

# **Medical management of internally contaminated workers at CEA : The example of the Marcoule nuclear center**

A.L Agrinier, L. Carbone,

CEA Marcoule, Medical Service

# Presentation of the Marcoule site

The Marcoule nuclear site is dedicated to :

- research activities (CEA)
- industrial activities such as the production of MOX fuel, ORANO for nuclear power plants, the treatment of radioactive waste (Cyclife, an EDF subsidiary) and the fabrication of artificial radioelements (Cis Bio International) for nuclear medicine.

The Marcoule nuclear site has a medical service to monitor the health of the platform 4500 workers and to deal with incidents of radiological contamination.

- The medical team is formed by 5 physicians and 11 nurses.
- Marcoule also has a medical laboratory for *in vitro* and *in vivo* analyses.

Scope of this presentation : to describe the medical treatment of a contaminated person

# Steps to treat a contaminated person (external contamination or intake)

1. Handling by radiation protection officers at the scene of the incident
2. Transport by paramedics to the medical unit
3. Handling by the nurse of the patient in the decontamination unit: contamination control, decontamination, nasal secretions.
4. *In vitro* and *in vivo* exams:  $\alpha$   $\beta$   $\gamma$ 
  - Immediate: tissues with nasal secretions, *in vivo* monitoring
  - Delayed: urine and faeces
5. Treatment :
  - Chelating agent: DTPA (Pu/Am)
  - Surgery: if contaminated wound
  - Psychological care
6. Dose calculation
7. Bio research programme: actinide behaviour and DTPA treatment





## **At the scene of the incident, radiation protection officers**

- Locating contamination on the worker (skin, clothing, mask)
- Quantifying the level of contamination at the workstation (direct measurement, smears)
- Quantifying the level of airborne contamination using airborne sensors
- Conditioning of the contaminated person (change of clothing, hand washing, containment of activity, mask, etc.)
- Collecting nasal secretions with tissues in case of inhalation, local DTPA treatment if wound

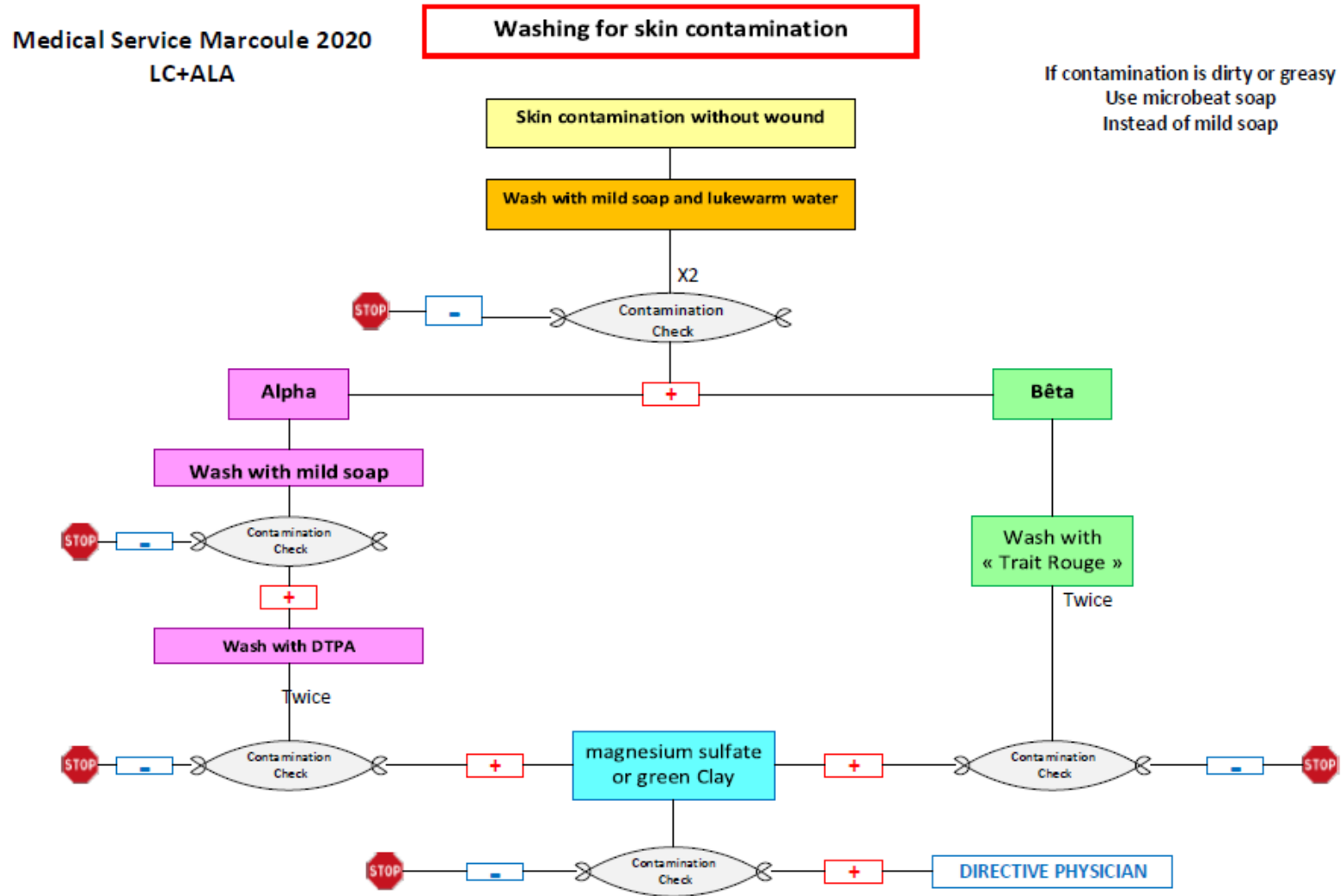
## **Transport by site paramedics to the medical service decontamination unit**

