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Regulatory challenges in the monitoring of medical radioactive effluents

ALLIANCE Webinar 2nd June 2022

Geert Biermans

geert.biermans@fanc.fgov.be

International and National Framework

- **EURATOM 35/36 + Recommendations**
- **Oslo-Paris Convention (OSPAR)**
  - Protection of North Sea and N Atlantic
  - Reporting liquid releases and monitoring of coastal waters
  - Nuclear, Medical and NORM

- **FANC Law and Royal Decree on Radiation Protection**
  - Monitoring of natural and artificial nuclides in the environment
  - Licensing of practices
  - Radiological Impact

Radioactivity Monitoring in Belgium

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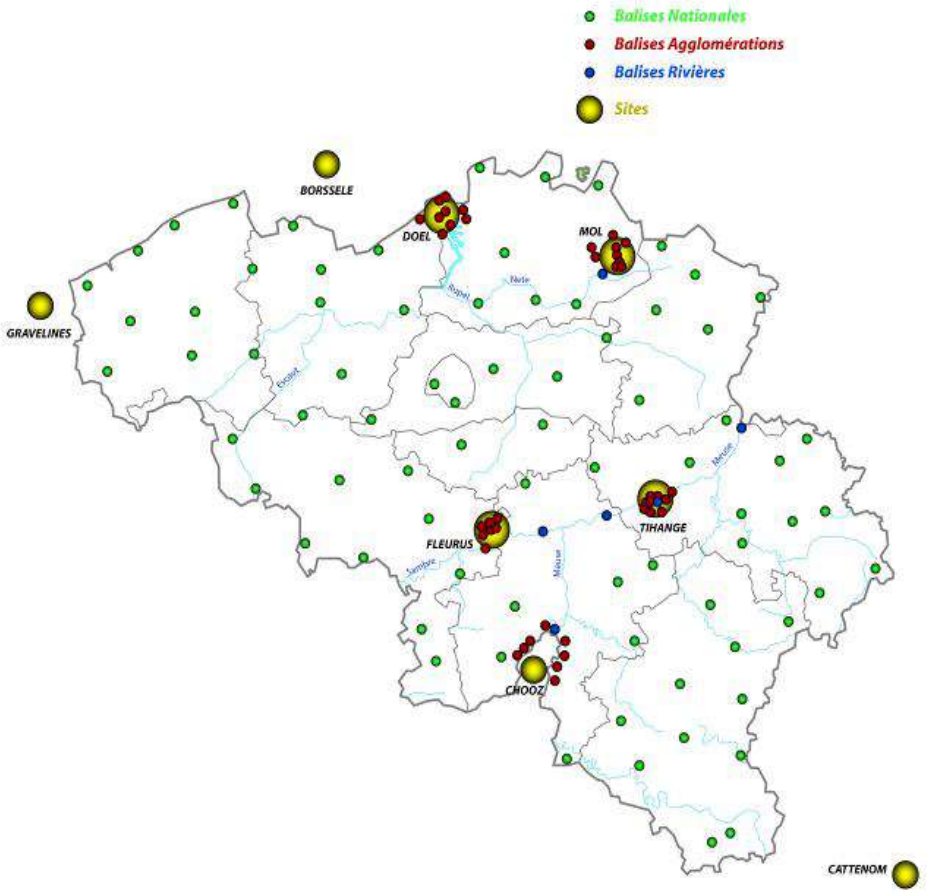
- **Source monitoring:**

  - Licensing
  - Inspections and Measurements
  - Independent verification

  → **For medical facilities, limited because of calculations or decay storage.**

- Environmental monitoring through **sampling**
- **Early Warning Network (TELERAD)**

  → **Focus on releases from NPP and NORM**



Challenges

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- **Increase in the amount of facilities**
  - Does this impact our approach?
  - Does this increase the overall environmental impact?

