Process Equipment Imaging by Tomographic Gamma Scan

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Project members

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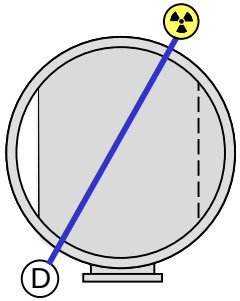
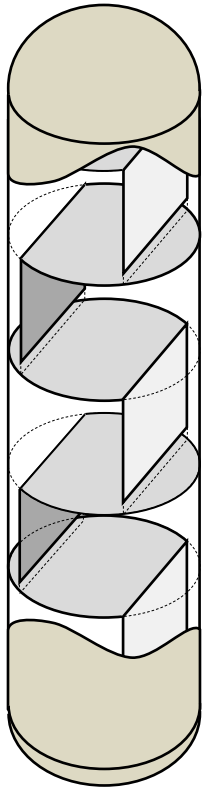
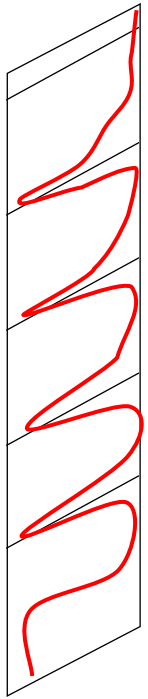
Background : gammascaning







… besides new developments

1D density profile

Knowledge, skills and talent …

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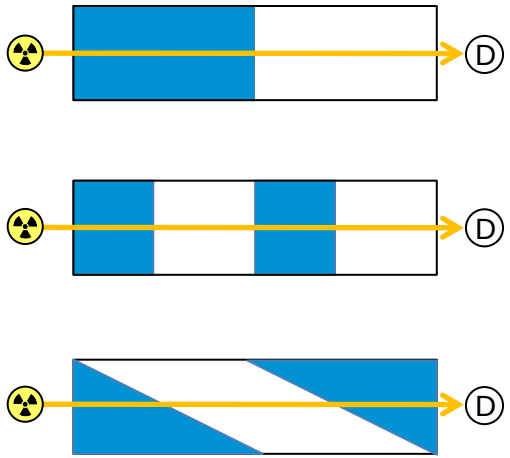
1D ?



Same counts

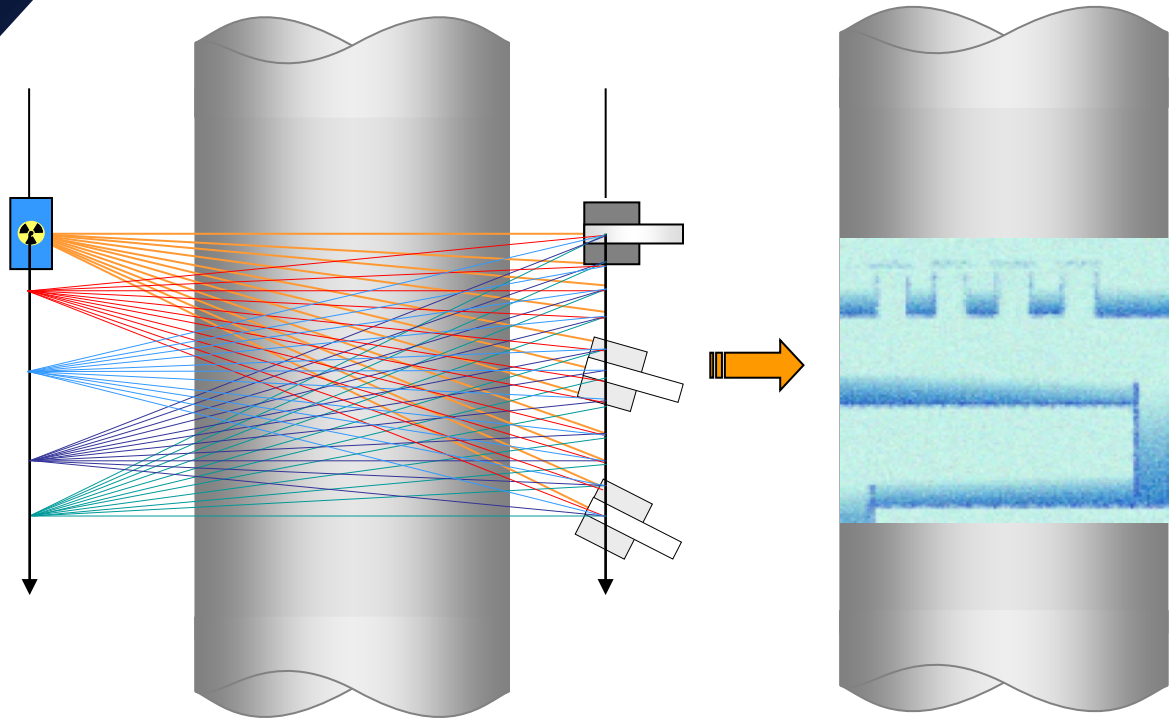
- Mean density values
- Carries no information about horizontal distribution

