
VINÇOTTE
150
SINCE 1872
Evolution radiation protection @ DHL
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One-stop-shop in radiation protection

- class II/A
- class III
- Transport
- Orphan sources

Health physics

- Dismanteling
- Decontamination of facilities after incidents
- Waste management
- Operational support

Projects/consultancy

- Nuclear medicine
- Radiology
- Screening mammography
- Dose optimization

Medical physics

- RPO
- General Radiation protection
- Medical physics (art 86)
- ADR

Training

- Personal dosimetry
- Callibration
- Gamma spectrosopy

Dosimetry & labo

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47
People

35
Experts

27
Certified in health physics
12 CI III, 10 CI II, 5 CI IIA, 6 T2, 2 T1, 5 VA7

16
Certified in medical physics
14 in radiology
5 in nuclear medicine

Handling

- Mostly medical isotopes
  - **Mo99-Tc-99m generators**
- Numbers
  - **50.000-100.000 colli**
  - **20.000-40.000 TI**
- Different steps
  - **Unloading truck with forklift**
  - **Counting/writing**
  - **Sorting in alcoves**
  - **Shrinkwrap**
  - **Loading in aircontainers**

Dose rates: big variation

- Dose rates during the unloading of a truck:
  - **Around the lorry:** **max. 100 µSv/h in contact**
  - **Position of the forklift driver:** **max. 30 µSv/h**
  - **Around palletized packages of Mo/Tc generators:** **max. 1 mSv/h**
  - **Estimated exposure time:** **a few minutes**
- Dose rates during the sorting out of packages per destination, in the concrete bunker :
  - **In front of the bunker** **< 1 µSv/h**
  - **In the bays** **40 µSv/h at the entrance + 800 µSv/h in contact with packages**
  - **Estimated exposure time:** **5-10 minutes**

Dose rates: big variation

- Shrinkwrapping packages on a pallet :
  - **In contact with a pallet** — **up to 800 µSv/h**
  - **Position of personnel** — **up to 250 µSv/h → 13 µSv/h after buying automatic shrinkwrapper**
  - **Estimated exposure time :** — **1-2 minutes per pallet (in total 5-10 pallets)**
- Loading of pallets in aircontainers
  - **Estimated exposure time:** — **1-5 minutes per pallet (in total 5-10 pallets)**
  - **Estimated dose after 1 container** — **3 µSv**
- Transport to and loading into airplanes of aircontainers
  - **In contact with the aircontainer:** — **max. 500 µSv/h**
  - **Position driver** — **max 10 µSv/h, in most cases lower**
  - **Duration of the transport** — **a few minutes**
  - **Duration of the loading** — **max 1 minute per pallet, personnel is close to radioactive aircontainer for a few seconds up to half a minute**

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a bureau company

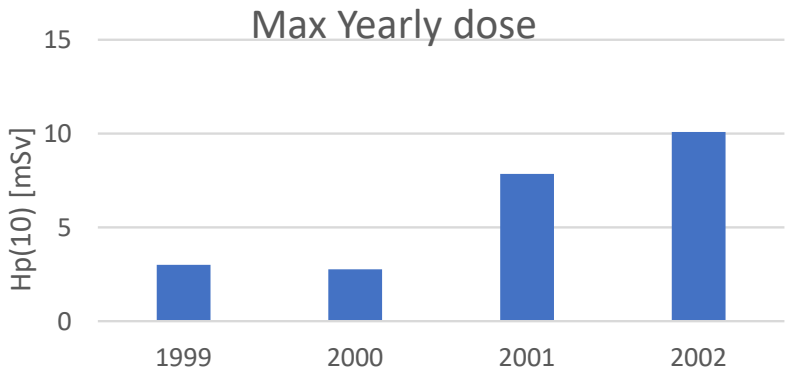
Legal context

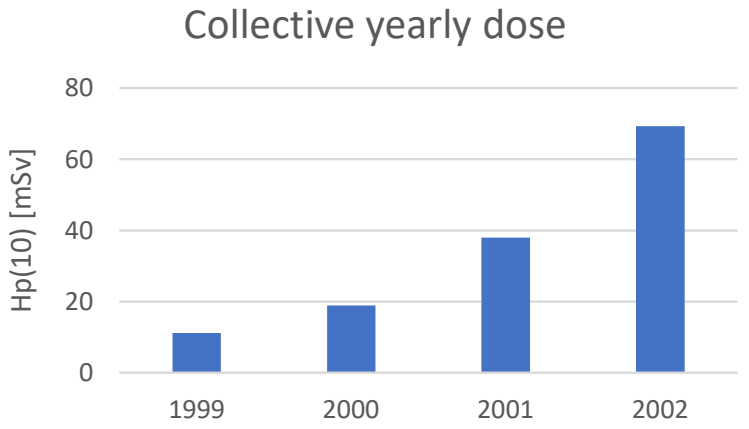
- 2001: RD ionising radiation
  - **No licensed activity**
  - **Support by RPE from Controlatom**
  - **Follow up dosimetry**

