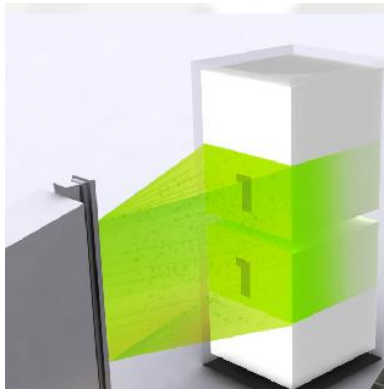
IBA X-ray solution:

- 2-level roller conveyors
- Product : 48” x 48” x 72”, 0.1-0.4 g/cm³
- Performances computed via Monte Carlo simulation (RayXpert)

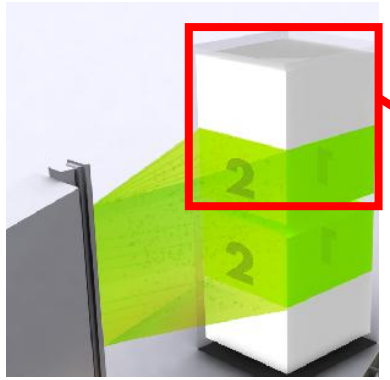


Vertical Beam Scanning: Product Overlapping (1)

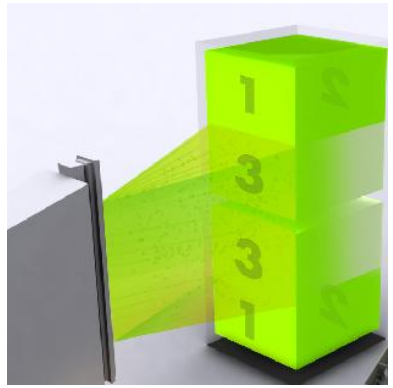
- To obtain a good dose uniformity along vertical axis, use product overlapping with 2 levels of product ➔ 4 passes process.