Gammascanning challenges

- Liquid Distribution
- MD trays
- “Dry” internals (demister chicanes,…)
- Unusual shaped equipments and internals

Master of Science Project

2010-2013



2D density vertical profile

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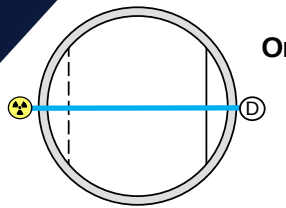
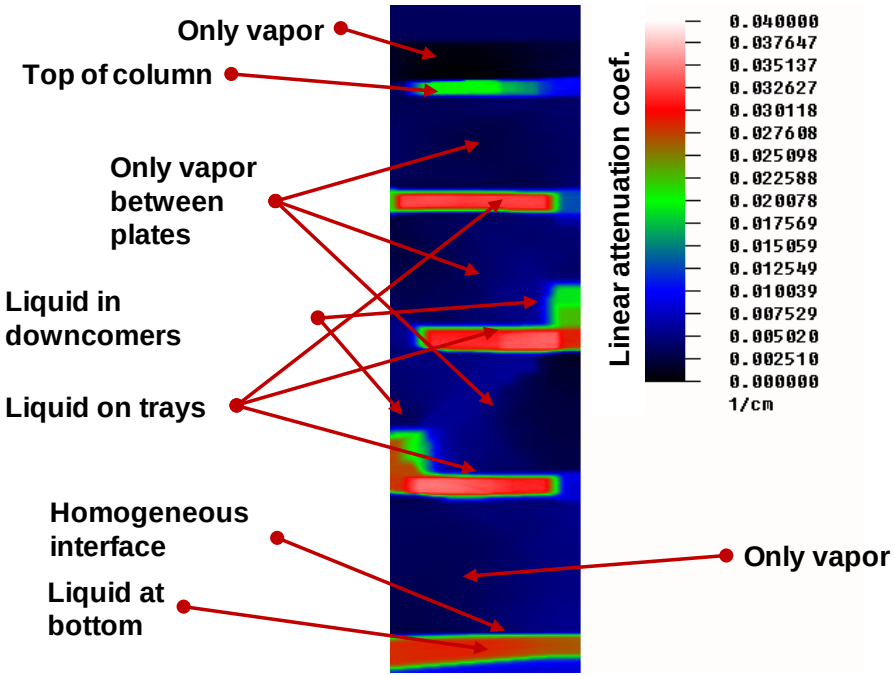
Trayed Column



Scan Orientation



2 in detector / 2 in steps / 1388 pos

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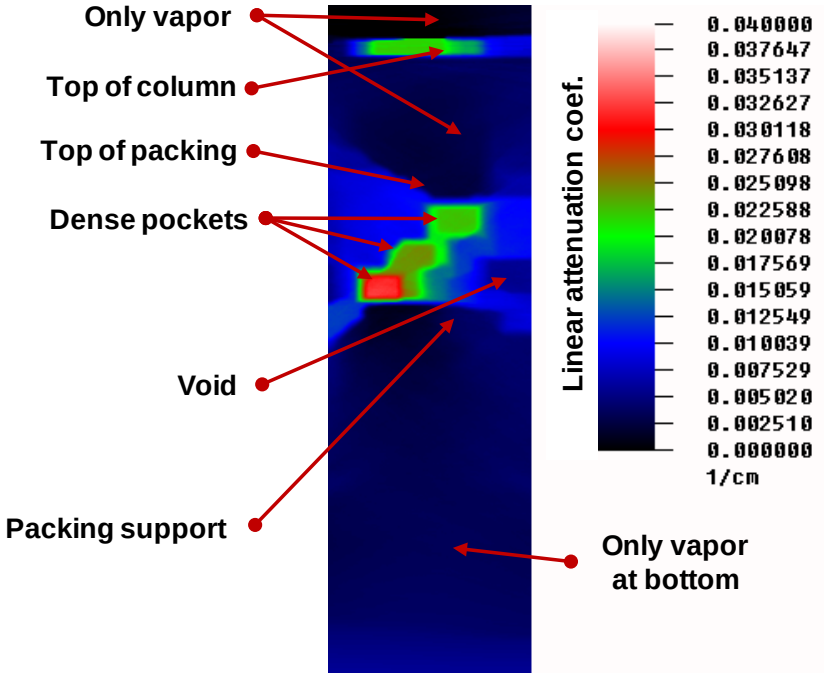
Packed column