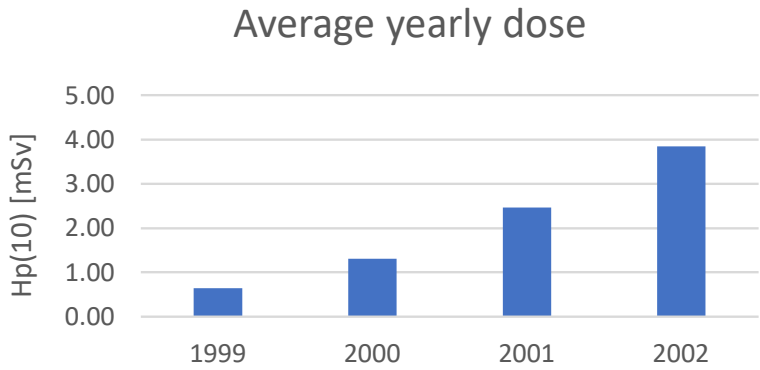
- Since 22/10/2017: publication RD Transport
  - **FANC Recognition necessary for the whole transport chain**
    - *Handlers airport*
    - *Transport companies (road, air, sea)*
    - *Terminal operator port*
  - **Recognition per group UN numbers**
- 2018:
  - **internal health physics department**
    - *Head*
    - *Different RPO's*

History

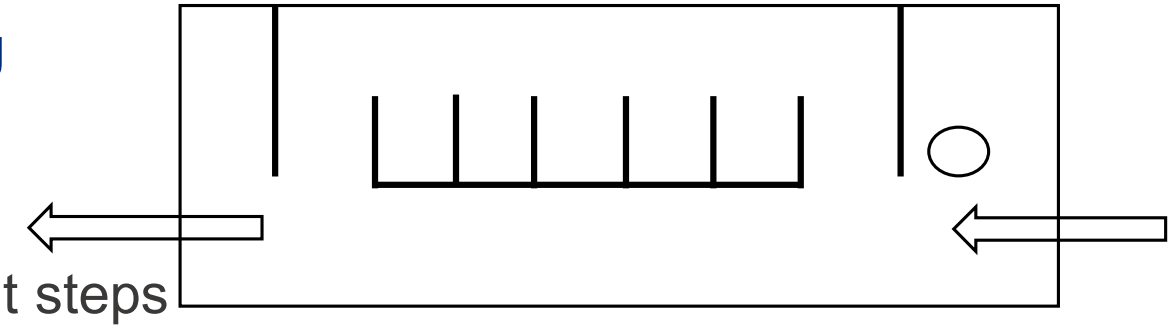
- 2001-2002
  - **Increase volume**
  - **Dosimetry**
    - *12-18 PEP*
    - *Max dose: 10 mSv*
    - *Average dose: 3.8 mSv*
  - **→ Construction first bunker**
    - *Multi block concrete: 60 cm*
    - *Different alcoves per destination*
    - *Max 100 TI per alcove*
      - 2 pallets of 50 TI
  - **Different steps**





