



# Orphan Sources

**Katleen De Wilde**  
**Industrial Facilities FANC**

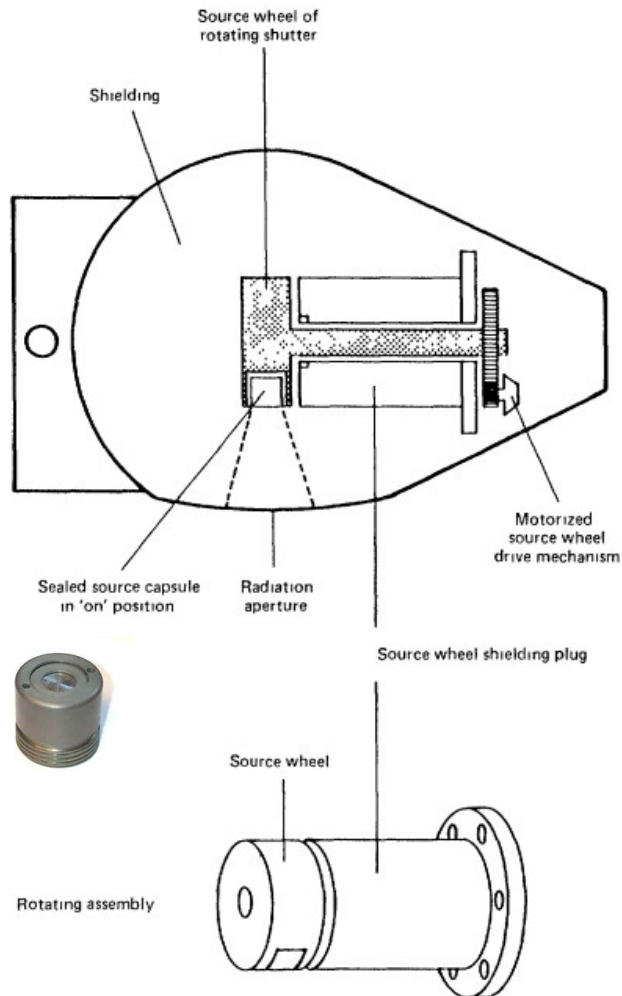
# PROGRAMME

- Introduction/regulatory framework
- Registration and follow-up
- How does an intervention take place?
- Who pays?
- Information to sector concerned
- Examples

# Introduction/regulatory framework



# BRAZIL (1987) - The Goiânia radiological accident



Teletherapy machine with Cs-137

Activity: 50.9 TBq (93g CsCl)

Dose rate at 1 m: 4.56 Gy/h



Contaminations of houses, public places, vehicles, people,...

200 people evacuated

3,500 m<sup>3</sup> radioactive waste

271 people contaminated

20 people hospitalised

4 deaths

\$20 million



4. The physicist W.F. monitoring for contamination at the Olympic stadium.



5. Monitoring people for contamination at the Olympic stadium.

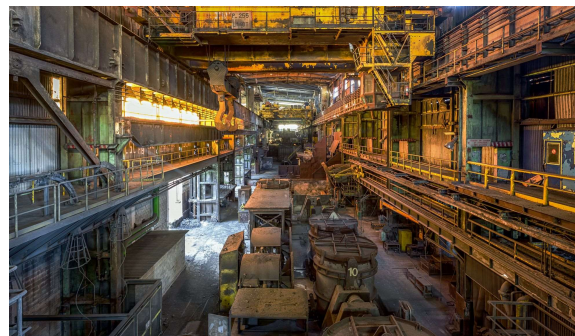
## Belgium (2011)- Duferco

Cs-137 in scrap

Activity: 10 GBq



Foundry



- Operation of furnace was stopped (15/09/2011 -> 10/10/2011)
- Medical examination of workers → no health implications
- Sampling of area → no contamination found
- Contaminated dust: 600 tonnes (t)
  - 350 t > 10 Bq/g = radioactive waste → process was developed
  - +50 t secondary waste generated > 10 Bq/g → radioactive waste
  - 150 t of dust between 1 and 10 Bq/g → disposed of as hazardous waste
  - 100 t < 1 Bq/g → released



## Legal framework

- Licensing, control and inspection mechanisms never 100% foolproof
- Use of radionuclides in 20th century not always controlled as today
- Certain applications (now forbidden) were used in public domain

*for example: radium-based paint used in clocks, radioactive lightning rods, radioactive smoke detectors,...*

In collaboration with  
ONDRAF/NIRAS  
Regions  
Sector concerned



**RD 14/10/2011 – Royal Decree concerning the Detection of Radioactive Material in certain Material and Waste streams concerning the Management of Facilities sensitive to Orphan Sources**

# Royal Decree



## Minimum requirements

- Training
- Notification to FANC
- Appointment of “responder”
- Vigilance procedure
- Temporary storage room



# Guidelines (FANC decision 17/11/2014)

## Forms

Annex 1: declaration form ([orphansources.be](http://orphansources.be))

Annex 2: inventory of radioactive substances

Annex 3: registration form for portal monitor

## Procedures

Annex 4: procedure in the event of detection of radioactive substances using portal monitor

Annex 5: search for a localised source

Annex 6: search for a homogeneous source

Annex 7: characterisation and determination of final destination by radiation expert

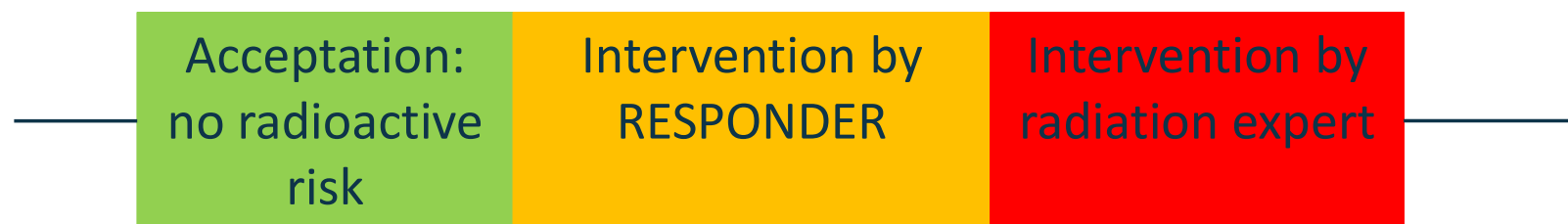


# General principles of Royal Decree & guidelines

Personnel is not occupationally exposed



Dose limit = 1,000  $\mu\text{Sv}/\text{year}$



# General principles of Royal Decree & guidelines

## **At portal monitor:**

Measure (cps) > 20 x background (cps)