# Decontamination block, by the nurse accompanied by a radiation protection officer

- Checking for contamination by a nurse at the entrance to the operating block using different sensors  $\alpha$   $\beta$   $\gamma$
- If residual activity: decontamination with +/- undressing, washing with mild soap, drying, new contamination checking.
- Collecting nasal secretions with tissues in case of inhalation



# Skin decontamination

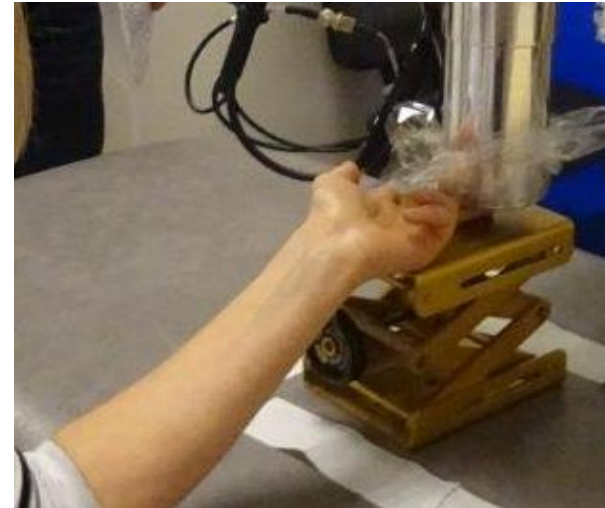


# Immediate (emergency) examinations: to classify the incident and initiate treatment

- *In vivo* monitoring :



Lung or whole body



Local if wound

- $\alpha$  and  $\beta$  counting of nasal secretions

# Tests performed with delayed results: to adjust treatment and dose calculation

- *In vitro* analysis of 24-hour urine sample ( $\alpha$  and  $\beta$ )
- *In vitro* analysis of 24-hour faeces sample ( $\alpha$  and  $\beta$ )

Results are available 15 days after reception by the laboratory.

In the case of a major incident, monitoring may continue for several weeks or even months.