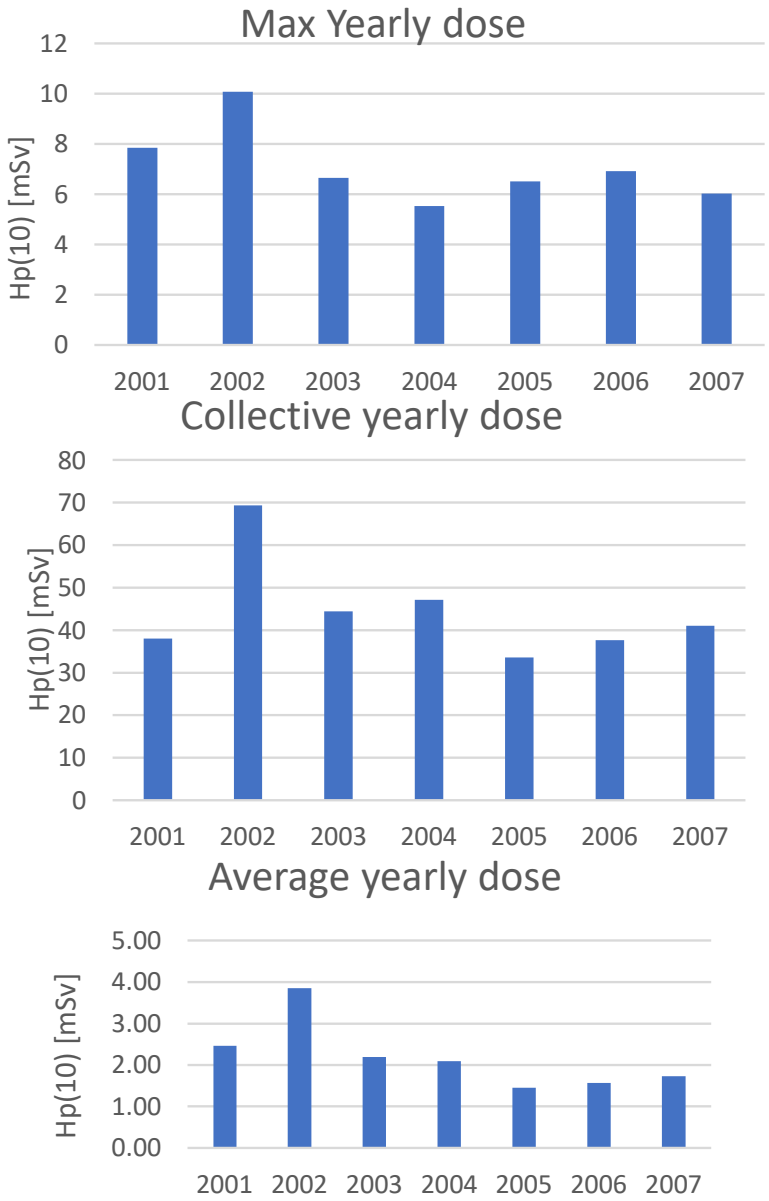


Handling



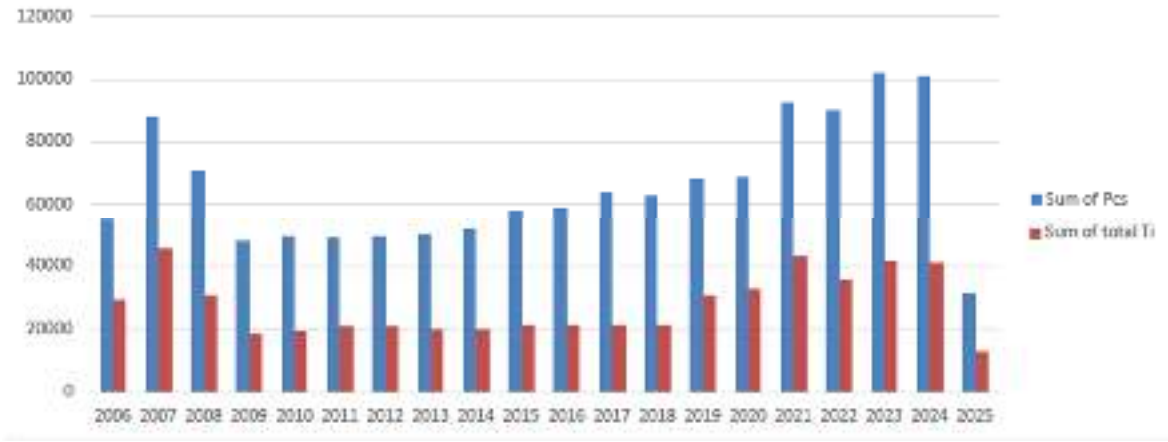
- Different steps
  - **Unloading forklift**
  - **Counting/writing**
  - **Sorting in alcoves**
  - **Shrinkwrap**
  - **Loading in aircontainers**