- **Increase in the amount of different therapies**
  - ‘exotic’ radionuclides with unknown environmental behaviour
  - How do you factor this into an evaluation of novel and promising therapies?
- **Change in patient treatment practices**
  - risk of mismatch between impact study and practice
- **Increased international focus (EC, OSPAR, …)**

→ Not a new issue. So our colleague Jurgen Claes set up a measurement campaign in 2012/3 as a pilot study to underpin our OSPAR data .

Measurement Campaign 2012/3

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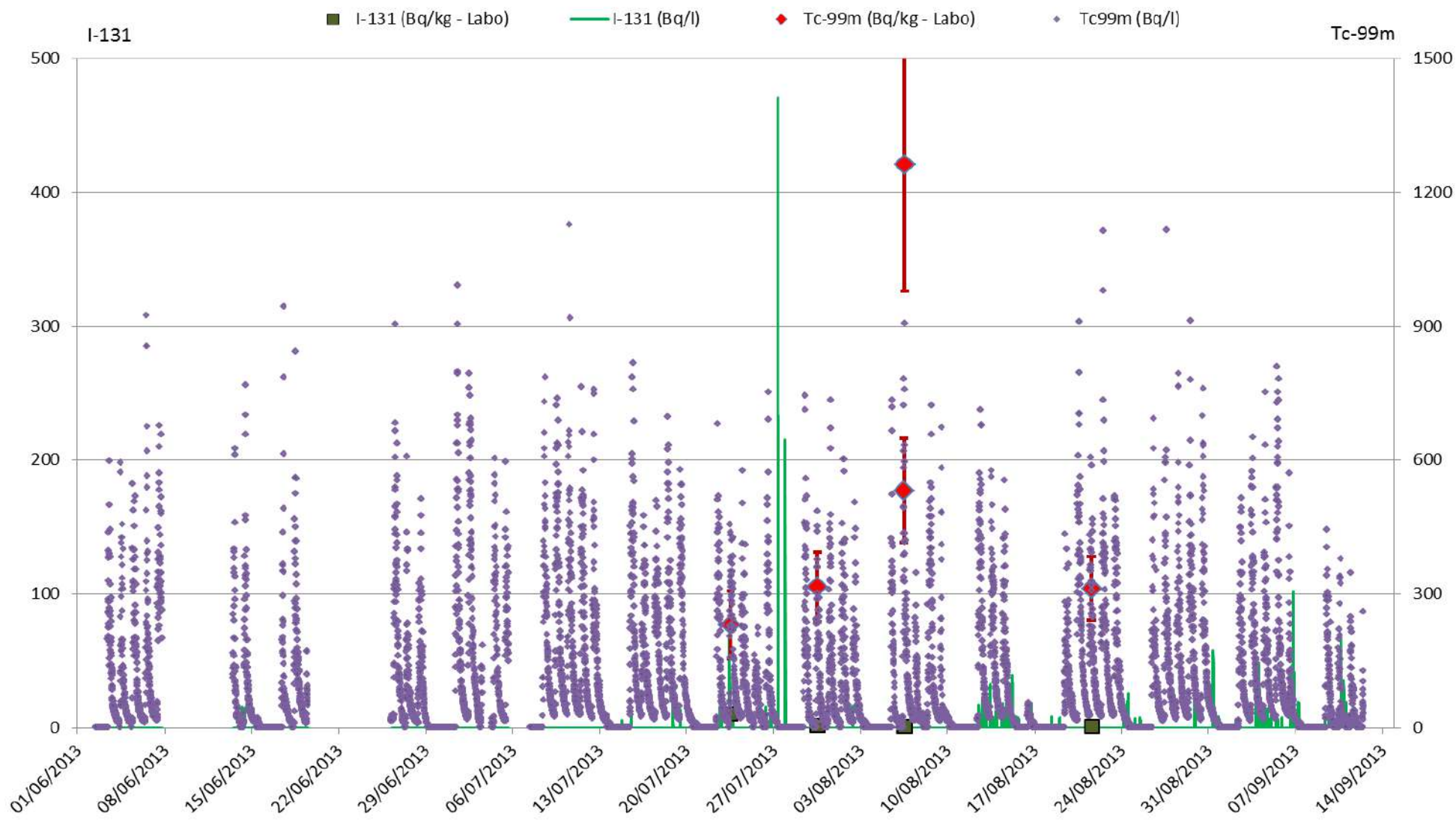
- **Objectives**
  - Study the **behaviour** of medical liquid discharges
  - Study the impact on workers in **Wastewater Treatment Plants (WTP)**