2 in detector / 2 in steps / 1286 pos

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PhD Thesis

2015-2018

Goal : apply the new technique on real field conditions

Started with a lot of challenges and ideas:

- Positioning hardware
- Automation
- Radiation detection system
- Data acquisition software

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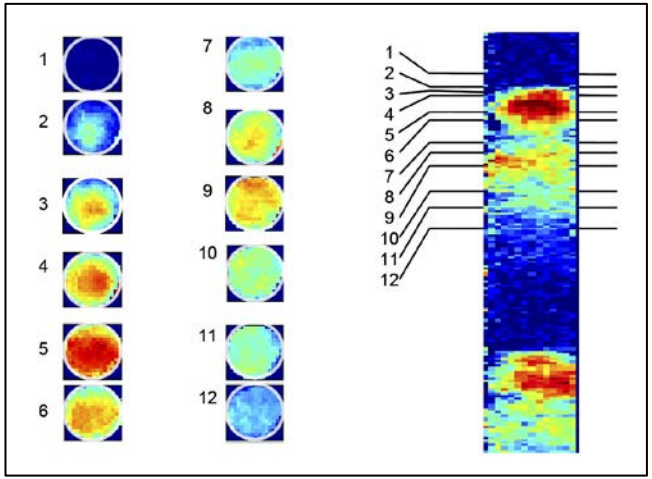
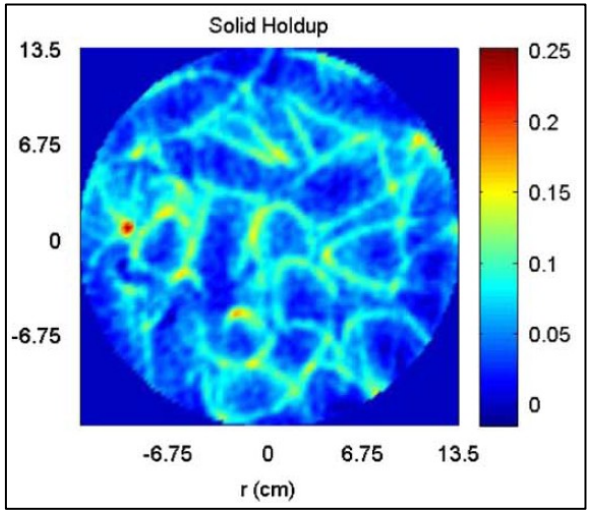
Research industrial tomography

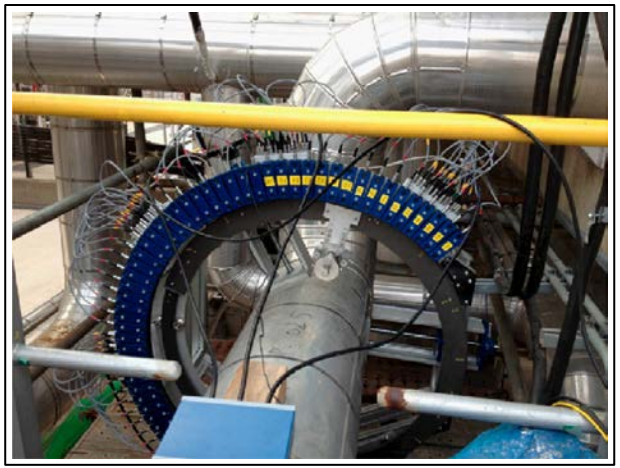
High accuracy and complexity

Norway project, 2013





Brazil project, 2009



Korea project, 2012

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Field equipment requirements

Transition to field is not straight forward

- Simple
- Versatile
- Light
- Easy usage and maintenance
- Robust
- Autonomous
- Few on-site requirements