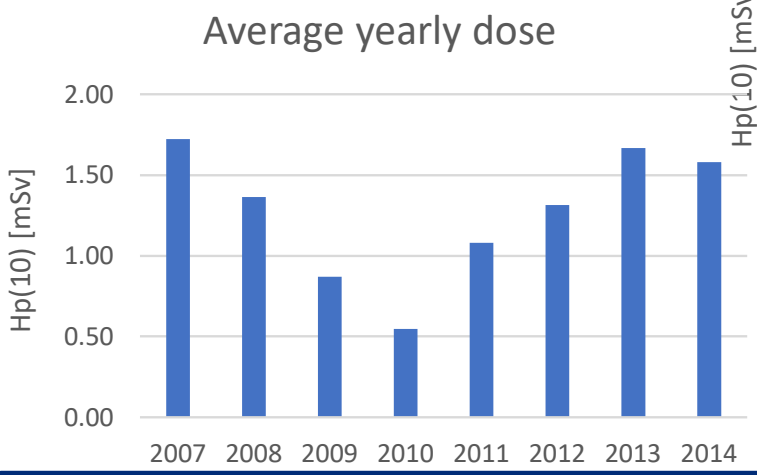
Results

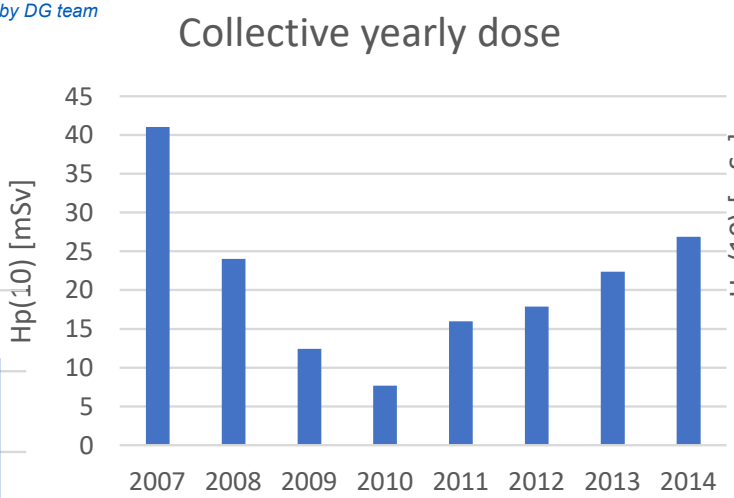

Max Yearly dose
Hp(10) [mSv]
12
10
8
6
4
2
0
2001
2002
2003
2004
2005
2006
2007
Collective yearly dose
Hp(10) [mSv]
80
70
60
50
40
30
20
10
0
2001
2002
2003
2004
2005
2006
2007
Average yearly dose
Hp(10) [mSv]
5.00
4.00
3.00
2.00
1.00
0.00
2001
2002
2003
2004
2005
2006
2007

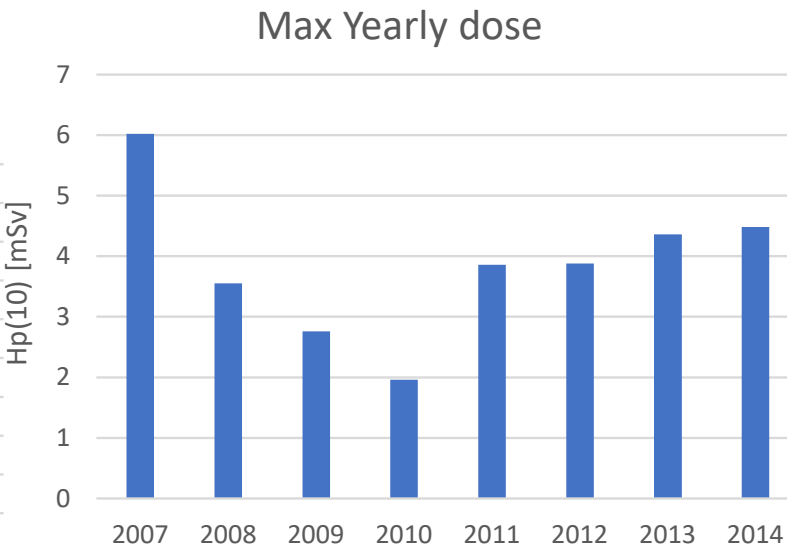
2008-2014

- 2009 - 2010
  - **Drop in volume: factor 2**
    - *Activities to Leipzig*
  - **Dosimetry: factor 2-3**
    - *Loading aircontainers was not done by DG team*
- 2011-2014
  - **Increase dose**
  - **Small increase volume**