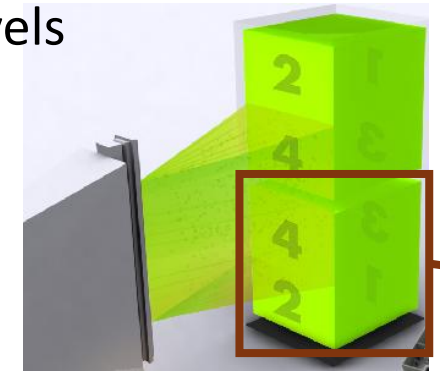
180° rotation



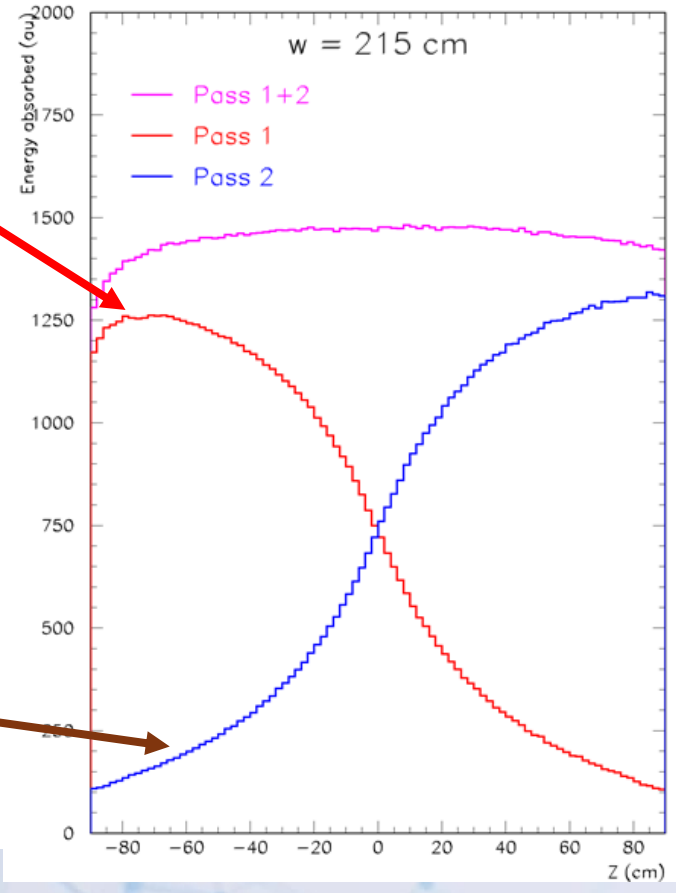
Swap upper and lower levels



180° rotation

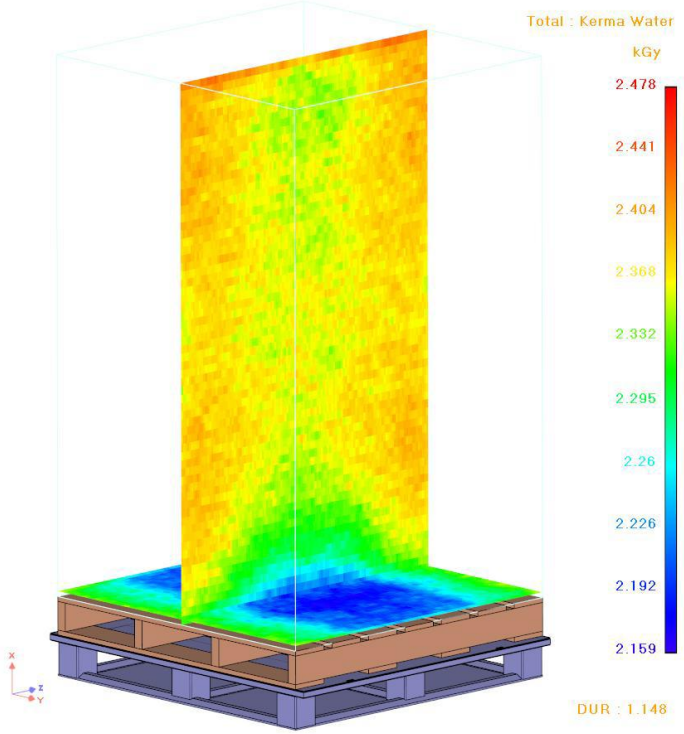


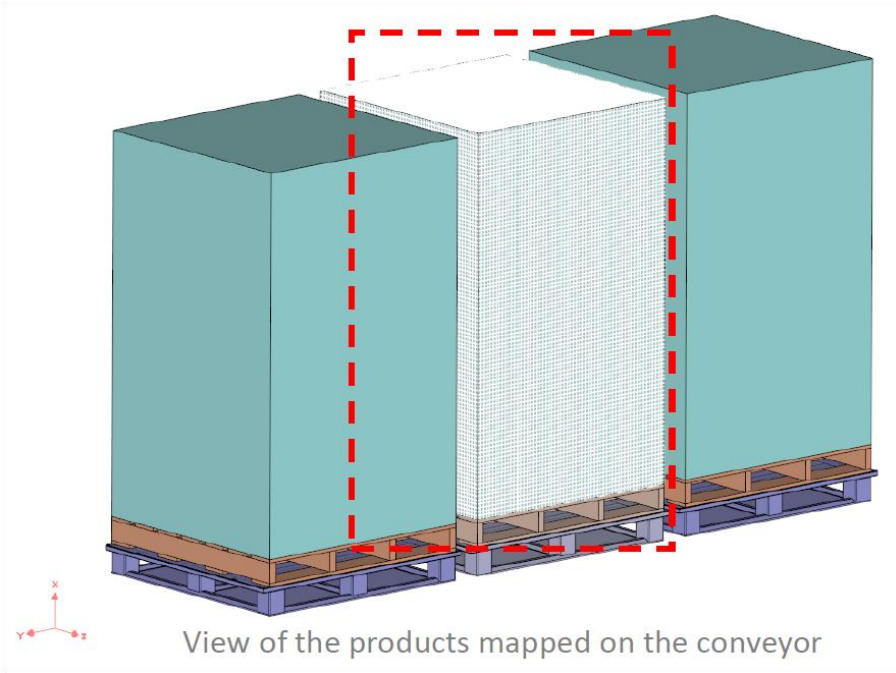
Pallet Height = 180 cm



Results

- Kerma water mesh computed in central product, 3D mesh (3 x 3 x 1 cm^3)
- Two-side irradiation with two levels produces a very uniform DUR as seen from the image