Keep it simple

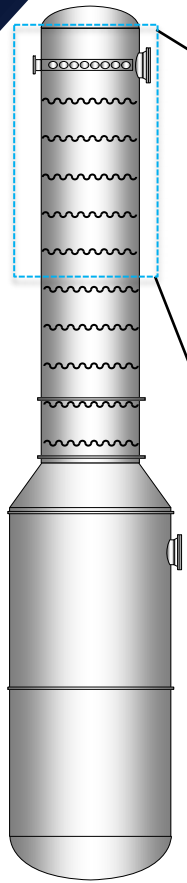
Focus on main objective

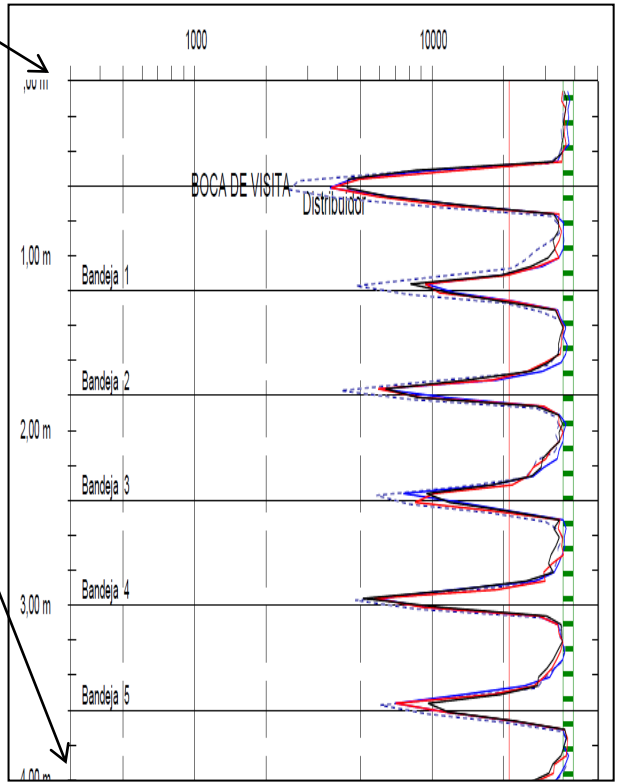
Is it possible to use a standard gamma scan equipment to collect the data needed for a tomographic gamma scan?

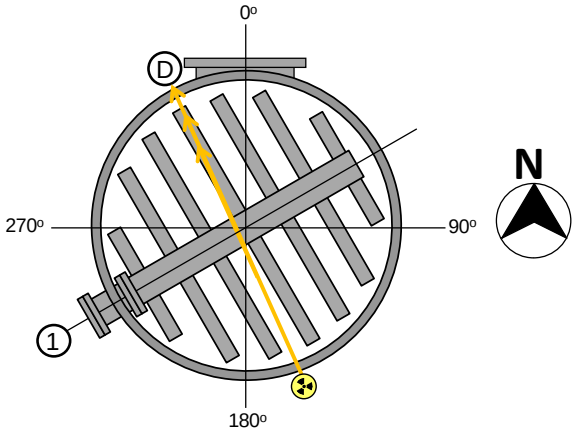
Answer : Yes !

- Review of gamma scan principles
  - ❑ New working procedures
  - ❑ Adapt equipment and software
  - ❑ Very low investment spent
- Patent Pending