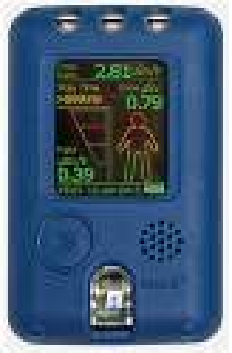




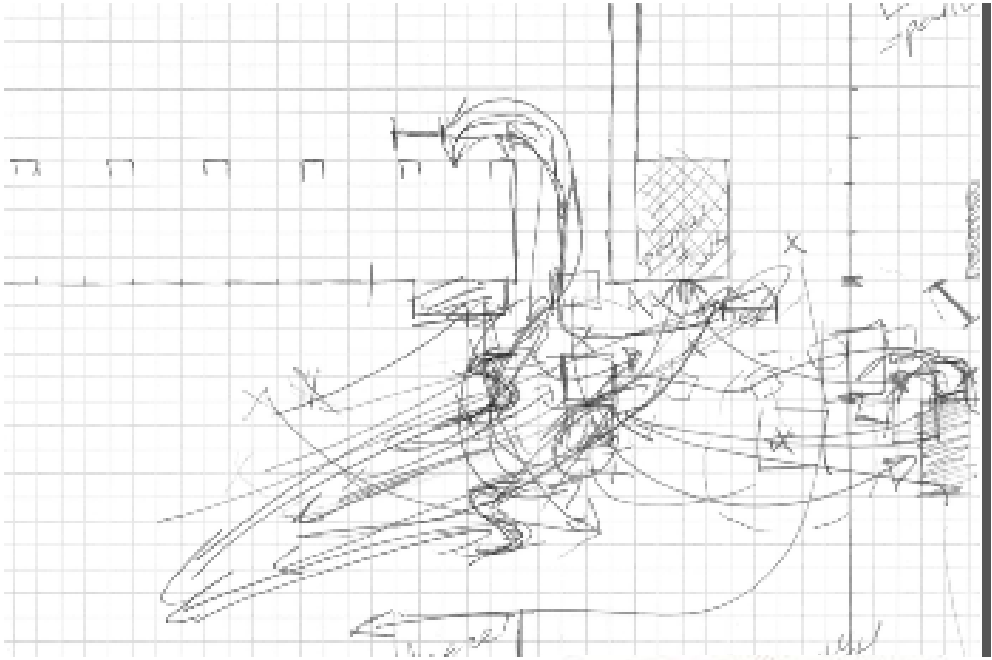


Optimalisation project: First Choice

- What is the problem?
  - **Increase in radiation exposure for all employees in the last years**
  - **Extra team members, but level of radiation remains high with peaks always for the same team members**
  - **No real explanation: no real growth on volume of RRY handled**
  - **No active follow up on exposure, nothing happens with the data of the digital dosimeter => action for staff close to internal exposure limit came relatively late**
- How big?
  - **Measure dose per step with new PED's**
  - **New PED's with alarm levels**