- **How?**
  - Immersed **gammaspectrometry** probes in inlet and outlet of WTP
  - **Lab** measurements (sludge and water)
  - Ambient dose rate in WTP
- **Where?**
  - WTP downstream of
  5 major medical facilities

Results at WTP inlet



Results at WTP inlet

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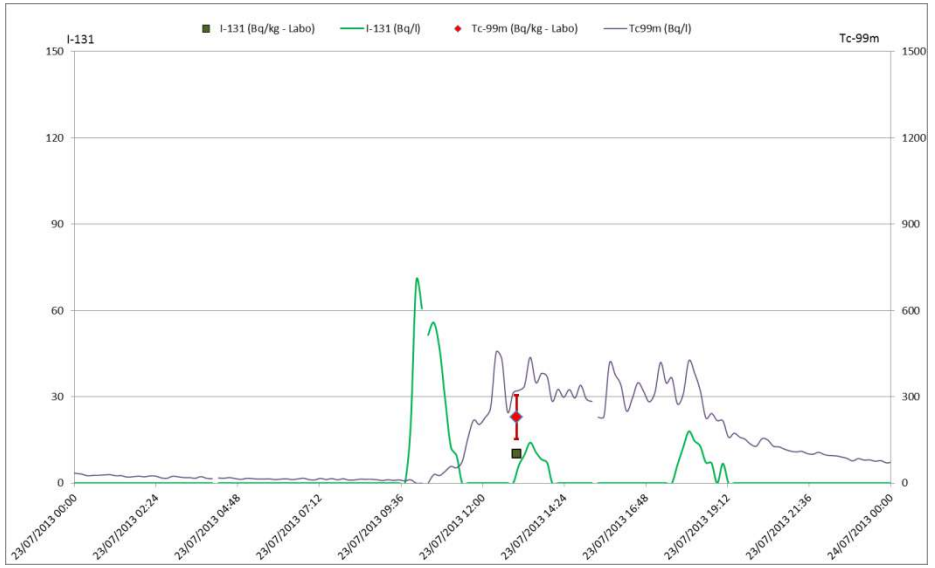
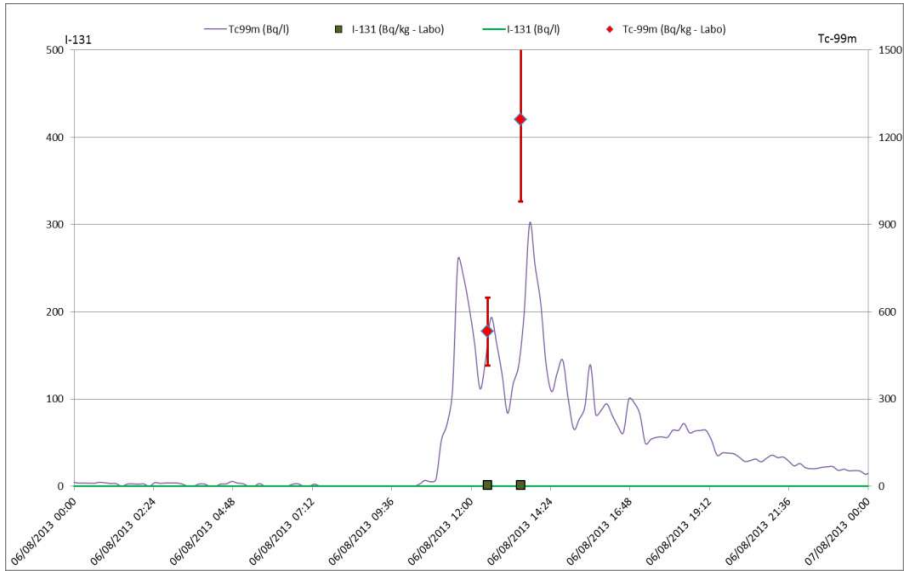
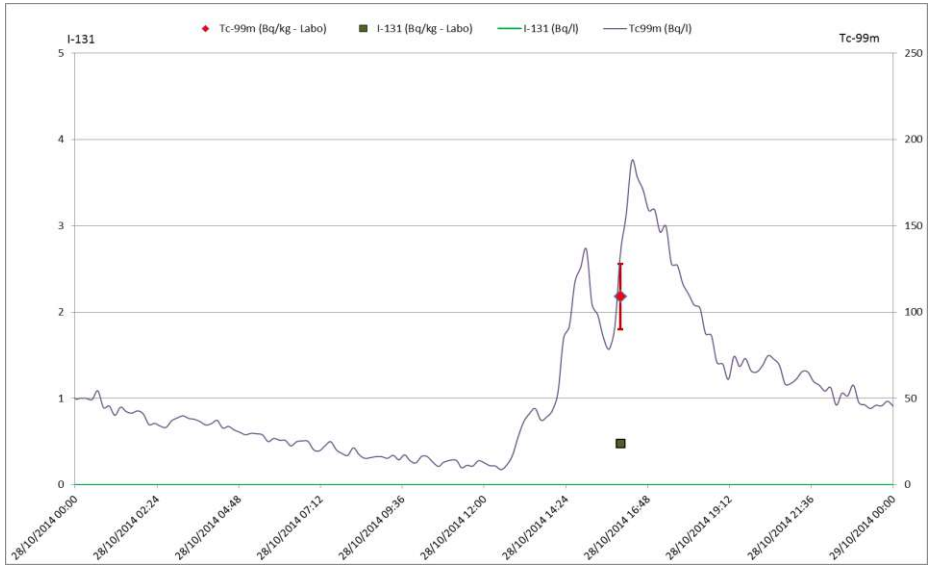
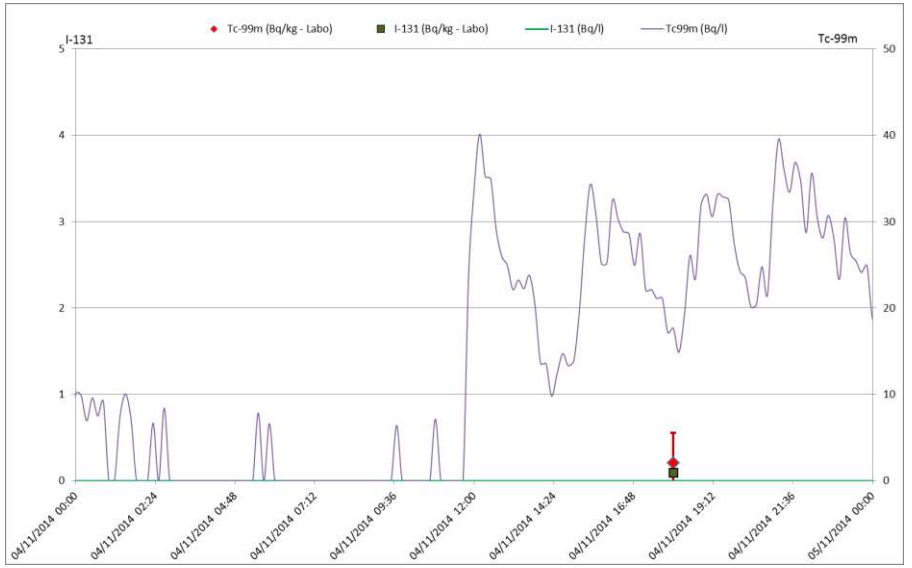
Facility 1