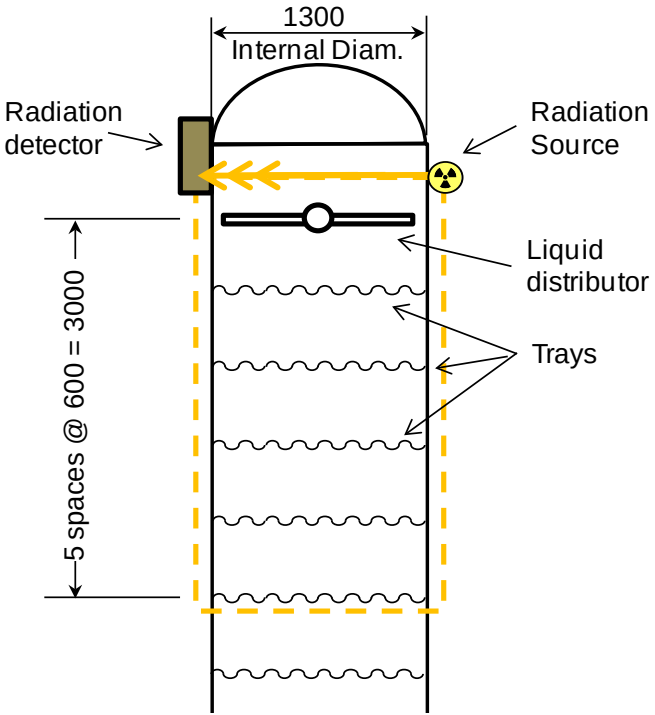
Case 1 – Ripple tray column

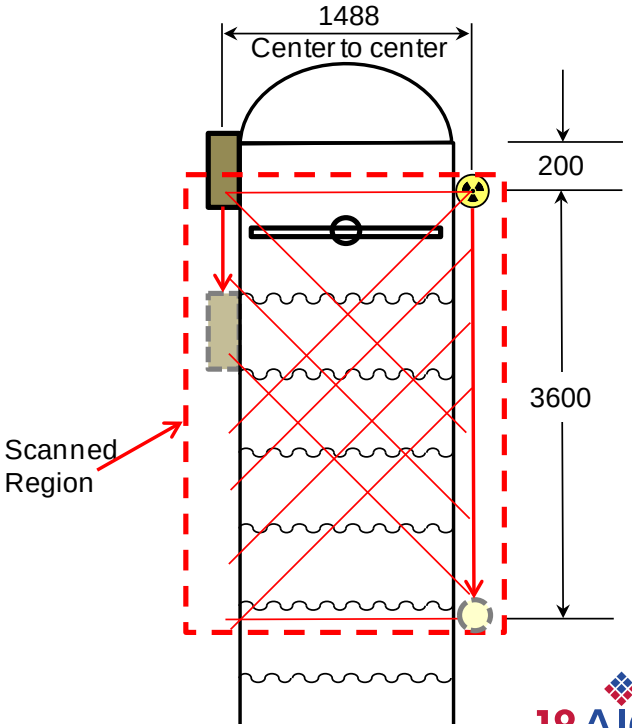






Scanned region





6,8 mCi Co-60

Results

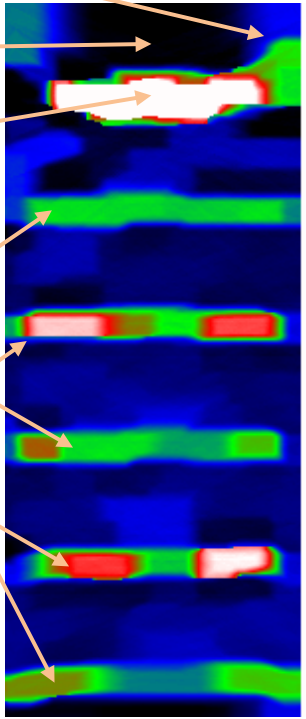
Manway Interference

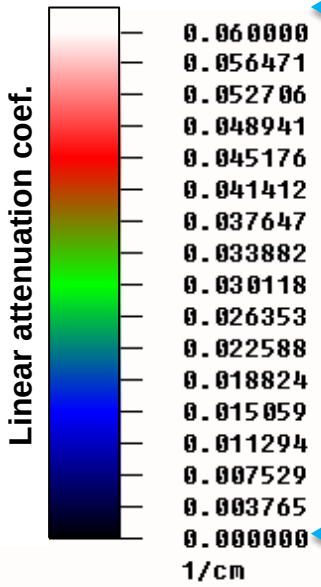
Only vapor

Symmetric distributor

Odd “lighter” trays

Even “denser” trays





Steel
7,8 g/cm^3
μ=0,419908 1/cm

Water
1,0 g/cm^3
μ=0,063162 1/cm

Air
0,001205 g/cm^3
μ=0,000068 1/cm

908 pos / 2 h scan time

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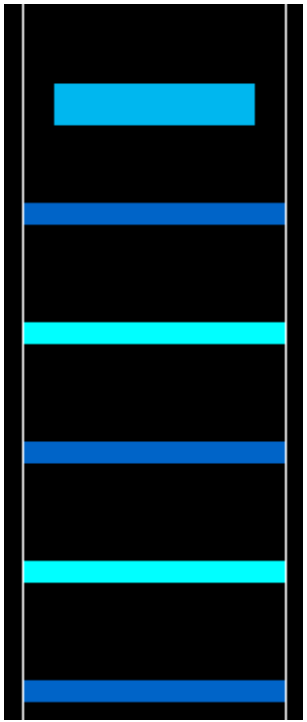
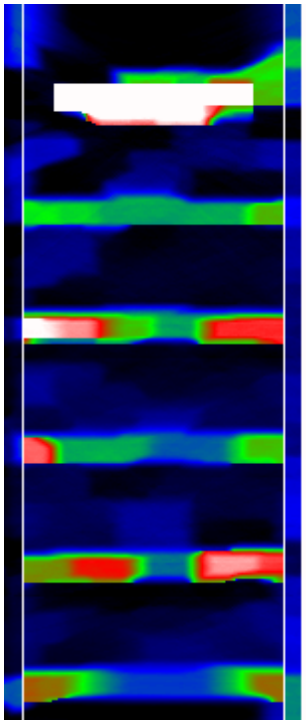
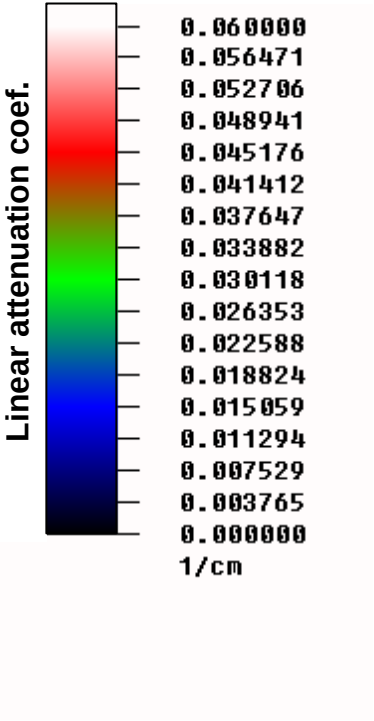
A priori image improvement