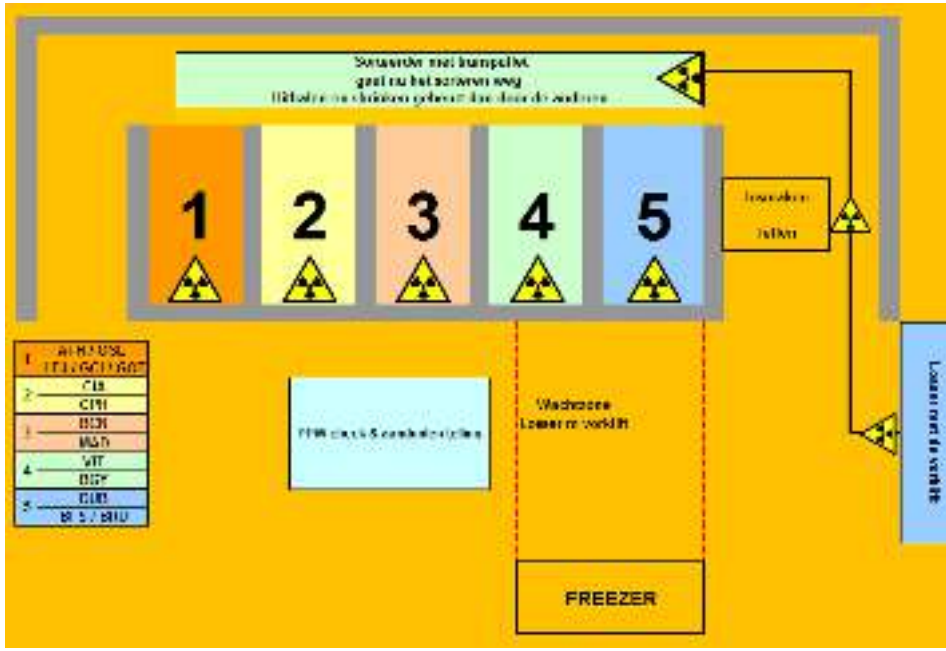
Optimalisation project: First Choice



- Analyze: What is the root cause of the problem?
  - **Spaghetti diagram of activities**
  - **Hotspot of activity around the pallets**
    - *paperwork on the shrinkwrap machine*
    - *Counting and writing within 1meter around the shipment*
    - *people engaged in other DG activities pass frequently by the pallets*
    - *during unloading wait with the load at the door*
    - *Driver was waiting too close*
    - *Different pallets at the same time*
    - *…*
  - **No correct application of basic radiation protection rules**
    - *Time*
    - *Distance*
    - *Shielding*

Optimalisation project: First Choice

- Improve: What is the best solution for the root cause?
  - **Tracerco per person**
    - *Real time exposure management*
    - *Self control*
    - *Ahead of game*
  - **Dose constraints**
    - *Daily dose limit: 25 µSv*
    - *Yearly: 4 mSv*
  - **Marking of zones in bunker and per task**
  - **Automatic shrinkwrap machine**
  - **Adapt procedures**
    - *Application of RP rules*
  - **Training**



Unloading	Before	After	
Average	6.678	4.406029	-34%
SD	7.135524	7.273567	

Writing	Before	After	
Average	7.809	1.645125	-79%
SD	3.742941	1.47877	

Counting	Before	After	
Average	7.809	6.805258	-13%
SD	3.742941	6.993253	

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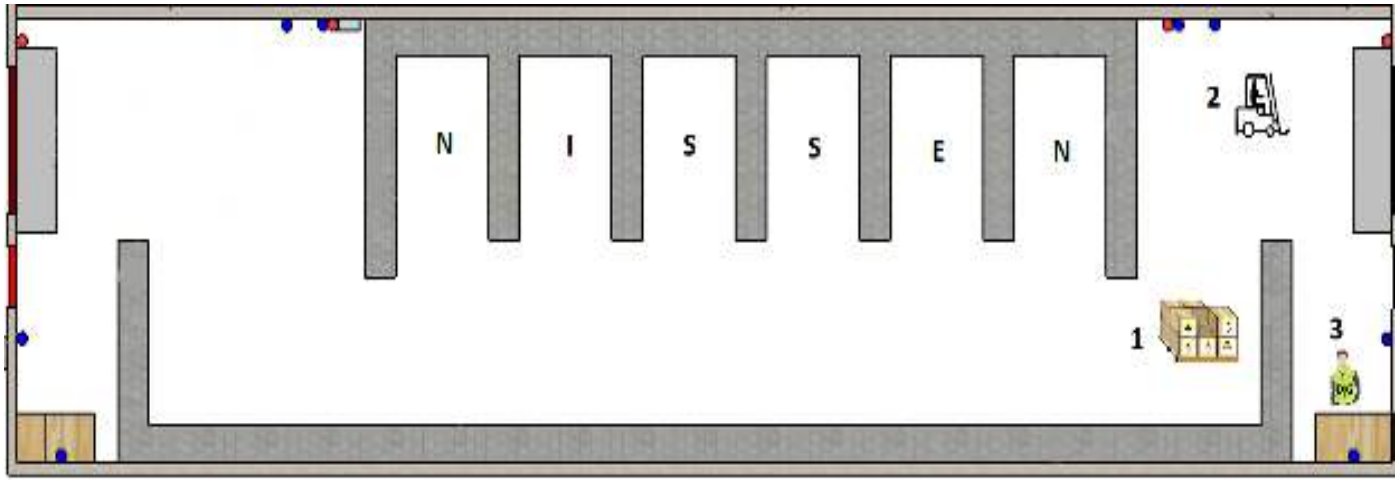
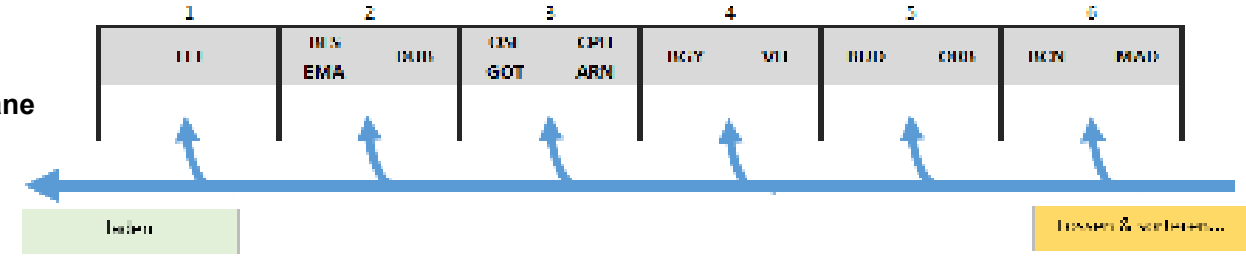
Since then