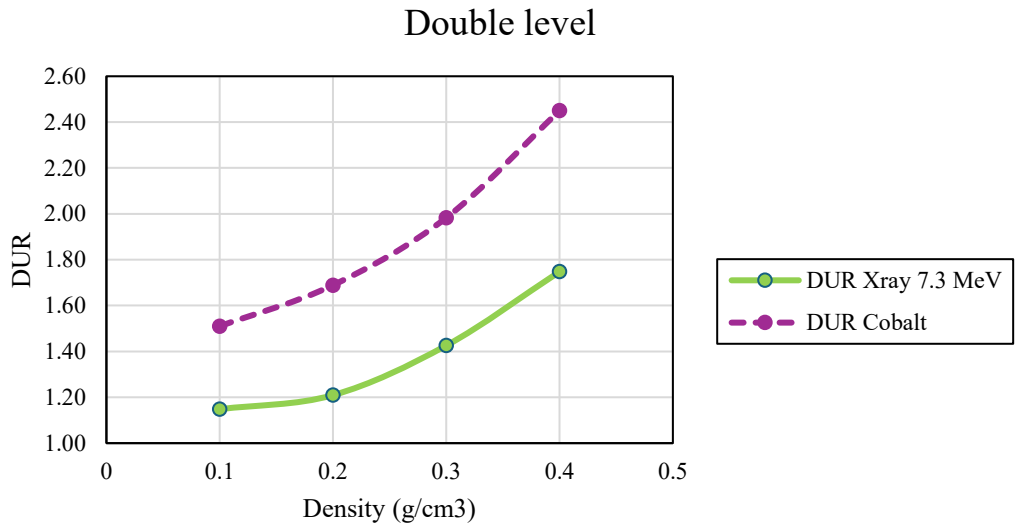




View of the products mapped on the conveyor

DUR Comparison

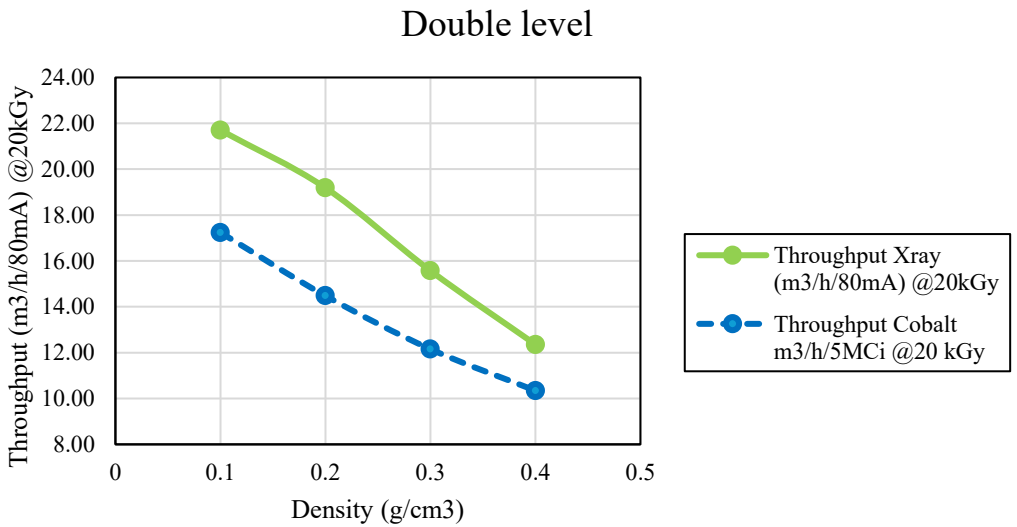
DUR



- 7.3 MeV, 80 mA X-ray solution provides better DUR than 5 MCi Cobalt pallet irradiator.
- The DUR is better for any density. The discrepancies of the DUR range from -12.8% for low density to -21.0% for high density.