# Treatment with DTPA



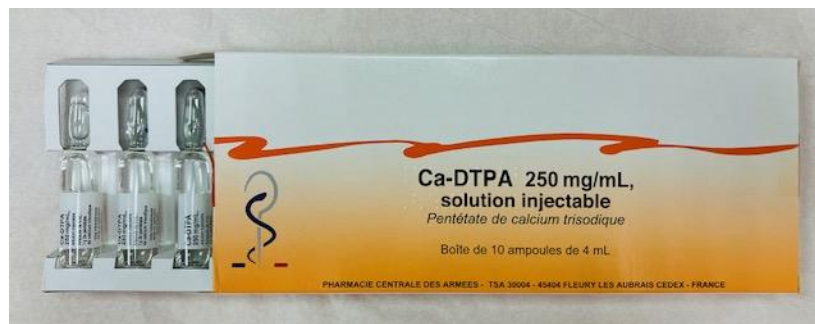
Intravenous  
(0.5 g)



Inhalation  
(0.5 g)



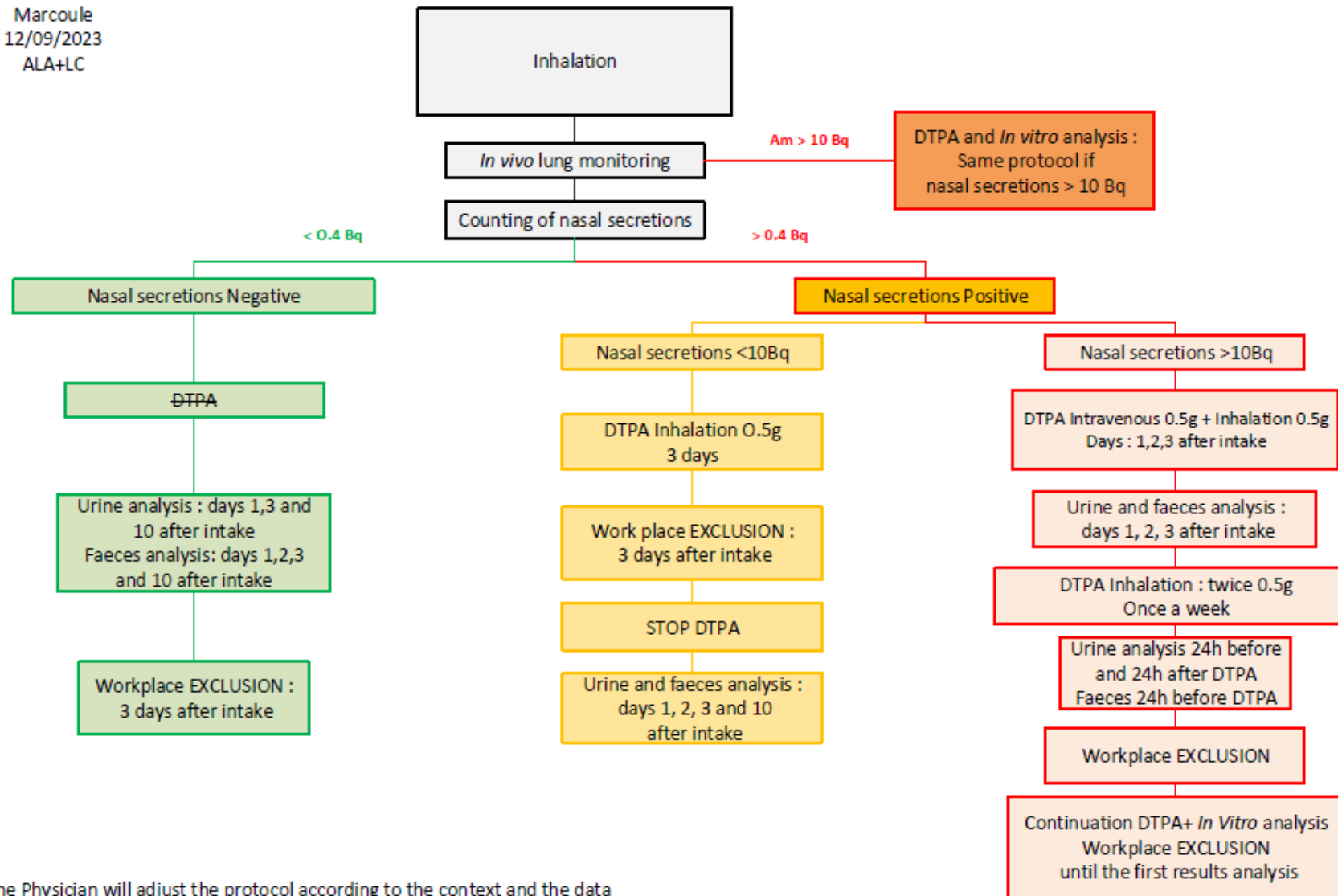
Local Treatment  
(1g)