## **When approaching vehicle:**

Measure ( $\mu\text{Sv/h}$ ) > 5  $\mu\text{Sv/h}$

## **When searching for and isolating source:**

Dose rate at chest level > 20  $\mu\text{Sv/h}$

Dose rate at 10 cm from source > 500  $\mu\text{Sv/h}$



# General principles of Royal Decree & guidelines



Return to sender? **NO**

⇒ Only if

- i. Load from abroad (*after approval by FANC*)
- ii. Load from hospital
- iii. Sender has portal monitor, registered with the FANC

**NEVER when dose rate > 5 $\mu$ Sv/h !**

## On-site storage possible

### Conditions:

- Dose rate in storage room < 100  $\mu\text{Sv/h}$
- Dose rate outside storage room < 1  $\mu\text{Sv/h}$
- Inventory
- Max 1 year



# Registration and follow-up



# Registration and follow-up of detections

**RESPONDER**



Storage



Declaration form



**FANC**



**Radiation expert**

Email with decision, request for information, certificate

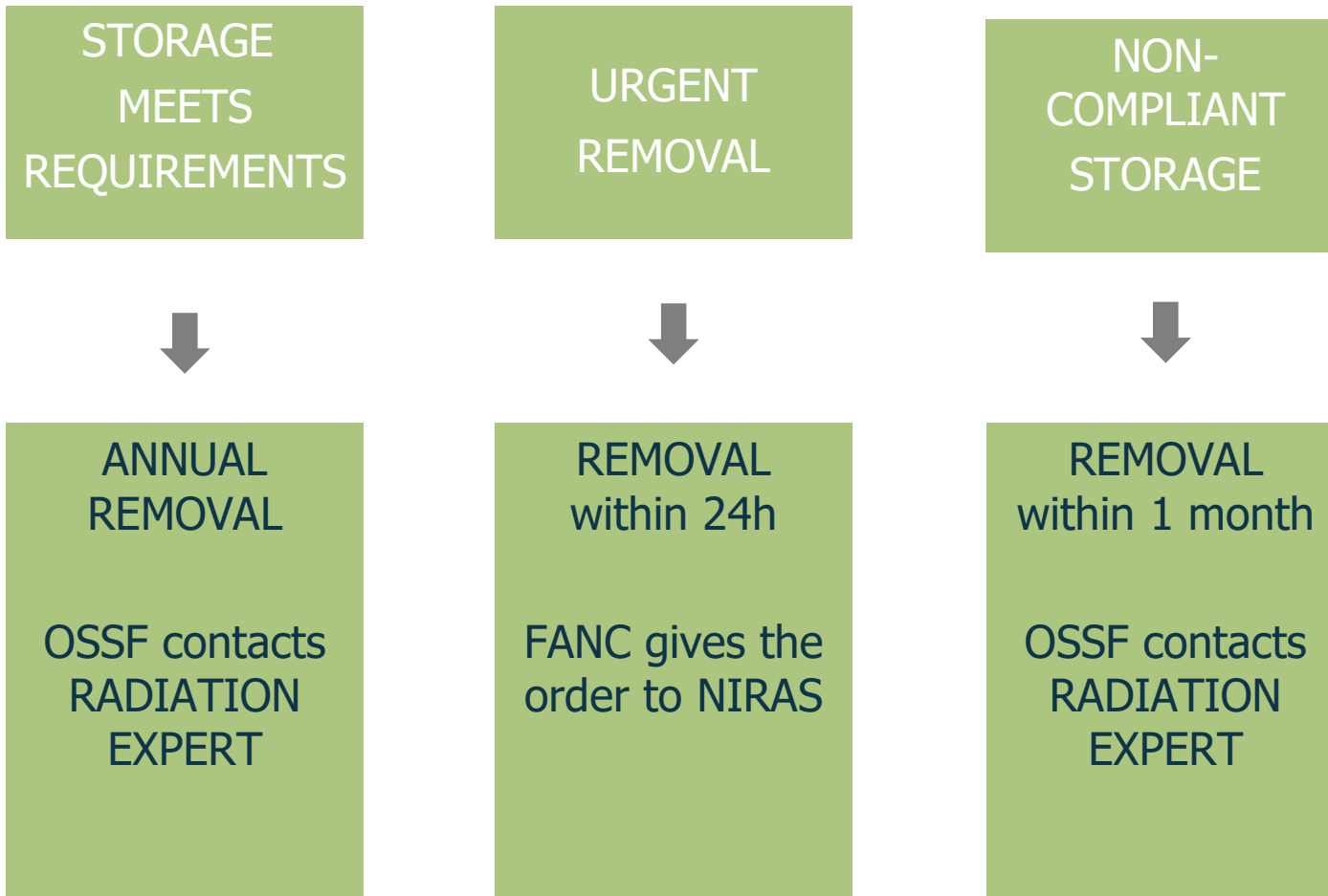
**ONDRAF/ NIRAS**

- Initial analysis: urgent measures where necessary
- Registration of alarm
- Decision on orphan source
- Follow-up: NORM, medical, etc.

bewerken_ID_1257	17-Jul-12	56611 Bionerga	Centrum Zuid
bewerken_ID_1258	10-Aug-12	13797 Indover	Poelvenkeweg
bewerken_ID_1259	10-Aug-12	52263 Aunabe Belgium	Watertorenstraat
bewerken_ID_1260	20-Jul-12	15733 Van Ganssewinkel Chemie	Berkbossebaan
bewerken_ID_1261	13-Aug-12	14832 Hetzli-Chimique	Nieuwe Dreef
bewerken_ID_1262	17-Aug-12	56611 Bionerga	Centrum Zuid
bewerken_ID_1263		51986 TRANSHUBEL	Zandbergen

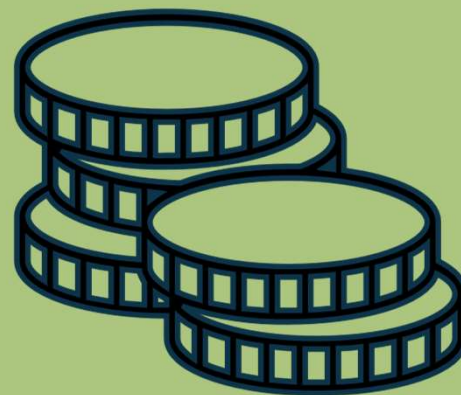
# How does an intervention take place?