Facility 2





Results at WTP Inlet

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- **What did we find?**

  - **Tc-99m** detected frequently: < 300 Bq/l, max 1100 Bq/l
  - **I-131** detected regularly: < 45 Bq/l, max 4800 Bq/l
  - **I-123**, **Sm-153**, **Ir-192** and **F-18** detected occasionally

- In general, **concentrations in compliance** with GRPIR-2001, with exception of I-131 (**exceeds limit of 45 Bq/l** in several installations)

- **Several explanations possible**, but difficult to trace back

  - **several sites** on the same sewer (R&D, Hospital,…)
  - but: can be used as a **screening tool** for inspection campaign

Ambient Dose rate in WTP facilities

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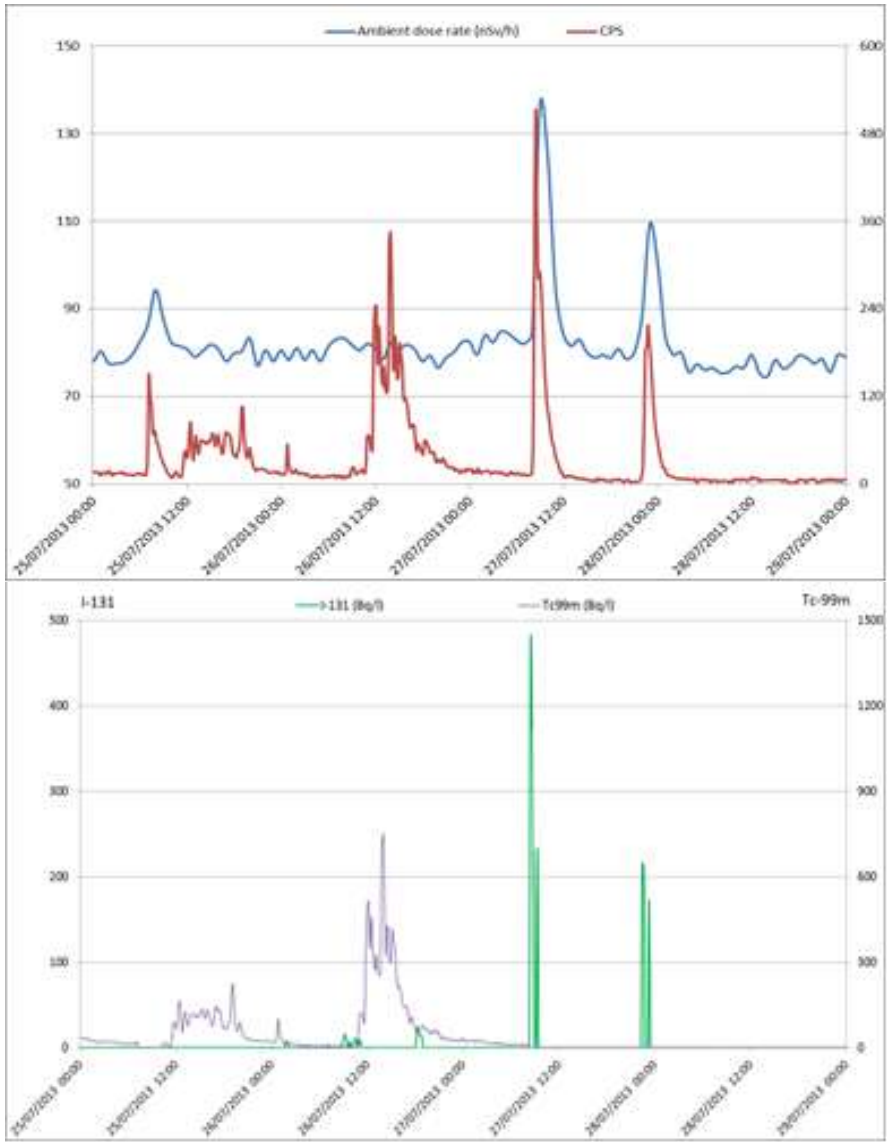
- Gamma probe was located outside, so less or **no shielding of metal and concrete**
- Ambient **dose rate peaks observed**
- Peaks are due to (high concentration of) **I-131**; no influence of Tc-99m on ambient dose rate
- Radionuclides with **higher energy gamma rays** can increase temporarily ambient dose rate
  - **I-131:** 95% gamma in range of 280 to 640 keV
  - **Tc-99m**: 89% gamma of 140 keV