provided by the central pharmacy of the  
French army

# DTPA: protocol if inhalation risk $\alpha$

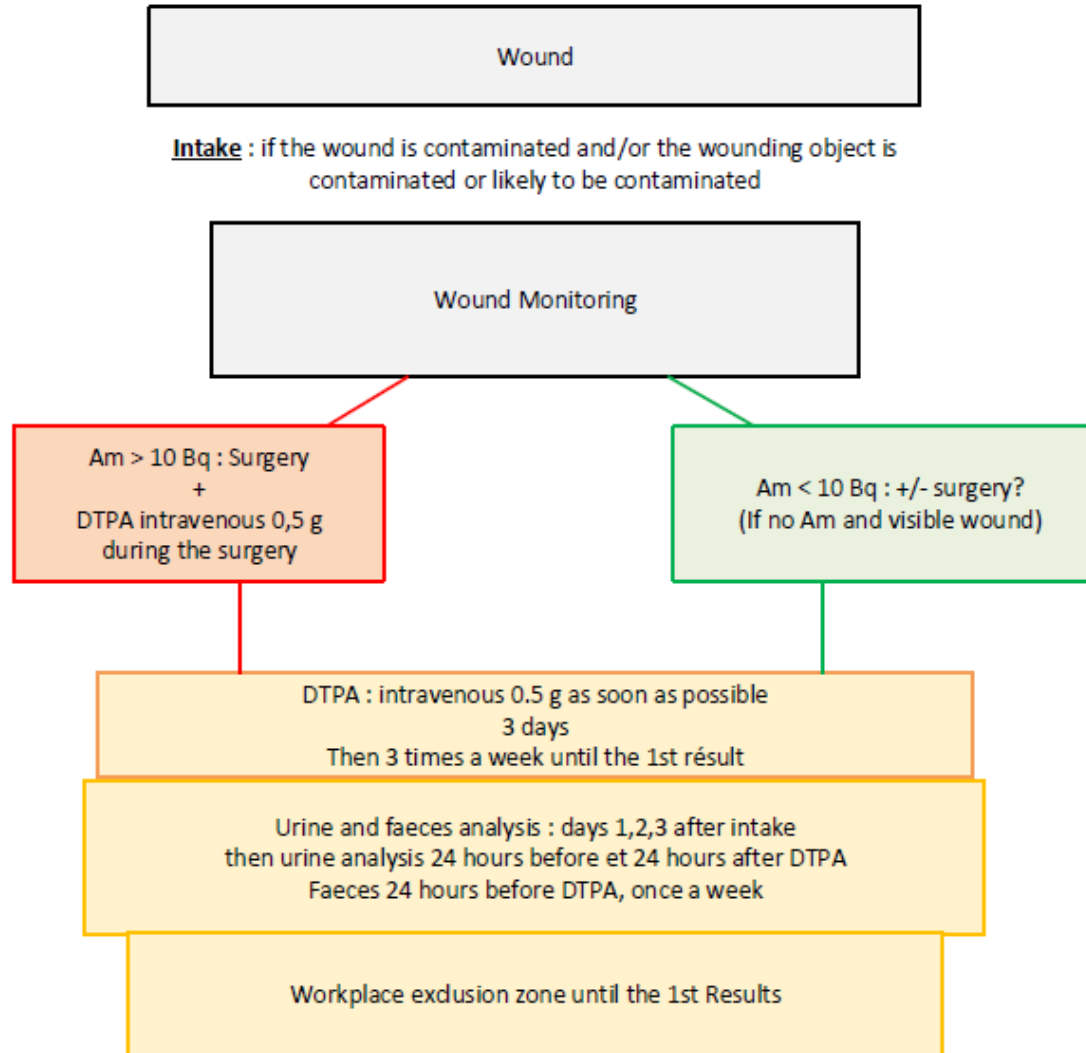
Medical Service  
 Marcoule  
 12/09/2023  
 ALA+LC