**Who pays?**



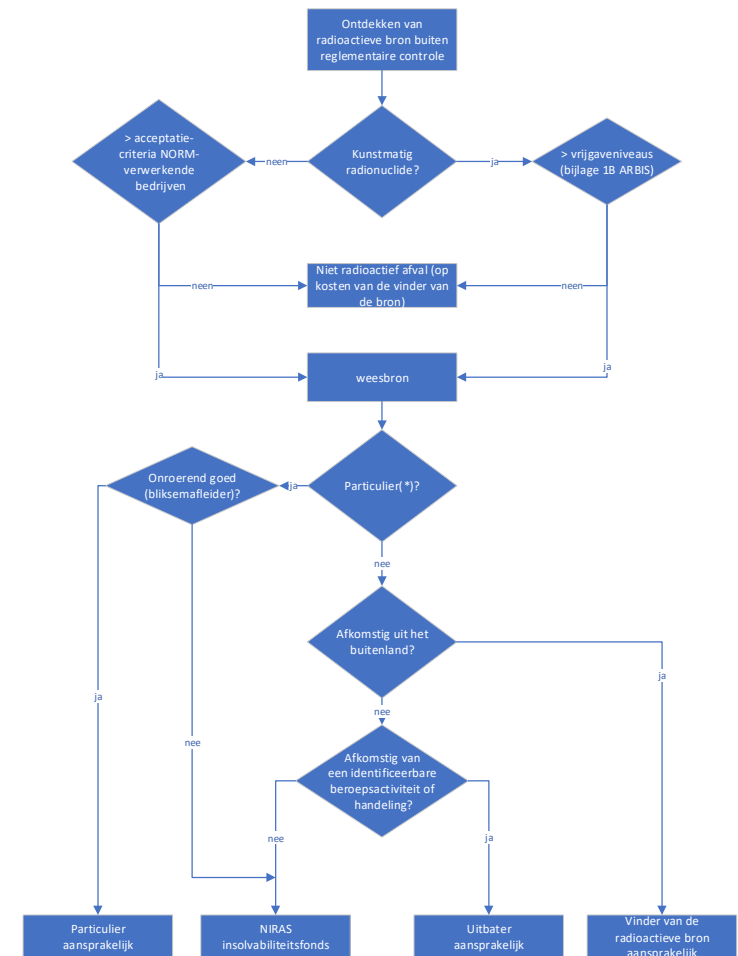
# Who pays?

- RD of 81 – art. 15
  - A source, declared by FANC as orphan source and waste, is charged to the **insolvency fund**.
  - FANC must designate the financially liable party according to **decision scheme**.

## Protocol agreement between FANC and ONDRAF/NIRAS on modalities applicable to the financial settlement of radioactive orphan sources as radioactive waste

- Decision scheme
- Tasks of FANC and ONDRAF/NIRAS
- Costs (not) charged to insolvency fund

**NOT LIMITED TO ORPHAN SOURCE SENSITIVE FACILITIES (OSSF)**



## Who pays?

### What the fund pays for:

- ONDRAF/NIRAS services
- Intervention by radiation experts (characterisation and packaging)
- Transport, interim storage, treatment, conditioning, storage, final disposal



### What the fund does **NOT** pay for:

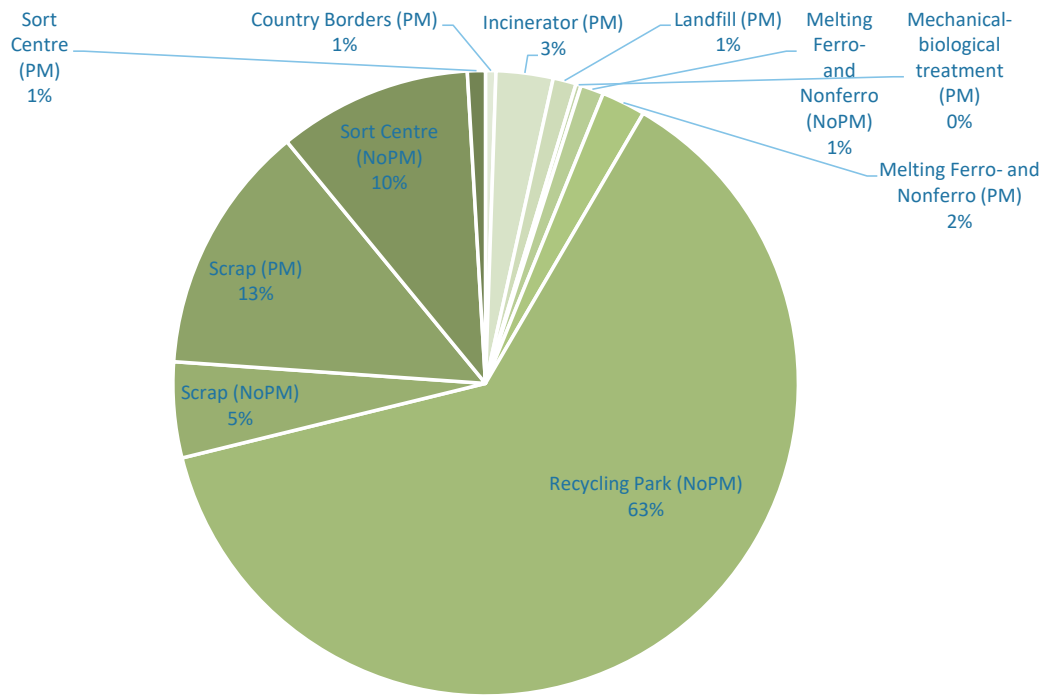
- FANC services
- Operator services (operation of the portal monitor, intervention, detection and recovery of the source)
- Events resulting from late or non-detection (decontamination of installations and sites and management of radioactive waste)



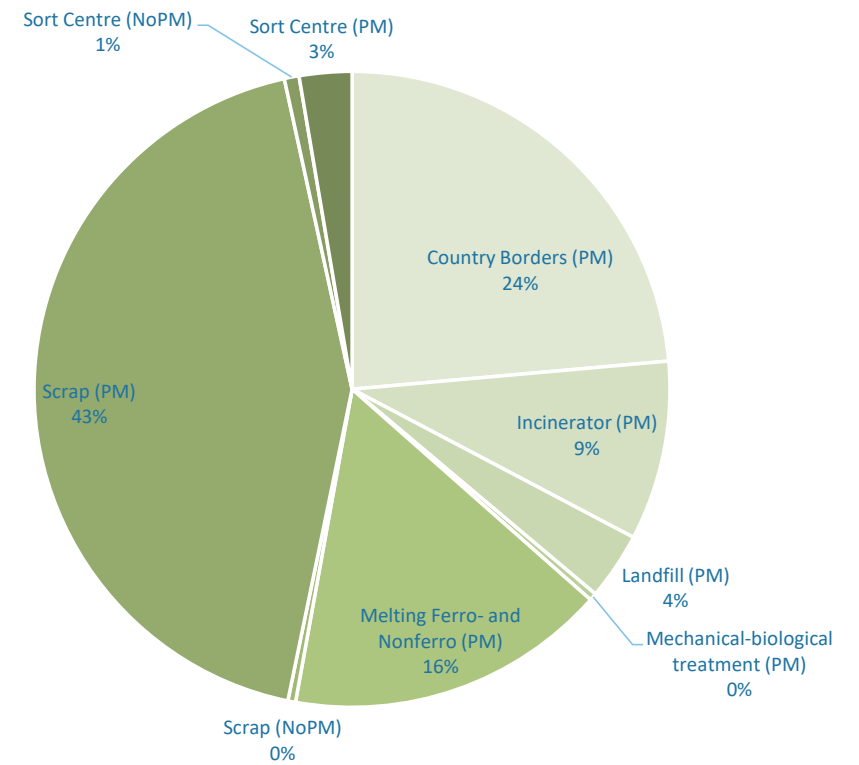


# Information to sector concerned

# Sector concerned



750 orphan source sensitive facilities



263 registered portal monitors

# Information to sector concerned



## Website:

- General info
- FAQ
- Posters
- Film
- Presentations

Trainings for responders, managers,...