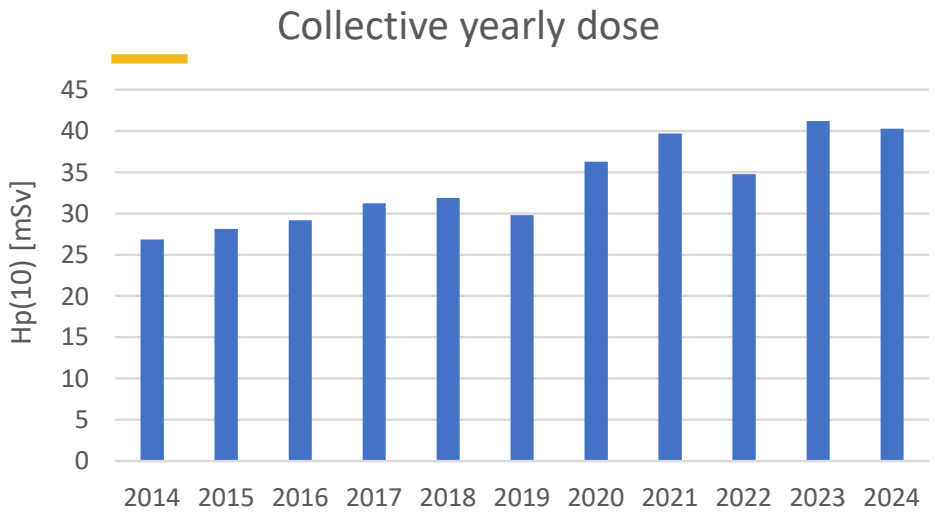
- New bunker
  - **Dedicated for class 7**
- Internal health physics department
  - **RPO**
  - **Digital checklists for bunker, ramp, check airplane**
- Dose constraint: 4→ 3 mSv/year
- Radiation protection program
- Handling security plan
- Training program
  - **Initial**
  - **Practical**
  - **Yearly refresh via dedicated e-learning**