The Physician will adjust the protocol according to the context and the data

# DTPA : protocol if wound $\alpha$

Medical Service Marcoule  
12/09/2023  
LC+ALA



The Physician will adjust the protocol according to the context and the data.

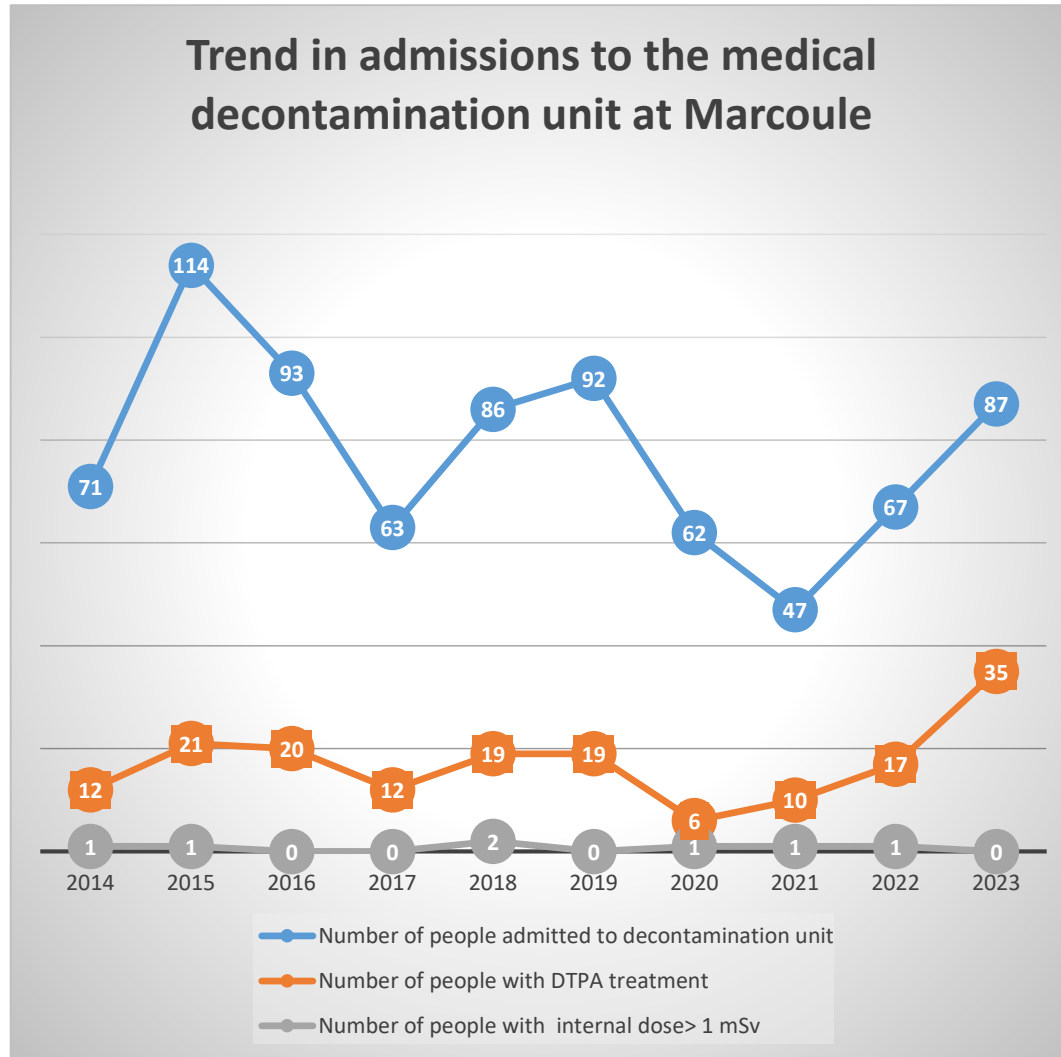
These protocols are carried out at Marcoule.