Yearly newsletter

Declaration tool: [orphansources.be](http://orphansources.be)



HOME OVER ONS D

Home > Professionals > Industriële activiteiten > Afval- en recyclagesector (weesbronnen)

Industriële activiteiten >

Afval- en  
recyclagesector  
(weesbronnen) >

Aangifte detectie >

Registratie  
meetspoort >

Tijdelijke opslag en  
verwijdering van  
radioactieve stoffen >

Opleiding &  
informatie >

Inspecties >

Handhaving >

### Afval- en recyclagesector (weesbronnen)

De niet-nucleaire afvalverwerkende en -recyclagesector wordt vandaag de dag geconfronteerd met het risico dat er in bepaalde afvalstromen radioactieve bronnen, namelijk weesbronnen, worden aangetroffen. Om deze sector te beschermen heeft het Federaal Agentschap voor Nucleaire Controle (FANC) hen **verplichtingen en richtlijnen** opgelegd.

Voor meer achtergrondinformatie betreffende de aanpak van het FANC, klik [hier](#).

- [Aangifte detectie](#)
- [Registratie meetspoort](#)
- [Tijdelijke opslag radioactieve stoffen](#)
- [Opleiding & informatie](#)
- [Inspecties](#)
- [Handhaving](#)
- [Themas](#)
- [Nieuws](#)
- [Deskundigen erkend voor weesbrongevoelige inrichtingen](#)

**AANGIFTE DETECTIE RADIOACTIVITEIT**

Met deze toepassing kan U, online aangiftes doen aan het Federaal Agentschap voor Nucleaire Controle (FANC) in kader van de weesbronproblematiek.

- Gelieve U eerst hieronder te registreren;
- Daarna kan U zich inloggen om een aangifte te doen;
- Hou het OE-nummer bij de hand dat overeenkomt met de geregistreerde weesbrongevoelige inrichting waarvoor U een aangifte wil doen. (Indien dit nummer niet gekend, informeer U via [radioactivity@fanc.fgov.be](mailto:radioactivity@fanc.fgov.be))

De aangifte via deze elektronische weg is conform het KB van 14 oktober 2011 en de richtlijnen van 17 november 2014.

REGISTREER
INLOGGEN
PASSWORD FORGOTTEN

**WAT TE DOEN?**

- Nummerplaat of andere foto noteren van de bezorger
- Contacteer Interventiewaard (interventiewaard@fanc.fgov.be)
- Interne veiligheidsprocedures. Draag bescherming indien en zolang het kan.

**VERBODEN!**

- Wegwerpen of verspreiden
- Als gewone afval behandelen
- Dins, drinken of eten in de nabijheid

**CONTACT:**  
FANC - Federaal Agentschap voor Nucleaire Controle  
T: +32 (0)2 299 11 11  
W: [www.fanc.be](http://www.fanc.be)

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**VERBODEN!**

- Aan meetspoort metten > 20 x nabijgrond
- Aan wand van vrachtwagen plaatsen > 20 cm
- In de buurt van de bron op buitste hoge plaatsen > 20 cm
- In contact met de bron plaatsen > 20 cm

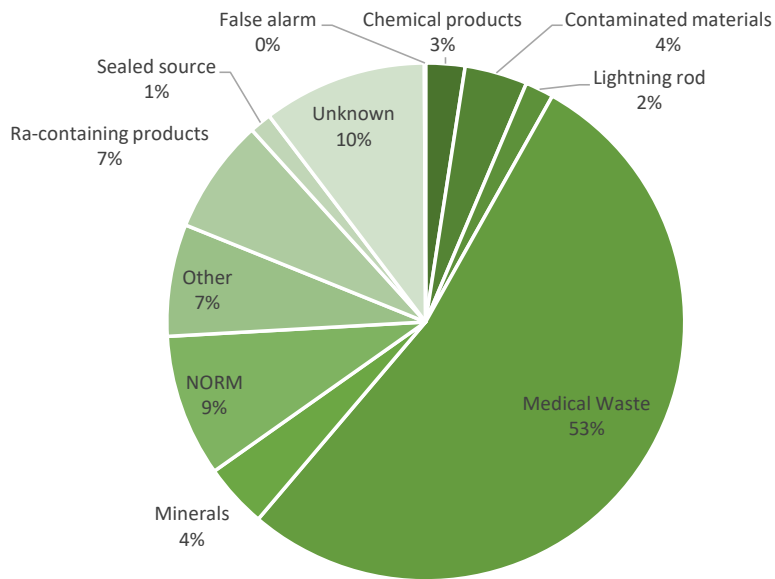
**CONTACT:**  
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# REX