- **No long term increase** in ambient dose rate in WTP → **limited impact**.



WTP Sludge and outlet

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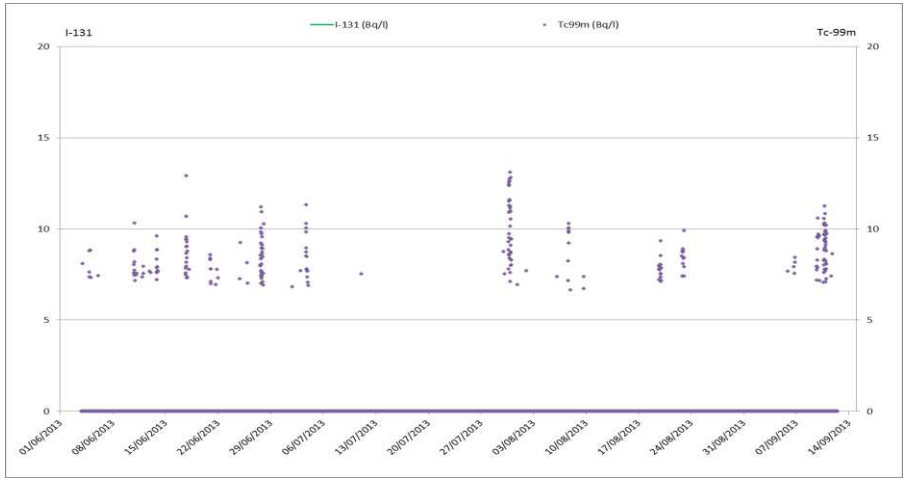
- Medical radionuclides are **present in sludge**
- In general, more **I-131** in dried sludge (fixation)
- For **Tc-99m**, concentration sometimes higher in fresh, sometimes higher in dried sludge:
  - Radionuclides tend to **concentrate in dried sludge**
  - **Higher transit time** for dried sludge (independent of WTP processes, weather influence/amount of rain,…)
  - Short half-life can **offset the concentration effect** (Tc-99m ~ 6 hours)
  - **Concentrations in compliance** with GRPIR-2001 (for solids)
- **No increase in ambient dose rate**
- **No radioactivity measured at the WTP outlet** (apart from Tc99m at one plant < 10 Bq/L)

WTP	Fresh Sludge (Bq/kg)		Dry Sludge (Bq/kg)	
	Tc-99m	*I-131*	*Tc-99m*	*I-131*
Facility 1	< DL to 22	< DL to 22	< DL	170
Facility 2	5 to 150	< DL to traces	< DL	5
Facility 3	<DL to 2	5 to 10	< DL	22
Facility 4	<DL to 21	10 to 22	70	50
Facility 5	11	6	55	20



Conclusions and Regulatory priorities

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- Impact of medical releases **limited**
- We do measure radionuclides, sometimes in high concentrations, but only upstream from WTP
- **Tracing releases back to origin** not always straightforward

- What is the impact of **novel treatments,** and **novel or evolving practices?**
- **Modelling** of release + WTP system is of prime interest → ***see presentation Jordi***
- **'incident' scenario's**