They have been drawn up on the basis of scientific data and our own experience.



- Workplace exclusion and continuation of treatment will be decided between physicians and dosimetry experts.
- Treatment is adapted on an individual patient basis, depending on the incident and *in vitro* analysis results of the follow-up.
- Break from medication :  
To determinate the efficacy of DTPA, treatment is stopped for 3 weeks.  
A single intravenous or inhalation of DTPA is then given, with urine analysis 24 hours before treatment and 24 hours after treatment.
- The corresponding internal dose is calculated by the Marcoule physicians in collaboration with experts.

# Admission curve and DTPA treatment



- Any risk of intake with a suspected dose > 1 mSv goes to the medical decontamination unit.
- DTPA is given immediately, because the benefit outweighs the risk (no or few side effects) and employees are reassured to receive treatment.
- Only few doses > 1 mSv are observed

# Psychological care



- Short term follow-up and short treatment: adherence to treatment reassures the patient (positive feelings)
- Long term follow-up and long treatment: anxiety-provoking, particularly waiting for the result of the dose calculation. Often, the employee no longer wants to be in contact with the risk (no longer wants to work in glove boxes).

# Collaboration with a research laboratory

- The research activities of the laboratory of radiotoxicology (LRT) at CEA aims at a better understanding of **biological behavior** of actinides following external and internal contamination via different routes to **improve therapeutic approaches**



- **Decontamination efficacy studies:**

*Ex vivo* and *in vivo* studies provide decontamination efficacy data of various decontamination products and protocols, to decontaminate damaged skin and deep wound following lung or wound contamination with different Pu/Am compounds

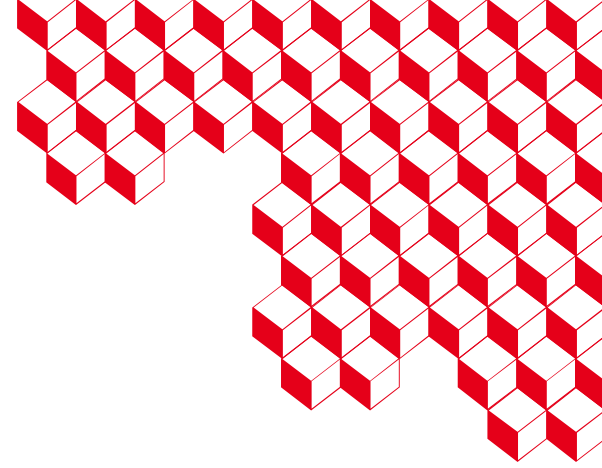
=> **recommendations for the most efficacious decontamination protocol/product according to the scenario of contamination**

- **Decorporation efficacy studies:**

*In vivo* studies in rats to demonstrate the efficacy of decorporating agents (such as DTPA) following contamination with actinides

- Different physicochemical forms of actinides
- Different DTPA formulations
- Different DTPA administration routes (pulmonary, IV) and protocols (early/late, unique/repeated, etc)

=> **recommendations for the most efficacious decorporation protocol according to the scenario of contamination**

The CEA logo, consisting of the lowercase letters 'cea' in a white, sans-serif font, positioned above a horizontal white line, all set against a red square background.

CEA MARCOULE  
FRANCE

# Thanks for your attention



Thanks for their contributions to **Anne Vandemeeren** (CEA), **Estelle Davesne** (CEA), **Pierre Laroche** (Orano), **Denis Michard** (CEA), **Olivier Gremy** (CEA), **Sophie Le Maout** (CEA)