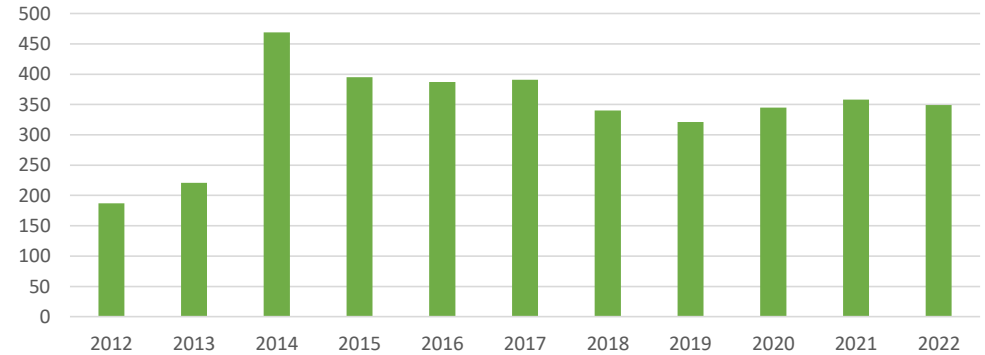
## some examples/statistics



# 3,763 alarms between 1/1/2012 and 1/1/2023



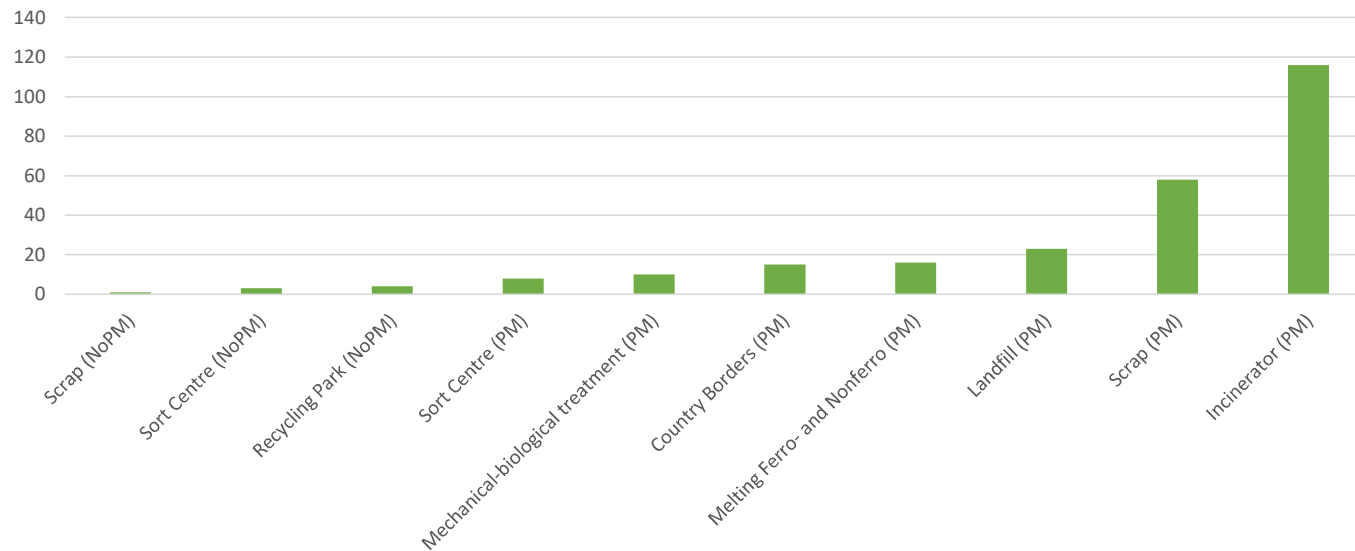
% alarms/type



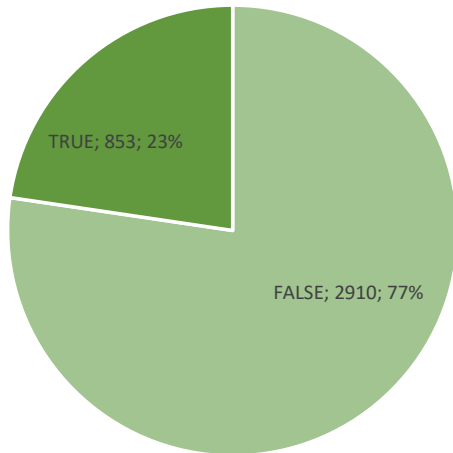
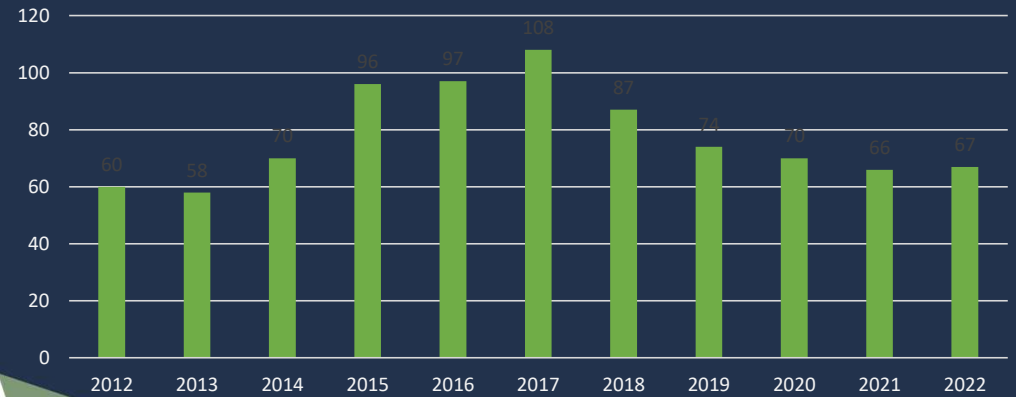
Number of alarms/year