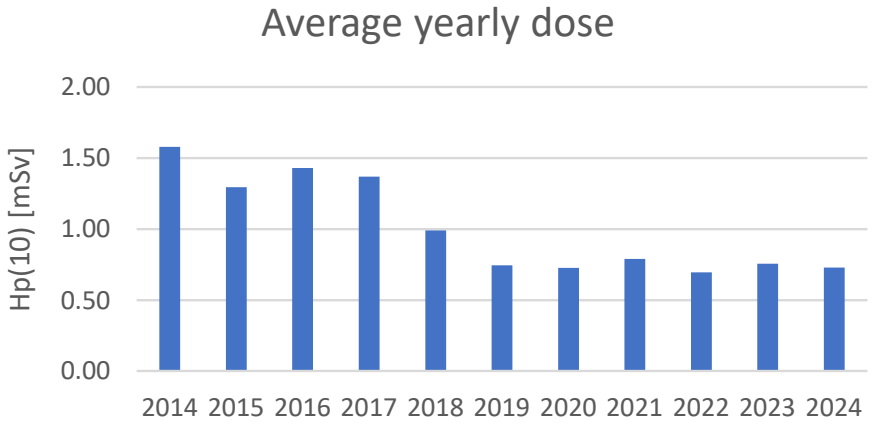


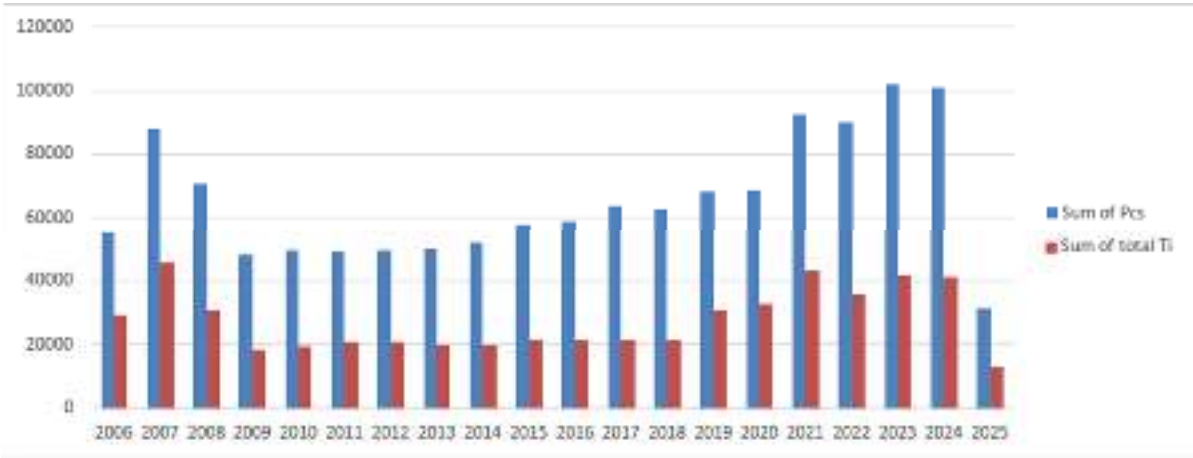


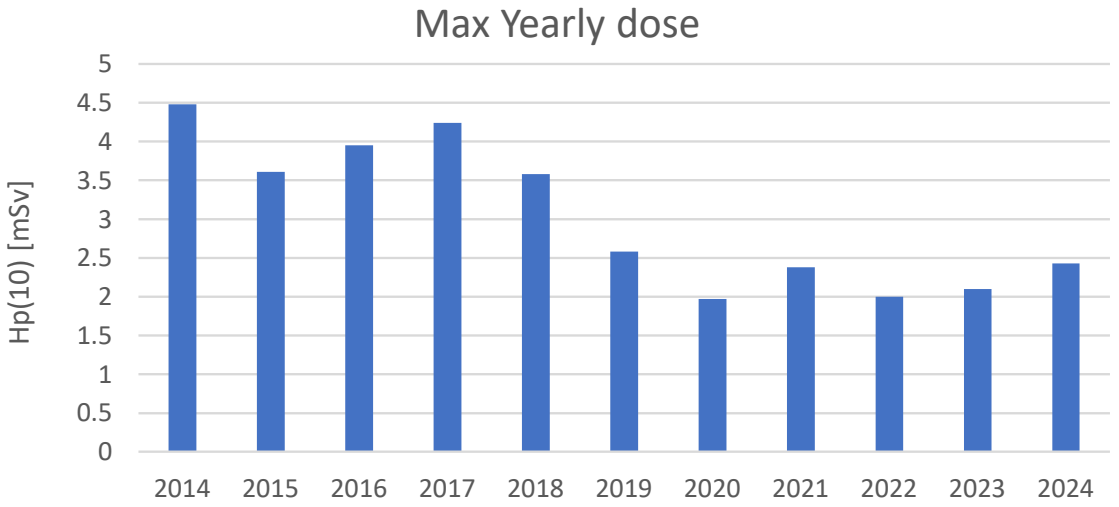
Actions
Carrying individual PED's (Tracerco's)
Exceeding of the daily dose limit: 25 µSv
Exceeding of the yearly dose limit: 4 mSv
Handling of the radioactive goods in the alcoves
Counting and sorting at different positions (1)
Usage of the table for paperwork (3)
Usage of a pallet truck
Keeping more distance by the Forklift “losser” (2)
Sorting and counting of 1 pallet at time

Results









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Conclusion

- Obtaining a dose during handling is inevitable
- Optimalisation by
  - **Shielding: bunker**
  - **Reduction of time and distance**
    - *Shrinkwrap machine*
    - *Active follow-up with PED*
    - *Adapt workflow*
    - *Clear instructions*
    - *Internal checks by RPO*
    - *Training*
  - **Still to be resolved**
    - *Loading aircontainers: how can it be done faster, more efficient,*