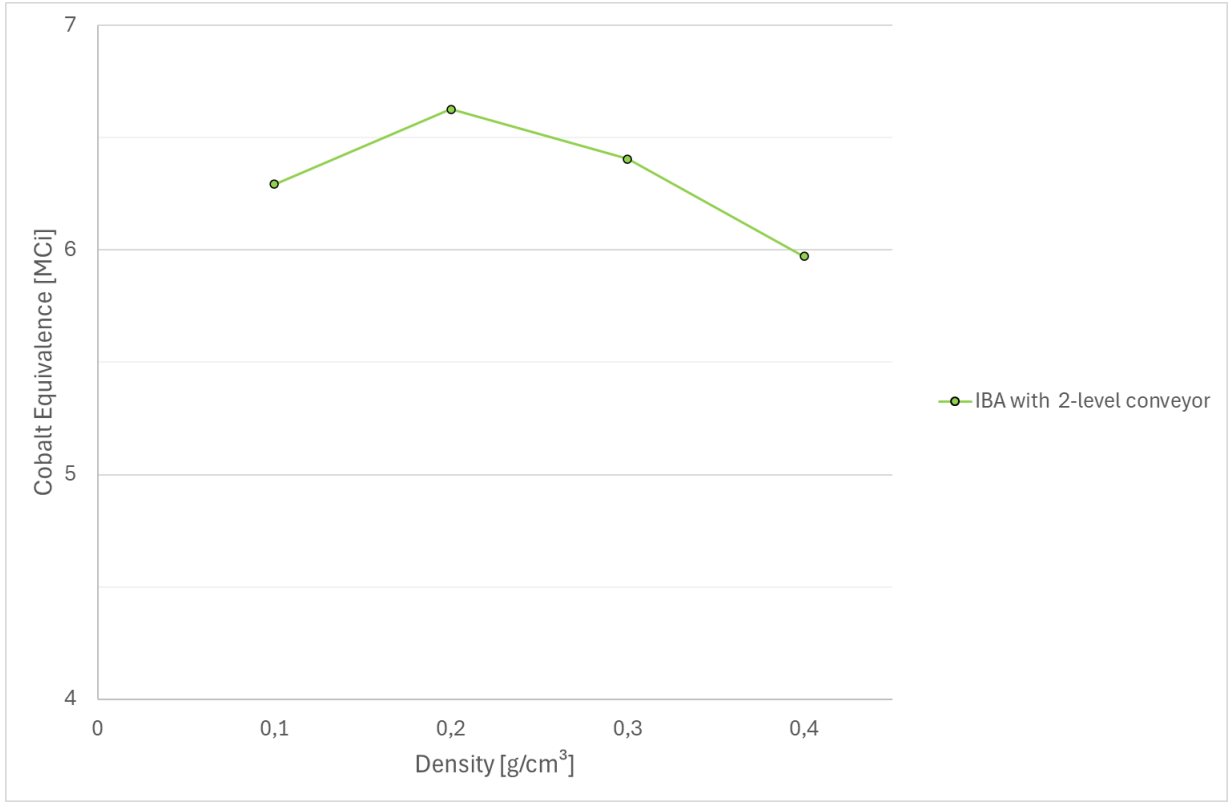
Performance Comparison

Throughput (20 kGy – 80 mA / 5 MCi)



- 7.3 MeV, 80 mA X-ray solution provides better throughput than a 5 MCi Cobalt pallet irradiator
- The throughput value for this configuration is better for any density. The increase on the throughput ranges from 15.9%for high density to 28.6% for low density.

Performance Comparison



➢ Need more than 6 MCi to reach similar performance as a 7.3 MeV, 80 mA X-ray irradiator.

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Conclusion

- A High-power X-ray irradiator provides a superior DUR to a Cobalt pallet irradiator
- A High-power X-ray irradiator provides a higher throughput when compared to a 5 MCi Cobalt pallet irradiator
- We need more community X-ray performance data

X-Ray technical talks series

Thank you!