Proposed solution



Resulted image



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Project status

More investigations

- Obtain image at different planes
- Images at different operational conditions
- Conventional tomography at different trays

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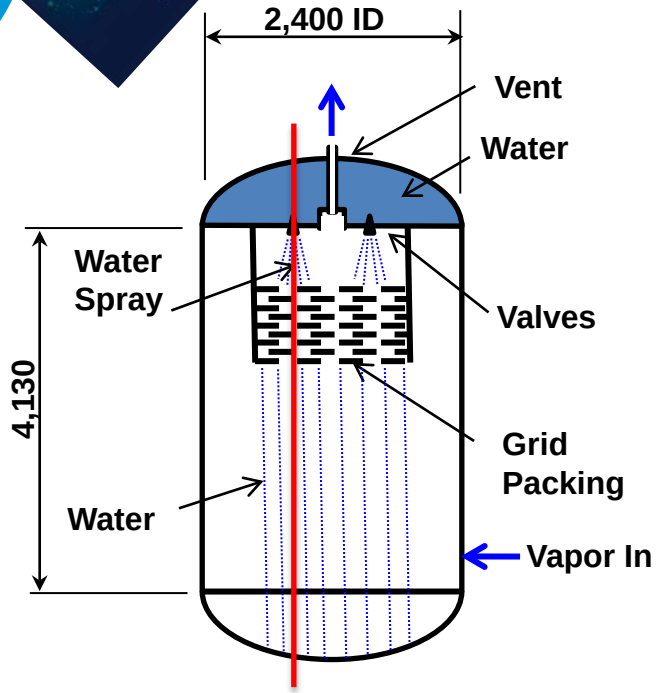
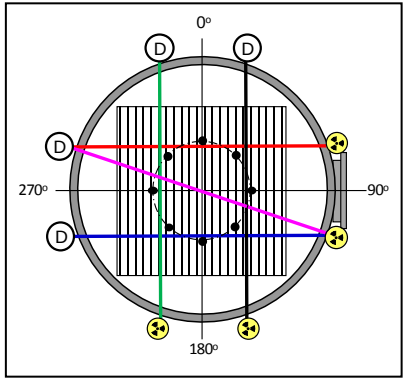
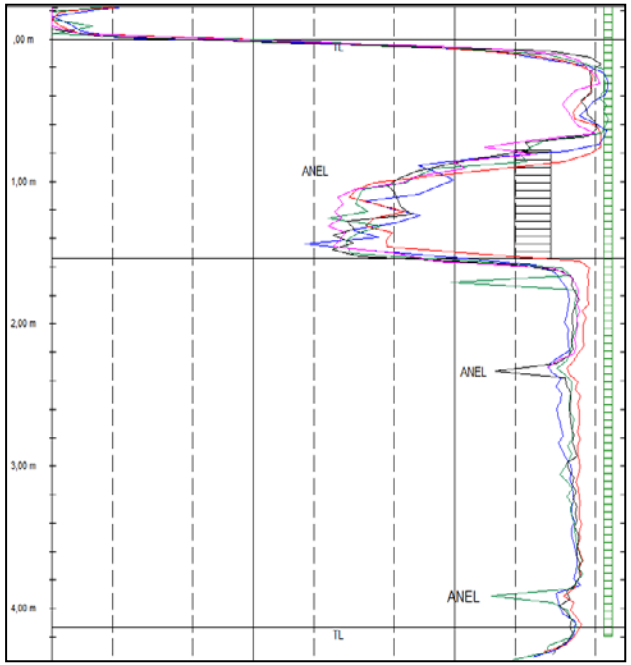
Case 2 – Deaerator