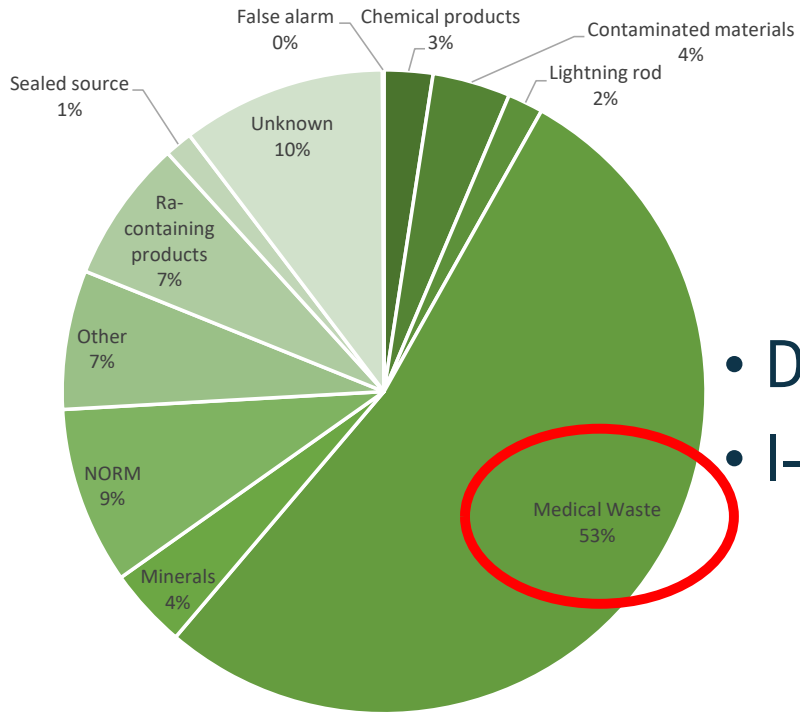


# 254 interventions by radiation expert between 1/1/2012 and 1/1/2023 (7%)



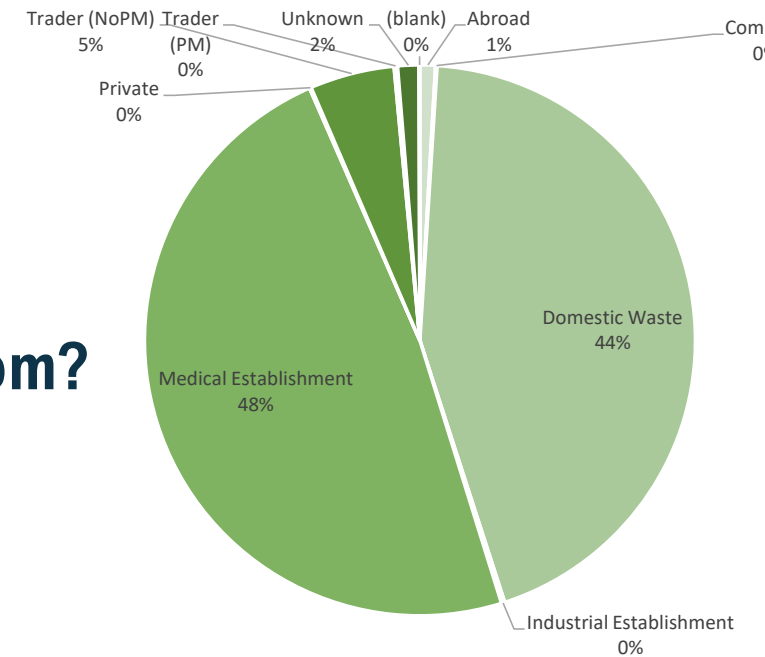
# 853 orphan sources (paid by NIRAS) between 1/1/2012 and 1/1/2023

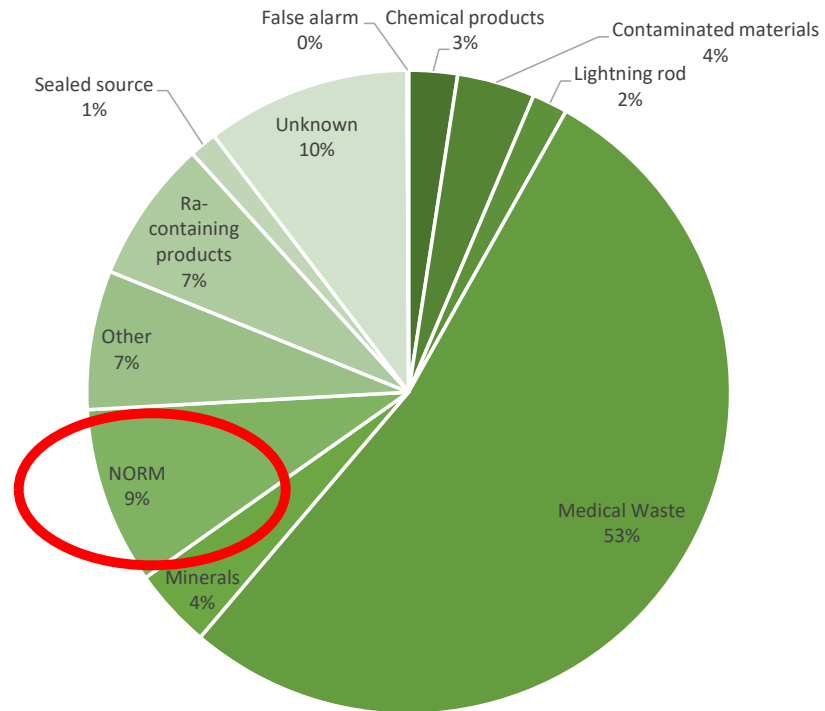




- Domestic waste or waste from hospitals
- I-131, Tc-99m, Lu-177

## Where does medical waste come from?





# NORM (9%)



- **Lantern mantles**
- **Thorium**
- **3  $\mu\text{Sv/h}$**



- **Mineral wool**
- **Thorium**
- **0.5 - 2  $\mu\text{Sv/h}$**



- **Fibreglass**
- **Thorium**
- **Some  $\mu\text{Sv/h}$**



- **Welding rods**
- **Thorium**
- **25  $\mu\text{Sv/h}$**

# NORM (9%)

Oven with refractory materials

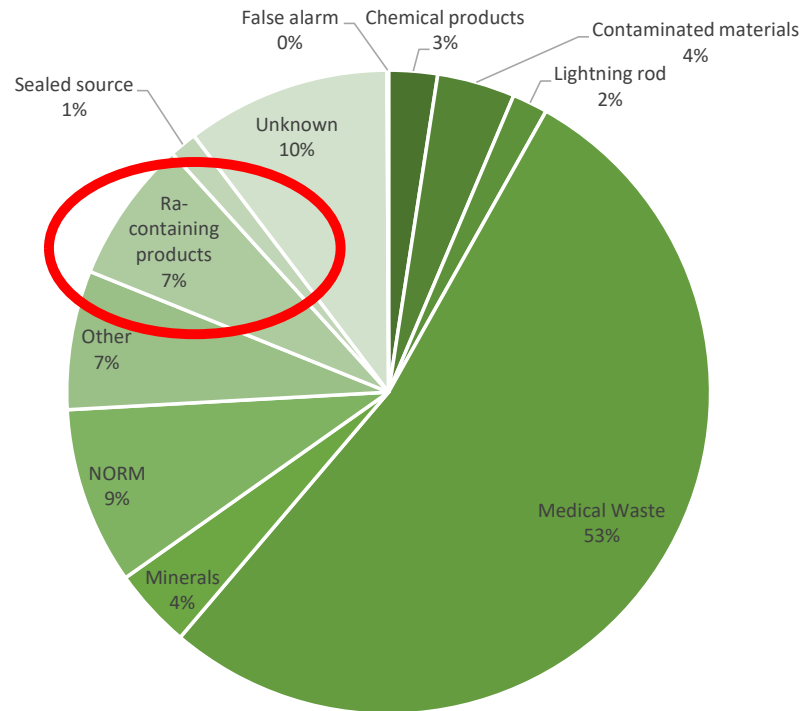


**Scaling**



**Contaminated filter**





# Ra-containing material (7%)



- **Altimeter**
- **Radium**
- **5  $\mu$ Sv/h**



- **Compass**
- **Radium**
- **3  $\mu$ Sv/h**



- **Key ring**
- **Radium-226, Caesium-137**
- **A few mSv/h !**



# Ra-containing material (7%)



- **Lifeboat**
- **Radium**
- **80  $\mu\text{Sv/h}$**

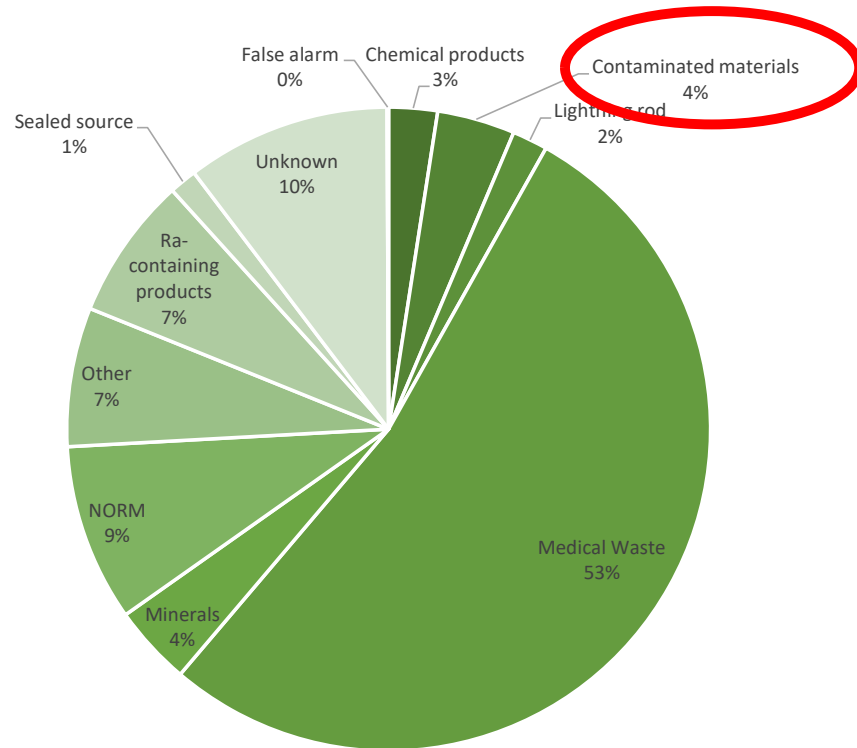
- **Toy**
- **Radium**



# Ra-containing material (7%)



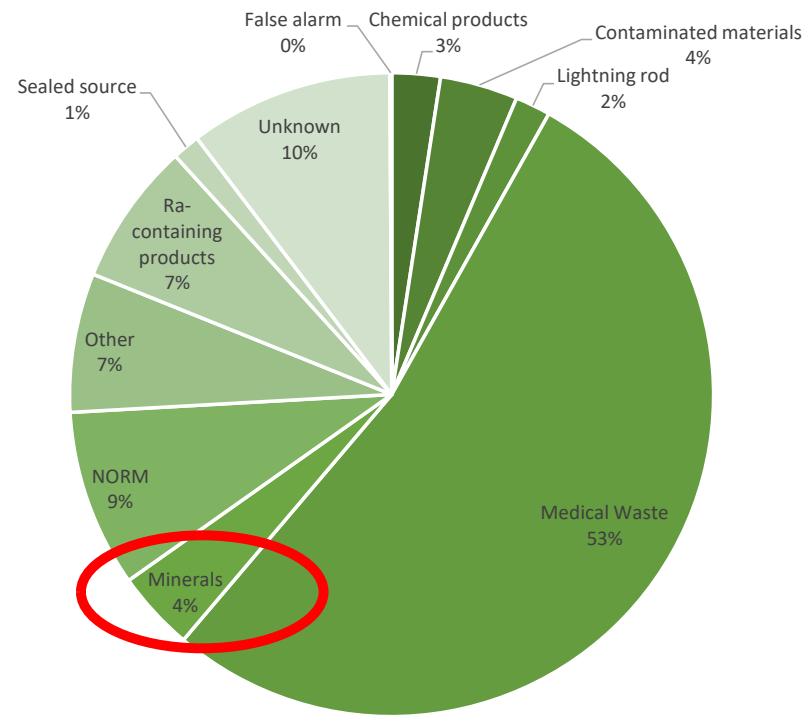
Ra-226: 358 MBq  
10,000  $\mu$ Sv/h at 1m



# Contaminated material (4%)

- At border/scrap yards/foundries
- Co-60, Ir-192, Sr-90
- 0.3  $\mu$ Sv/h – xx mSv/h in contact