9,5 mCi Co-60

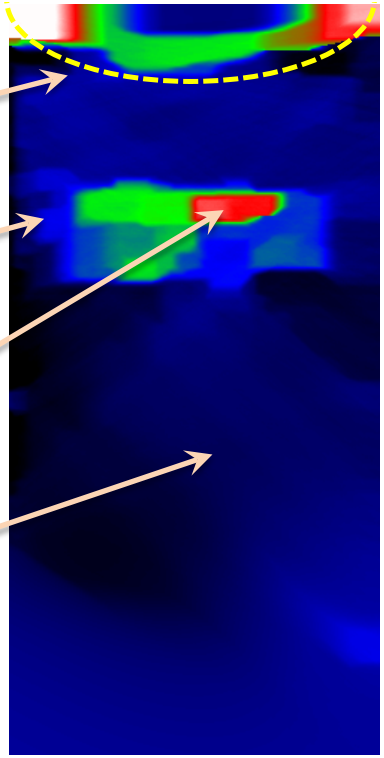
Results

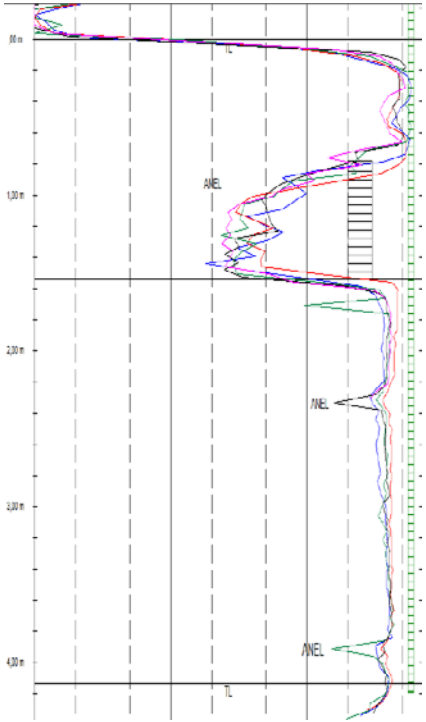
Empty area

Packing on place

Dense spot

Vapor





1371 pos / 3,5 h scan

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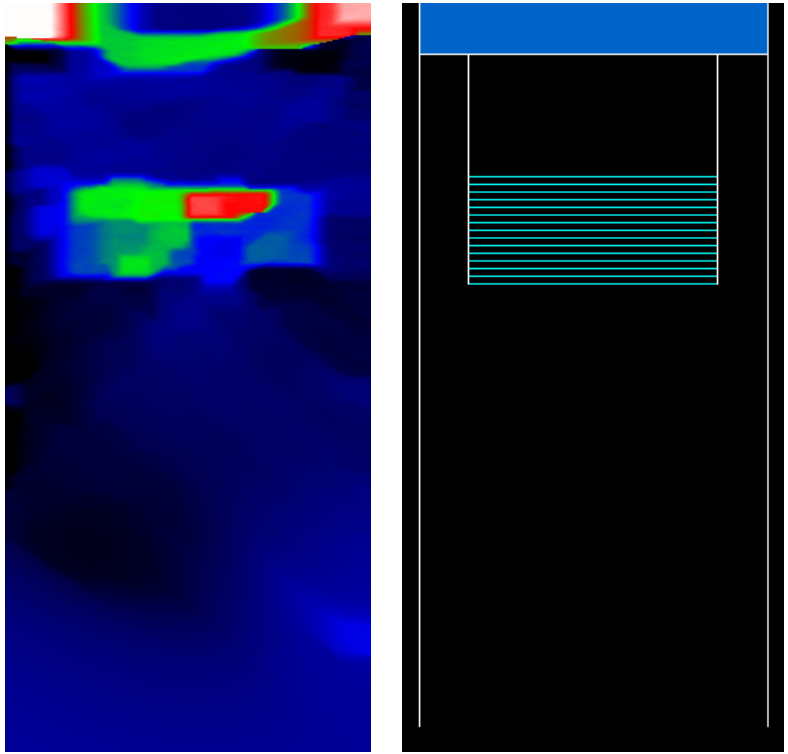
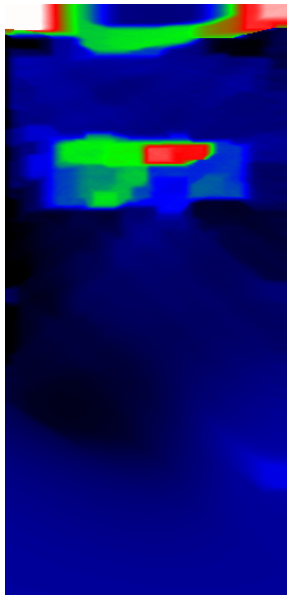
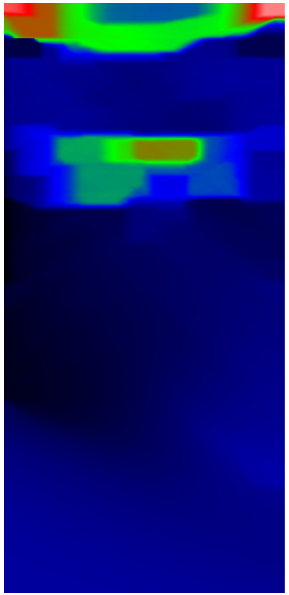
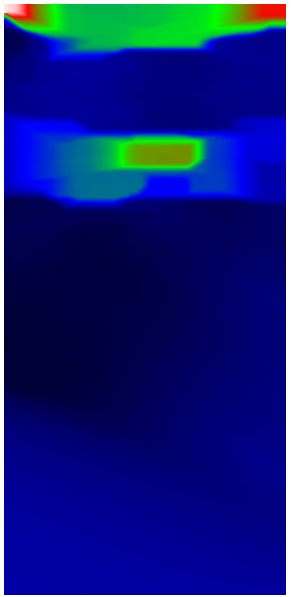
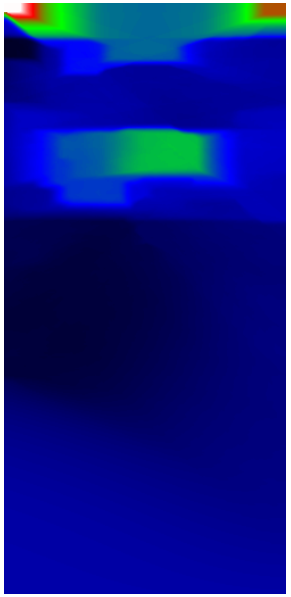
A priori result



Effect of scan increment

All Data D10S10 1371 pts	D20 S20 353 pts	D30 S30 157 pts	D40 S40 89 pts
			
3,5 h	54 min (estimated)	24 min (estimated)	14 min (estimated)

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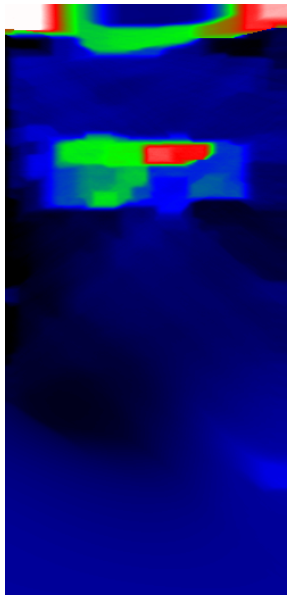
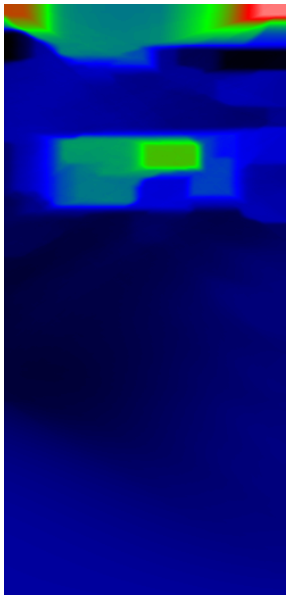
Multi-detector systems

All Data
1371 pts



3,5 h

D50 S10
281 pts



43 min
(estimated)

With 10 detectors
@ 50 cm spacing
52 positions
8 min (estimated)

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Project status

- Customer decides to live with the problem until next turnaround
- More tests being scheduled

Summary

- Successful transition to field
  - ❑ Similar sources
    - Bigger sources – depending on diameter, wall thick and internals
  - ❑ Good scan time
    - Bigger acquisition times – depending on diameter, wall thick and internals
  - ❑ Same gamma scanning equipment
  - ❑ Low investment cost

Summary

- Revealing more features and new information
  - ❑ Better understand existing problems
  - ❑ Open possibilities for other situations

Coming next…

- Multi-detector scans
- Multi slice scans
- 3D images

Thank You !