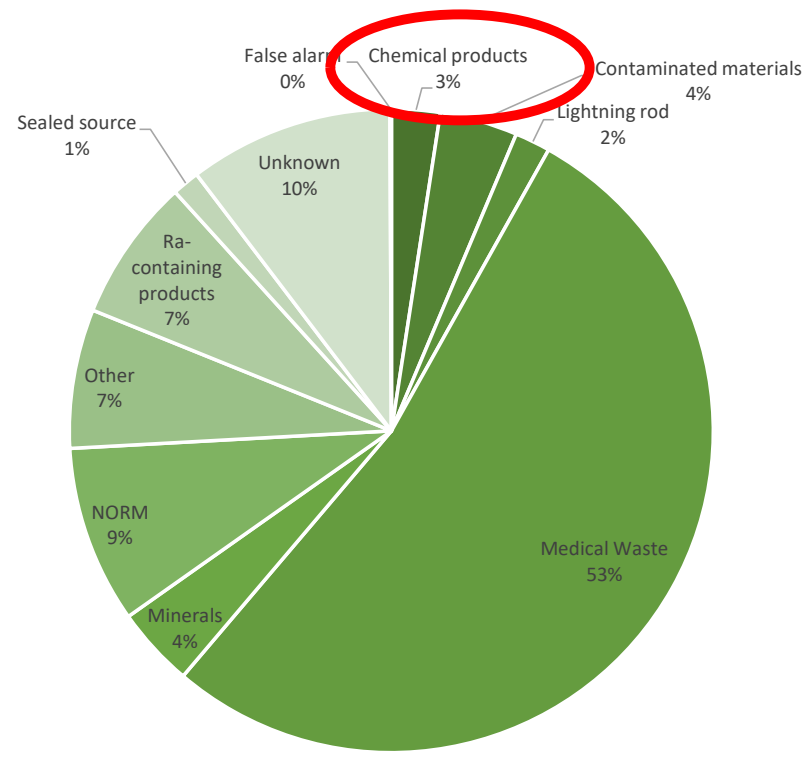


# Minerals (4%)

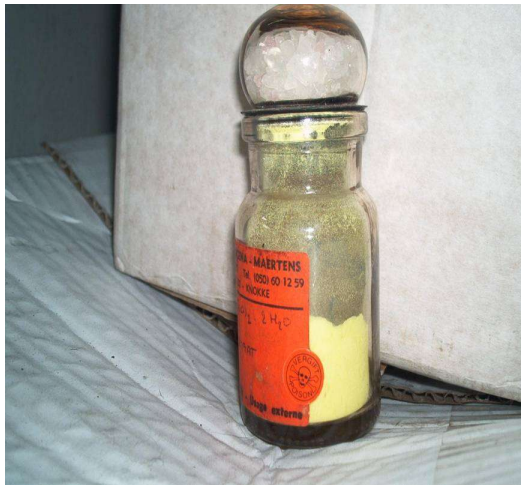


- Natural uranium
- 1  $\mu\text{Sv/h}$  – mSv/h



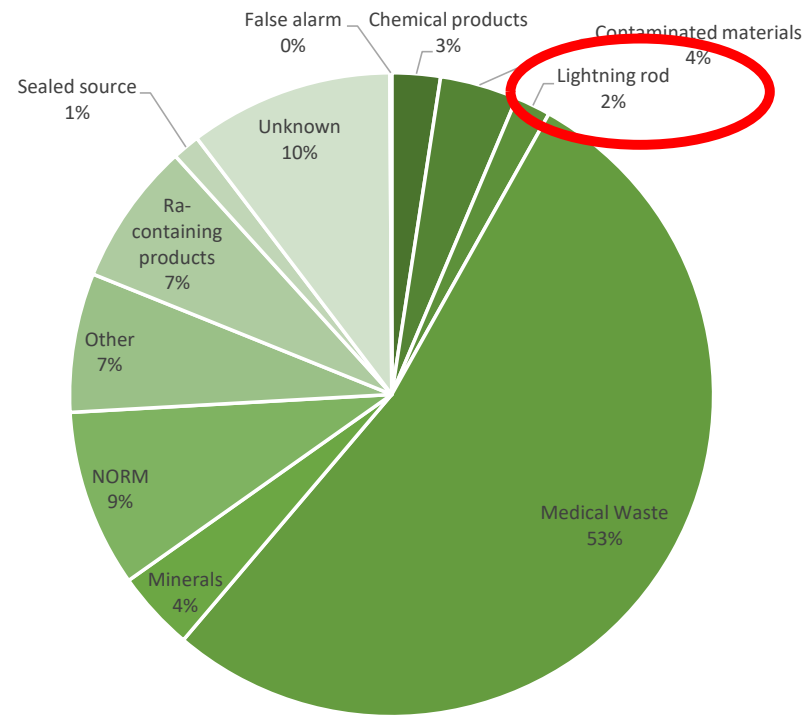


# Chemical products (3%)

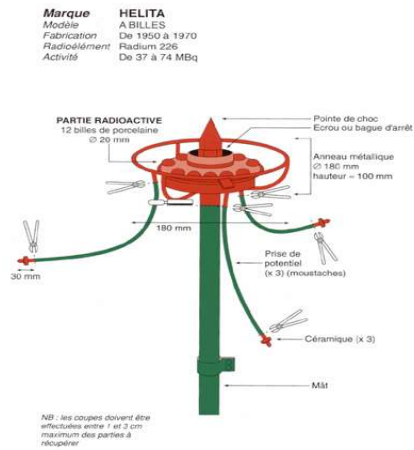


- Pharmaceutical products
- Uranyl acetate / Thorium
- 0.1 - 15  $\mu\text{Sv/h}$

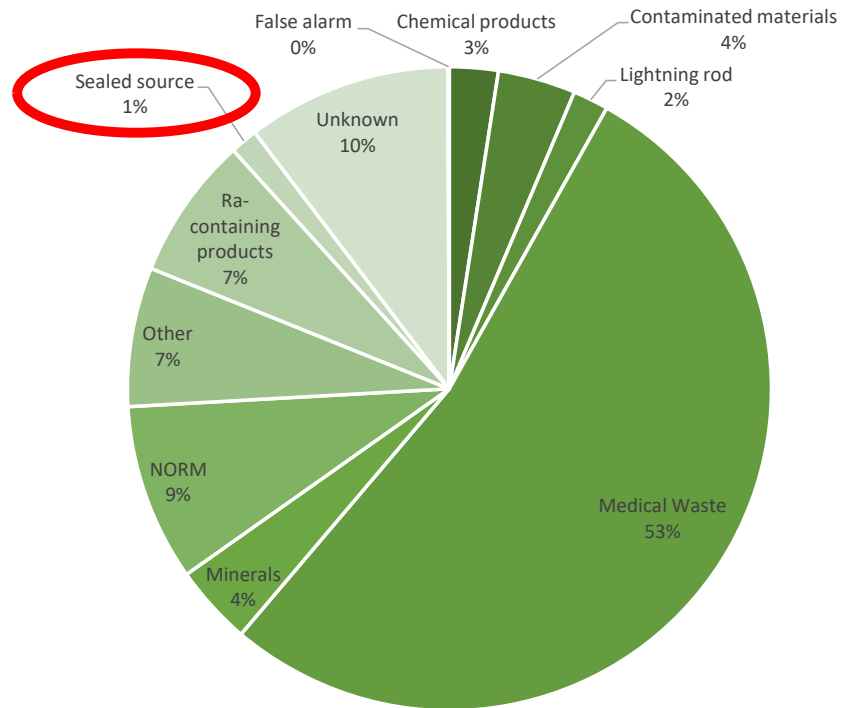




# Lightning rods (2%)



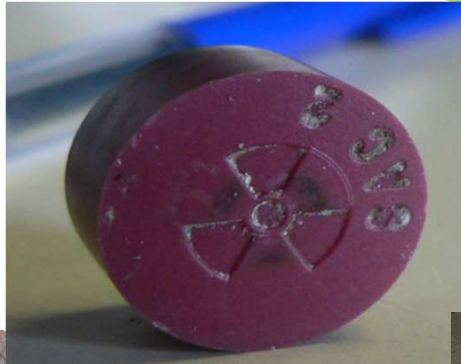
- Radium-226/ Americium-241/ Krypton-85
- A few mSv/h



# Sealed sources (1%)

Considerable variation in:

- Nuclides
- Dose rates



# Sealed sources (1%)

## Never 100% prevention of accidents

- Detection limits of portal monitors;
- Alfa-radiation sources;
- Well-shielded sources;
- Defect, maintenance of portal monitor;
- ...

Radioactive pacemaker

0.13 g. Pu-238 = 92.5 GBq = 2.5 Ci

Dose-equivalent inhalation = +/- 400,000 Sv (!)

Inhalation of 1.65  $\mu$ g = 5 Sv



Shielded gauging system

Typical activity when new:  
Cs-137: 370 MBq to 370 GBq;

Co-60: 37 MBq to 37 GBq

Am-241: 370 MBq to 74 GBq



# Sealed sources (1%)

- At waste incineration plant – Domestic waste
- 0.06 mg Ra-226
- 600  $\mu\text{Sv/h}$  – closed state
- > 1,000  $\mu\text{Sv/h}$  – open state



# Sealed sources (1%)

From a hospital – shielded and encapsulated  
Cs-137 - 500 MBq

External dose rate = 50,000  $\mu\text{Sv/h}$  (!) in contact  
**IGNORED BY FIRST SCRAP DEALER**



# Conclusion

Belgian approach is a **total approach** with **obligations** for the sector involved, but also **guidelines, information** and a **financial solution**.

→ Internationally recognised as good practice by IAEA







Thank you!